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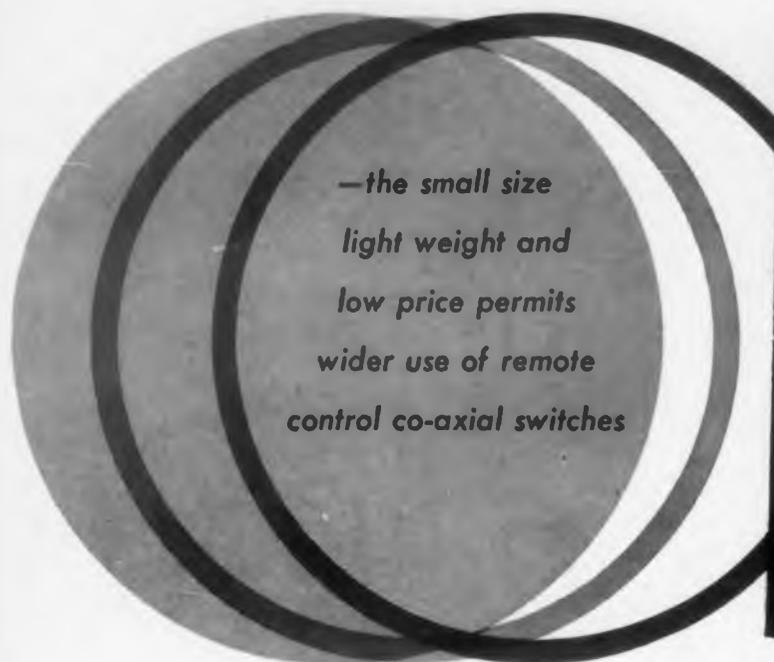
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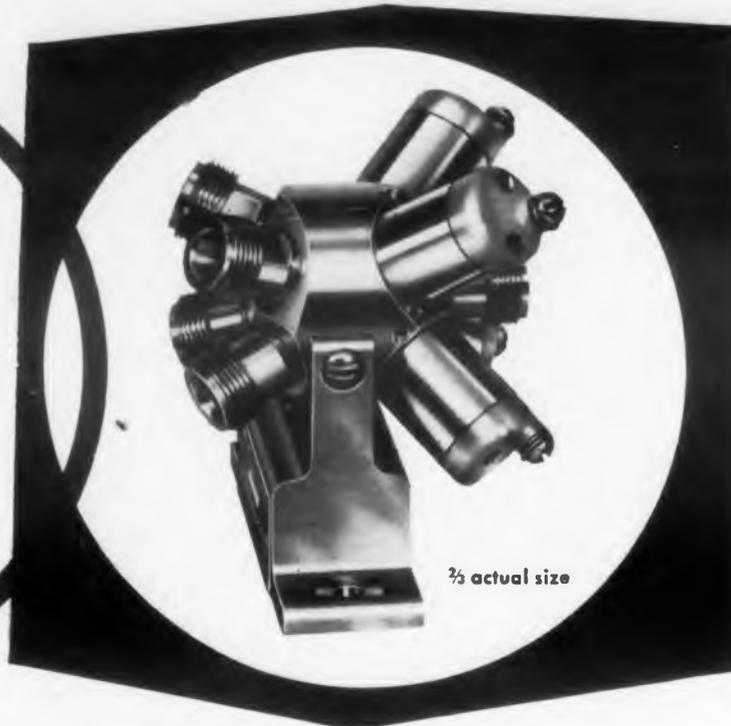
Less than a square inch of panel space is needed for this tiny cathode-ray tube. Where panel space is limited, several can be easily used to monitor critical waveforms.

February 1955

ANOTHER NEW MINIATURE BROAD BAND R.F. CO-AXIAL SWITCH BY **TRANSCO**... SP4T TYPE

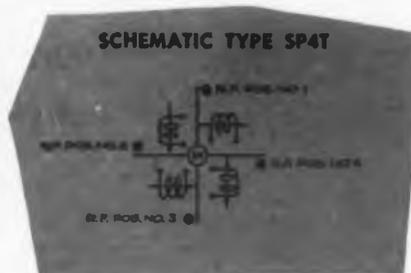


—the small size
light weight and
low price permits
wider use of remote
control co-axial switches



This latest addition to the miniature Transco line gives you still more latitude in designing with co-axial switches. Now you can switch *four* circuits by remote control with this small-size unit. The two models offered give wide flexibility in application. Performance is excellent for frequencies up through X Band. This new SP4T unit weighs only 12 ounces, and occupies only 3" x 3½" x 2½" complete with mounting bracket. It's built with typical Transco reliability for broad-band use, at surprisingly low cost. Send for complete technical data.

MODEL DESIGNATION				
COAX SWITCH MODEL NO.	R.F. POS. NO. 1	R.F. POS. NO. 2	R.F. POS. NO. 3	R.F. POS. NO. 4
14100	NO	NO	NO	NO
14300	NO	NO	NO	NC



CHARACTERISTICS

Frequency Range: O through X Band
Life Duration: 500,000 operations minimum.
Actuator Power Rating: 18-30 VDC at 0.18 Amps.
max. per coil.
Weight: 12 ounces, including mounting bracket.
Ambient Operating Temperature Range: -65° F.
to +225° F.
Actuating Time: 10 milliseconds
Switch Models are available with two R.F. circuit
combinations. (See Model Designation)
Overall Dimensions: 3" x 3½" x 2½", including
mounting bracket.
Designed to meet MIL-E-5272

TRANSCO PRODUCTS, INC.
Always the Finest in Avionics
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CIRCLE ED-1 ON READER-SERVICE CARD FOR MORE INFORMATION

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If design for manufacturing is your responsibility, you qualify for a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles.

If you have a design responsibility not indicated by your title, add a description of those responsibilities.

Any job change requires requalification.

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ELECTRONIC

DESIGN

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February 1955

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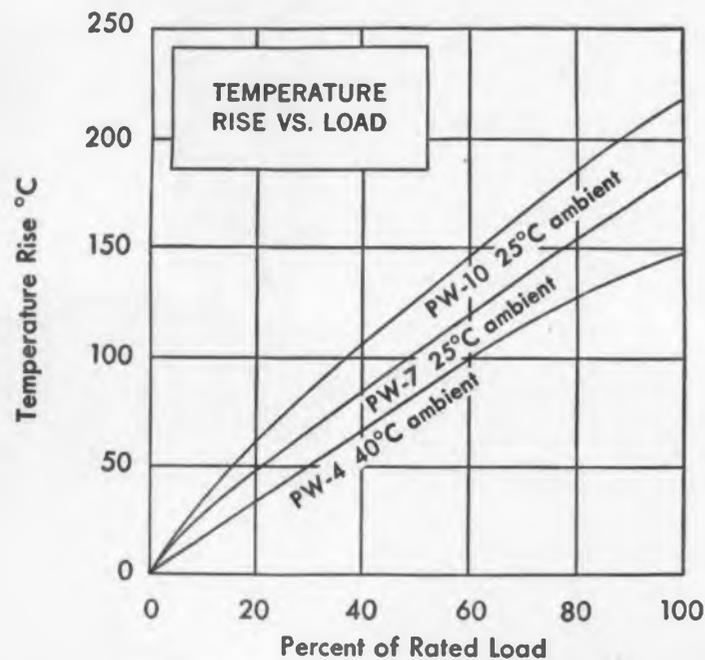
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4 WATT

Type PW-4 allows safe operation with hot-spot temperatures up to 165°C. Fully insulated housing will not burn or support combustion.



7 WATT

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10 WATT

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Editorial

Information Please

These days, many electronic design engineers are busy working on classified military equipments. Undoubtedly a lot of excellent design thinking is being embodied in these devices. Because of the nature of the projects however, these design ideas are part of the working knowledge of a relatively small number of engineers.

Occasionally, some of this information reaches the main body of electronic designers when projects are declassified. An article may be published in the trade press or a paper may be presented before a technical gathering. We would like to encourage more of this dissemination of information because it is one of the best ways to stimulate design thinking and to get new and fresh approaches to design problems.

The designer of commercial devices profits because he can incorporate some of these new ideas in his designs and produce a better product for the electronic market. The designer of military equipment gains because much duplication of design effort can be avoided by the knowledge that solutions to problems now being worked on have already been achieved.

We have two further suggestions along these lines. One is that engineers be permitted, and in fact be encouraged to write about declassified projects. Articles for publication should be prepared on the overall projects, and especially on the design details that reflect new design thinking. Many of these details merit special attention and are well worth being written up as separate articles.

Our other suggestion is that it might be possible, within the limits of reasonable security, to write on isolated design details of classified projects. This could be done by disassociating the design detail from the project and presenting it as an idea by itself. Here a real service could be rendered electronic designers. Present work on military projects could be greatly speeded up and needless design duplication could be avoided. It is very likely that when design details of declassified projects are published duplication of effort has already occurred. By getting design information out sooner duplication could be nipped in the bud.

There's no telling how many million defense dollars could be saved by getting this information to designers. There is also no telling how many new advances in electronic equipment design are being delayed by this lack of information.

We are confident that the American electronic design engineer can make much more effective use of this information than our potential enemies.

Engineering Review . . .

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

Music Synthesizer . . . An electronic system capable of generating any tone produced by the human voice or any musical instrument has been developed. The experimental device, illustrated at the right, can also produce tones beyond the capabilities of the voice or conventional instruments. Not only is the system of great aid in composing, but it will enable composers to include entirely new tones in their music.

Developed by Radio Corp. of America at its Princeton, N. J., laboratories, the synthesizer has already been demonstrated for leading musicians, who expressed great interest. With the keyboard-operated synthesizer, a composer who plays only one instrument, or no instrument at all, can simulate an entire orchestra. The device could also be used to rejuvenate old records. It will enable composers to include sounds from rare instruments that few available musicians can play.

Train Tickets Sent Electronically . . . Electronic facsimile-transmitting methods have been adapted to a device that transmits train tickets in 8sec to outlying ticket offices from a central bureau. The electronic signals are carried over leased telegraph and telephone lines between offices.

Adapted by the Western Union Telegraph Co., 60 Hudson St., New York 13, N. Y., from their "Interfax" facsimile equipment, the system is known as "Ticketfax". To send a ticket, a railroad employee in the central bureau merely places it in the transmitter. The ticket is automatically wrapped around a transparent 4" drum which revolves at 1800rpm, or five times as fast as standard facsimile gear. A photoelectric cell scans the ticket and delivers pulsed information to the transmitter.

At the receiver, a revolving drum with electro-sensitive paper wrapped around it moves laterally

past a stylus that converts the pulses into marks on the paper.

The first installation of Ticketfax was made at the 30th-Street Station of the Pennsylvania Railroad in Philadelphia, Pa. It enables the line to speed up ticket service and concentrate in one place all personnel, records, and forms involved in both ticket sales and the making of reservations.

The locations already tied into the new system by

facsimile are the railroad's North Philadelphia, Suburban, and Paoli stations and its city ticket offices at 1607 Walnut St. and the Benjamin Franklin Hotel and at 914 Market St., Wilmington, Del. Facsimile receivers are also available for the offices of large business firms in the area served by the line. "Ticket-fax" could serve as the basis for a nation-wide automatic ticket and reservation service.

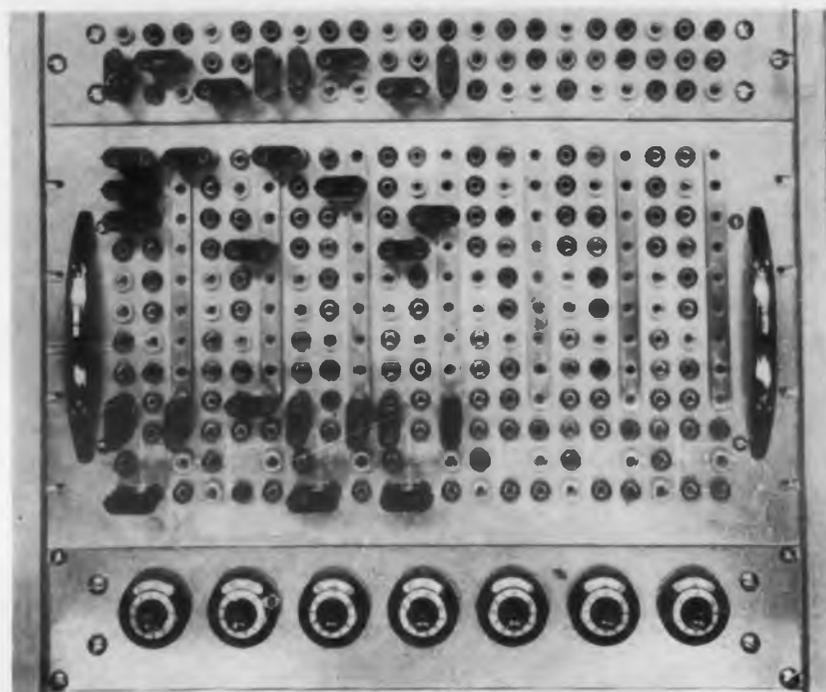
Multi-Color Displays . . . By using color cathode-ray tubes, friendly and enemy aircraft can be displayed in different colors on radar screens. An experimental radar indicator incorporating a color tube has been developed and is now in operation at the National Airport, Washington, D. C.

The radar set was developed by Chromatic Television Laboratories, 1501 Broadway, New York 36, N. Y., under a U. S. Navy contract. It utilizes the Lawrence picture tube (*ED, January, 1955, pp. 119-121*) with few modifications in the version developed for color TV.

The multi-color display will enable operators to follow the situation more easily and with less fatigue. It can also be used in airport operations to speed-up and simplify GCA landings.

The music synthesizer is being operated by Dr. Harry F. Olson, Director, Acoustical and Electro-Mechanical Research Laboratory, RCA Laboratories, Princeton, N. J. Dr. Olson supervised development of the experimental device.

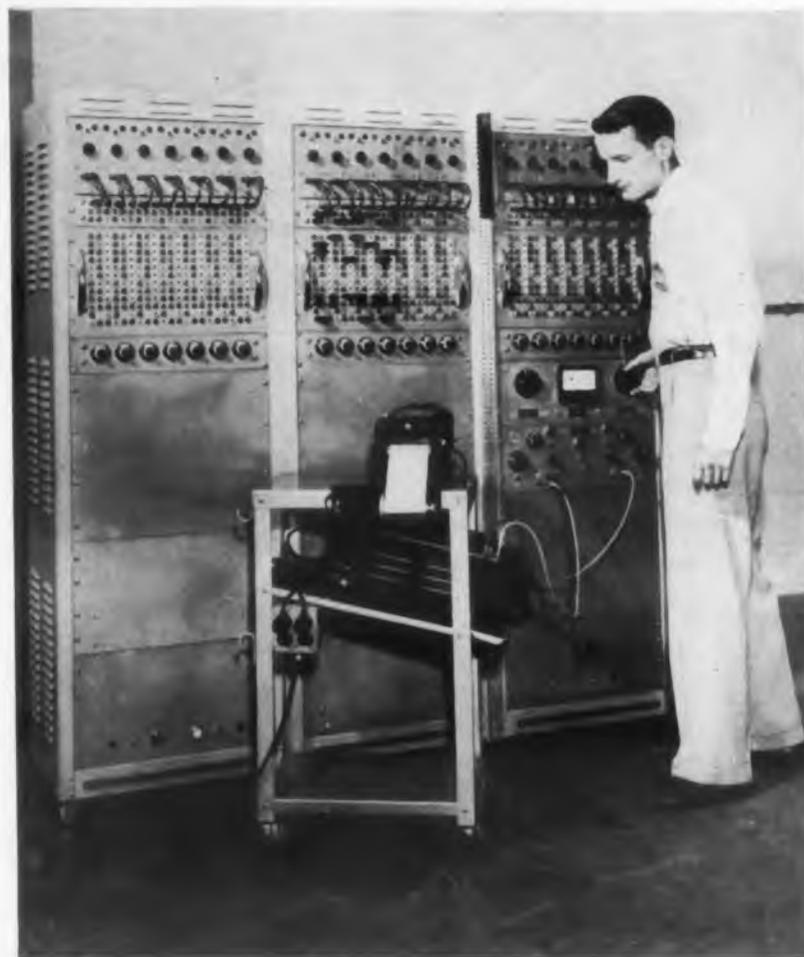




One of the plug-in problem panels employed in the Battelle computer. Most connections are made by the dual-jacks. The vertical straps minimize the number of connections required. Operation of amplifiers as summers, integrators, or differentiators is made by the shorting plugs on the small, non-removable panel at the top. The coefficient potentiometers are located directly below their respective patch-panel connections.



One of the d-c amplifiers in the analog computer.



The Battelle Analog Computer in operation. The 21 d-c amplifiers are mounted at the top of the panel.

Analog Computer . . . A new analog computer recently constructed and put into operation at Battelle Institute, 505 King Ave., Columbus 1, Ohio, features unusual ease of operation and maintenance. Instead of patch cords, dual-jacks are employed to make all but the most complicated connections. Photos of the complete computer and some of its component parts are shown on this page.

Each of the 21 d-c amplifiers in the instrument incorporates a lock-in overload indicator to tell when the amplifier has been saturated (driven beyond its linear $\pm 100v$ range) and also show polarity of the overload. The neon lamps used as the overload indicators remain lighted until a reset button has been pressed. Thus it is not necessary for an operator to constantly watch the computer to determine if a particular solution is valid.

The feedback and input resistors are mounted within the computer, rather than plugged into the patch panels, to make the connections more mathematical in nature.

A group of companion non-linear units is being developed to supplement the computer. A typical unit is the relay-amplifier, which is useful in computer work in the simulation of backlash, dead space, coulomb friction, and certain kinds of hysteresis.

Electronics and Personnel . . . Even if large-scale electronic systems become common in offices, people will still be needed and man will still be master of his machines, J. D. Elliott, Detroit Edison Co., told the Office Management Conference of the American Management Association. Despite the great speed, flexibility, and capabilities of electronic office machines, Mr. Elliott pointed out, they are more limited in some respects than standard office machines because they are more dependent on human beings.

On the basis of what Detroit Edison has learned in studying the possible application of electronics to some of its office operations, Mr. Elliott also denied three other "basic misconceptions": that a few high-priced highly educated specialists or technicians will be necessary to set up and operate the machines, that those workers still needed will lose their feelings of individuality because their jobs will be reduced to simple, repetitive tasks, and that wholesale layoffs will follow complete electronic systems.

His company has concluded, he said, that many people in the present organization are capable of planning procedures for electronics, programming operations, and operating the equipment; also instead of decreasing the workers' sense of individuality, electronic equipment may be expected to reduce the number of repetitive jobs and create new ones calling for creative thinking, initiative, and responsibility.

Reductions in personnel will practically all be in the data-processing phase of electronic operation, Mr. Elliott said. The number of employees in the planning and input phases will actually increase.

Pulse Height Analyzer . . . A pulse height analyzer has been developed by the National Bureau of Standards, Washington, 25, D. C., in conjunction with its program for studying high-energy X-rays. The device separates the pulses issuing from a crystal spectrometer, which is used to select certain photons issuing from the Bureau's 50mev betatron or its 180mev synchrotron.

The wealth of information coming from the crystal spectrometer may be obscured by the distribution of electrical pulse heights. It is necessary to direct the pulses of different heights into different recording units. However, the standard electronic circuits designed for this purpose are cumbersome and costly. The Bureau's analyzer is compact and economical.

The analyzer makes use of a cathode-ray tube. The pulse whose height is to be measured is applied to the vertical deflection plates, thus charging the phosphor of the cathode-ray tube in a line whose length is proportional to the voltage pulse height. During the dead time between betatron pulses, a linear sweep is applied to the same set of vertical deflection plates. Simultaneously, a set of time gates are started. When the linear sweep passes the end of the original charged line, a pulse is picked up in a wire screen covering the outer face of the cathode-ray tube. This pulse is then accepted in the time gate that is open at that instant. Since the sweep is linear, the time of occurrence of the pickup pulse is a measure of the height of the initial pulse.

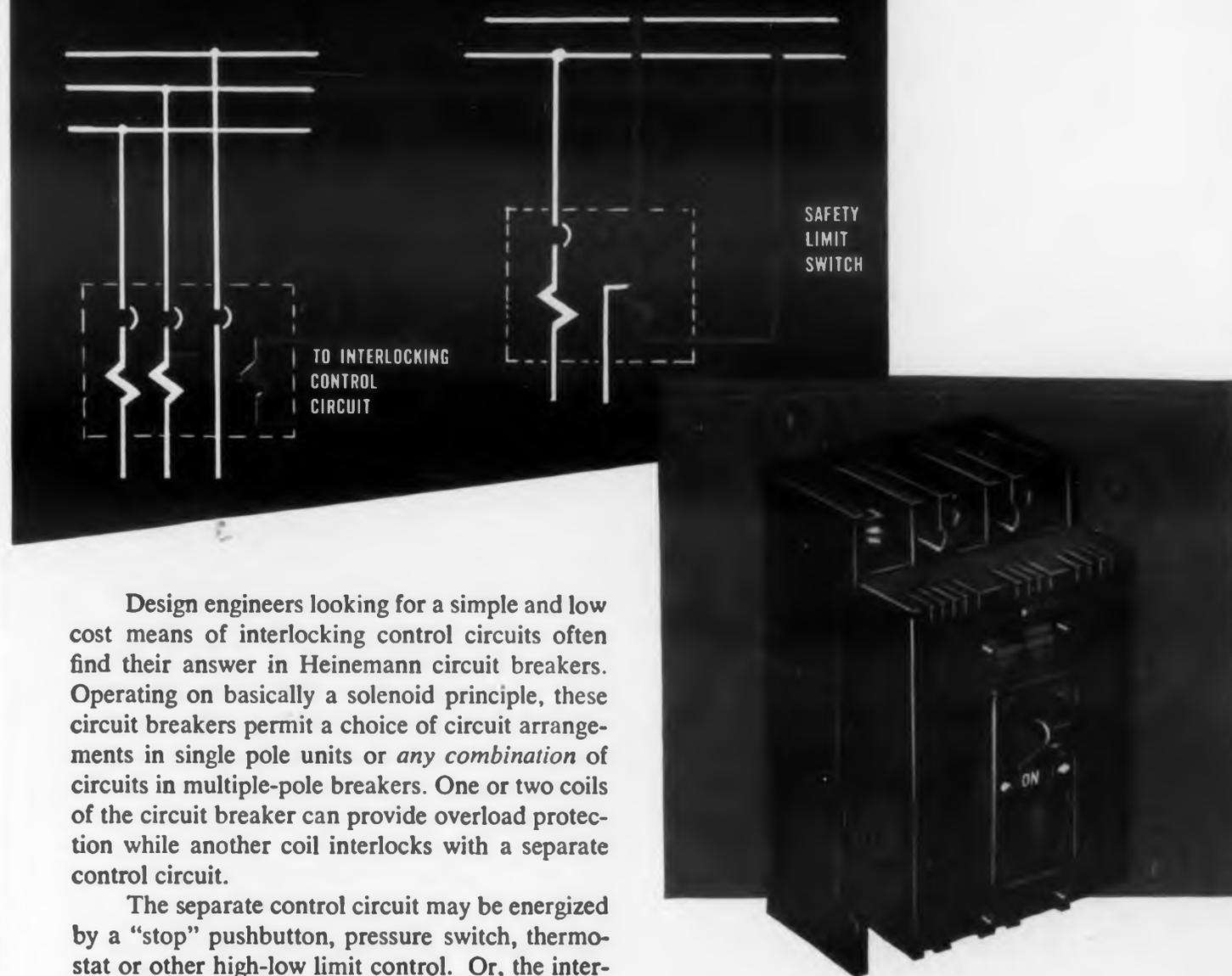
Some of the advantages of the system are as follows: a variety of pulse shapes can be accepted for measurement without special pulse-shaping networks; more than one pulse occurring within a single cycle can be detected and measured during the "off" time of the X-ray source; and the circuit components are straightforward and can be inexpensively constructed.

Russia Leads U. S. in Standards . . . The United States ranks 13th among the national standards organizations of 34 nations in degree of participation in international standards work, 15% behind Russia. France participates in 2-1/2 times as many committees of the International Standardization Organization as this country. The United Kingdom leads in the number of committees for which it serves as secretariat nation. It heads 18 committees; the United States heads 8, Vice Admiral G. F. Hussey, Jr., USN (Ret.), managing director, American Standards Association, reported to the group.

Admiral Hussey also reported on the 50th anniversary meeting of the International Electrotechnical Commission last September. Forty-three international recommendations were brought to the final stages of approval at the meeting. This is more world electrical standards than the IEC had produced in its 50-year history. More than 800 delegates from 21 nations attended the 258 sessions held by the 49 IEC technical committees that met.

HERE'S A SIMPLE WAY

...to provide control interlocks



Design engineers looking for a simple and low cost means of interlocking control circuits often find their answer in Heinemann circuit breakers. Operating on basically a solenoid principle, these circuit breakers permit a choice of circuit arrangements in single pole units or any combination of circuits in multiple-pole breakers. One or two coils of the circuit breaker can provide overload protection while another coil interlocks with a separate control circuit.

The separate control circuit may be energized by a "stop" pushbutton, pressure switch, thermostat or other high-low limit control. Or, the interlocking coil of the circuit breaker may be used for overload protection, tripping the circuit breaker and opening the main power supply when an overload occurs in the interlocked circuit. Thus, a single Heinemann circuit breaker can serve three functions: (1) As the power switch, (2) as overload protection, and (3) as the means of control interlock.

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CBS-Hytron Qualifies for Signal Corps Honor Inspection Program



CBS-Hytron is the first and (as of January 15, 1955) the only receiving-tube manufacturer qualified for the Signal Corps honor inspection program . . . the Reduced Inspection Quality Assurance Plan — RIQAP.

The Signal Corps Supply Agency has informed CBS-Hytron: "The completeness of your manufacturing process and quality controls, the supporting inspection records, and the quality of your end product have enabled us to adopt a reduced inspection plan on your Electron Tubes."

The Signal Corps found that CBS-Hytron is producing a quality of product which is "either equal to or better than the Acceptable Quality Level established by the Government."

Equivalent quality of product is available to you, too.

Quality products through *ADVANCED-ENGINEERING*



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CIRCLE ED-9 ON READER-SERVICE CARD FOR MORE INFORMATION



Electrostatic Speaker . . . Another phonograph incorporating an electrostatic speaker (*ED, September, 1954, p. 9*) has been placed on the market. Illustrated above, the speaker has a frequency reproduction range from 7000 to 20,000cy. It consists of 16 slender units arranged as facets on a half-cylinder. This arrangement radiates the sound uniformly throughout the room.

Each of the 16 units consists of two electrodes: a fixed backplate made of ribbed aluminum and a movable electrode made of a new polyester plastic only 1/2000" thick on which a metallic film has been deposited. A steady polarizing voltage is applied between the two electrodes, causing the plastic membrane to be attracted towards the backplate. The membrane is held permanently under mechanical tension by the action of two springs and a supporting bar. The output signal from the amplifier is applied to the electrodes superimposed on the steady voltage. The membranes moves back and forth in close accord with signal variations.

The electrostatic speaker is incorporated, along with an 8" conventional speaker, in the Model 1347 table-model phonograph made by Philco Corp., 445 E. Tioga St. Philadelphia, Pa.

Phono Cartridge with Low Distortion . . . The first low priced phonograph cartridge with less than 1% intermodulation distortion is the claim made for the Ronette "Fonofluid" system cartridges. The extremely small mass and high compliance of the moving system of the cartridges enables the stylus to remain in contact with the groove walls at high velocities, contributing to its ability to track and to its low intermodulation distortion.

The cartridges, which are imported from Holland by the Ronette Acoustical Corp., 135 Front St., New York 5, N. Y., are designed for turn-over operation and feature two entirely independent non-interacting sapphire styli. This means that the stylus not in use does not vibrate at its own free resonance frequency and does not extract energy from the acting stylus, removing another serious cause of intermodulation distortion.

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Germanium Optical Filter . . . Very thin sections of germanium are being used as optical filters to absorb all but the infrared light spectrum. Known as the "Germanium Transmission Filter", the filter is 1/8" thick x 1-1/8" diam. It is made from highly purified single germanium crystal such as transistors are made from.

The germanium sections are ground, polished, and coated on both sides. Due to the high refractive index of germanium, the sections are anti-reflection coated for maximum transmission at 2.5microns. They are well suited for use in conjunction with lead sulphide infrared photo detectors, since the combination provides sensitivity between 2 and 3 microns.

The filters were developed by Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass., who plan to introduce a series of optical products made from semiconductor materials.

"Noise-Free" Lighting . . . "Noise-Free" incandescent lamps for TV and motion picture studios have been developed. The noise produced by high-wattage lamps in studios is often picked up by microphones and heard as a hum. Manufactured by General Electric Co., Syracuse, N. Y., the new lamps are available in 1000- and 2000w sizes.

Temperature Symposium . . . The possibility of using semiconductors and superconductors as thermometers was discussed at an international symposium on "Temperature, Its Concept and Measurement" held last October at Washington, D. C. Sponsored by the American Institute of Physics, the National Bureau of Standards, and the Office of Ordnance Research, Department of the Army, the symposium was attended by more than 400 scientists from here and abroad.

J. G. Duant of Ohio State University and S. A. Friedberg of Carnegie Institute of Technology discussed this unusual use for semiconductors and superconductors.



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162-181

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24 standard G-E industrial and military cathode-ray tubes are illustrated, rated, fully described. Basing diagrams are included.

18 phosphors most in demand are described as to color, persistence, and field of application . . . also, spectral-energy emission and persistence curves are plotted for each phosphor.

9-page section is devoted exclusively to tube, gun, and phosphor research . . . design . . . manufacture . . . testing. Includes many photographs of C-R products and processes.

Laminates from Corn Cobs . . . Resins for use in making glass-fabric-base laminates are being prepared from such non-critical materials as corn cobs and other vegetable by-products. According to the January, 1955, issue of *Industrial Research Newsletter*, published by Armour Research Foundation, Chicago, Ill., Wright Air Development Center, Dayton, Ohio, has developed a "furan resin" that produces low-pressure glass-fabric-base laminates with flexural strength up to 65,000psi and edge-wise compressive strength up to 40,000psi.

More Iron Powder Used . . . The use of iron powder in the United States in 1954 showed a substantial increase as compared with 1953. According to the Metal Powder Association, 420 Lexington Ave., New York 17, N. Y., iron powder shipped to U. S. consumers by domestic producers amounted to 15,667,059 lb in 1954 compared with 12,509,630 lb in 1953, an increase of about 25%. Imports into this country, largely from Sweden, totaled 19,669,660 lb in 1954 compared with 13,928,506 lb in 1953.

Interlingua Taught . . . The first college course teaching Interlingua, a new international language, began this month at New York University. Dr. Alexander Gode, the formulator of the language, is the instructor.

Designed primarily as a medium of technological communication, Interlingua consists entirely of elements shared by all the major languages of Western civilization.

Better TV Broadcasting . . . An improved method of TV broadcasting that assures a sharp monochrome picture on a black-and-white receiver when the program is telecast in color has been developed. In this method the monochrome picture is produced by its own signal rather than by mixing the color signals. Therefore, color

◀ CIRCLE ED-7 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 1955

mi-registration at the station does not affect the monochrome picture.

In present methods of color broadcasting, the monochrome picture is formed by superimposing the red, green, and blue pictures. In the new method, developed by General Electric Co., Syracuse, N. Y., the luminance, or black-and-white, picture is formed directly from a sequential color camera before registration problems are met. The monochrome picture is then fed, unchanged, through a conversion device at that station. At the same time, the color signals, which were also picked up by the sequential camera, are encoded for the simultaneous color signal, as required by the FCC. The two independent signals are mixed and sent as one signal.

The home monochrome receiver utilizes the black-and-white portion of the signal exactly as originally viewed by the camera. The color receiver picks up both parts of the signal. The color picture is sharp because it is formed by adding the color pictures to the black-and-white picture.

Whisker-Wire Welder . . . A machine that forms and welds 0.001" thick gold whisker wires to the semiconductor material in diodes has been developed. The end of the wire can be positioned to tolerances within ± 0.005 ".

Manufactured by Federal Tool Engineering Co., Cedar Grove, N. J., the welder forms wire to a specified "U" or "S" shape, and cuts it at either a 30° or 45° burr-free angle.

Tape Controls Embroidering . . . An experimental embroidering machine controlled by perforated tape has been developed. It was described at the recent Winter General Meeting of the AIEE by Louis Casper, Electrotex Corp., New York, N. Y.

The machine responds to tape control at the average rate of 500 stitches per needle per minute. The electronic apparatus controlling the machine can be located in a remote, lint-free room.

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PERFORMANCE



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Uniformity . . . low power consumption . . . small size . . . complete absence of microphonics . . . proven reliability . . . and resistance to shock and vibration. These are the all-important features of Philco alloy junction transistors which make them best for your application.

You will also welcome the simplified circuitry, ease of assembly and cost reductions now possible in transistorized products. And Philco production facilities

assure a dependable supply of high quality transistors —at a price which makes their use practical in new product design!

Employ Philco alloy junction transistors, and gain the benefits of their superior performance. Take the first step to improve your product and cut costs. Write today to Philco, Dept. ED. Get complete technical specifications, price and delivery information on the Philco hermetically sealed transistor.

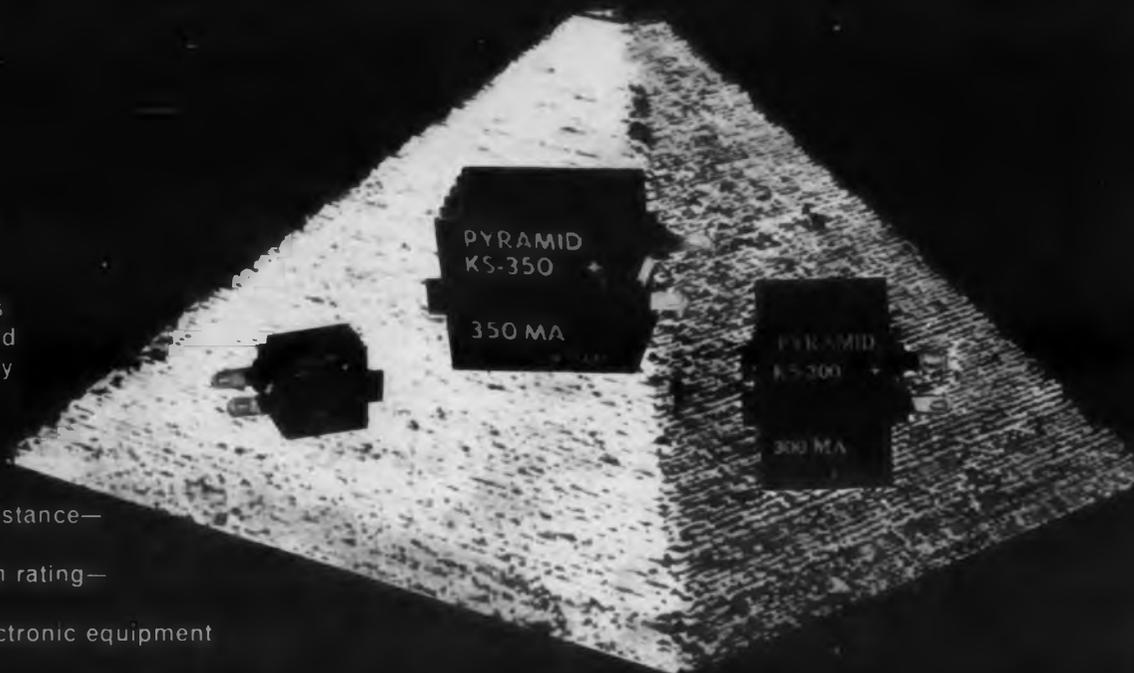
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the first NEW DESIGN of selenium rectifiers IN OVER 20 YEARS

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by PYRAMID

No center mounting
Full air ventilation between plates
Light contact and constant assembly pressure
No center hot spots
Lightest weight per unit of output power
Lower initial forward resistance—better voltage regulation
Smaller overall size for each rating—cost no more
Better for all electrical and electronic equipment because of

- Improved convection cooling
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KOOL-SEL is the rectifier

most readily adaptable to printed circuit applications.

Because of the fixed edge mount yoke, assembly requires only one whistler die, one hole fixed, one hole variable to three dimensions. For complete information write

RECTIFIER DIVISION



PYRAMID ELECTRIC COMPANY North Bergen, N. J.

Data Recording Equipment . . . necessary step to the widespread use of automation—the cataloging of available automatic data recording equipment—has been completed by the Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill., and Under Air Force sponsorship, the Foundation compiled a 74-page booklet that describes the operation and manufacturers' specifications of 70V sound data recording instruments.

The booklet, "A Catalog of Devices Useful in Automatic Data Reduction," provides a clearinghouse of information for government agencies using miscellaneous automatic devices on equipment manufactured by more than 50 different companies. It will be distributed throughout the U. S. Air Force.

Million-Watt Station . . . A TV station with an effective radiated power of 1,000,000w has gone into operation. Clear, steady pictures have been received as far as 125 miles from the station, WBRE-TV, Wilkes-Barre, Pa.

The station previously radiated 225,000w, but now utilizes a 25kw transmitter and a pylon antenna with a gain of nearly 50 to more than quadruple its former output. The new equipment was supplied by Radio Corp. of America, 30 Rockefeller Plaza, New York 20, N. Y.

Delay Dimming . . . A new electronic automatic headlight control incorporates an electronic delay in its circuit to provide for smoother control of car headlights under all operating conditions. The delay prevents flickering of the headlights in passing a string of cars in traffic.

The unit, made by Dynotron Corp., Cleveland, Ohio, includes a lens and photoelectric circuit and is enclosed in a small metal case. The dimmer also provides for proper control of lights when approaching cars on hills and curves and on city streets and in areas where the general illumination is high.

◀ CIRCLE ED-5 ON READER-SERVICE CARD

... read
ging **Quiet TV** . . . A new use has been
ecordin sound for the "Florac" miniature
leted b m-fm radio first announced in ELEC-
, Illinois **RONIC DESIGN** (November, 1954,
ago, Ill. 8, and January, 1955, pp. 48-49).
hip, th to keep the noise level down, patients
ge book hospitals are using the radios, which
ion an ave hearing-aid speakers, to receive
s of 7 TV sound while their TV receiver's
icture is on but sound is off.

Device This arrangement is less complicated
Reduce than connecting earphones to the TV
ouse of set and running wires across the room
agencie the patient's bed. The patient is also
e device ble to control the sound.

by more Only slight adjustments need to be
It will made in the standard model to enable
U. S. Air to receive the sound for channels 2
and 4. The Florac radio is a product
of Ultra-Miniature Electronics Co., 246
E. 46th St., New York 17, N. Y.

TV sta
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y Radio
kefeller

Pure Silicon . . . The "zone-melting"
method of purifying semiconductor
materials, originally developed to
purify germanium (*ED, March, 1954,*
p. 5), has now been applied to silicon.
Large crystals of silicon with impuri-
ties measured in parts per million
have been produced at the General
Electric Research Laboratory, Sche-
nectady, N. Y.

In the zone-melting process, induc-
tion heating coils are moved along a
cylindrical ingot of very pure silicon
in a gas-filled tube sweeping nearly
all the remaining impurities to one
end of the ingot. The process is based
on the fact that the impurities are
not equally soluble in the solid and
liquid states of a substance.

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Mica Strike . . . One of the biggest
strikes in the recent history of mica-
mining has been made in the south-
western corner of North Carolina
near Cowee in Macon county, which
borders on Georgia and South Caro-
lina. The mining operations are
under the direction of the Minerals
Processing Co., LaGrange, Ga.

Experts estimate the property to
contain a large tonnage of good
quality and valuable block mica.

CARD

CIRCLE ED-10 ON READER-SERVICE CARD ➤



J. L. ADRIAN, CHIEF PROPELLER DESIGN ENGINEER, PROPELLER DIVISION, CURTISS-WRIGHT CORPORATION, CALDWELL, N. J.

G-E aircraft motors meet C-W's toughest specs

"When Curtiss-Wright was developing its now famous Electric Propeller," says J. L. Adrian, Chief Propeller Design Engineer of the company's Propeller Division, "it faced very strict design requirements. For instance, C-W needed a propeller pitch-changing motor that would function with precision under the rigors of combat military service—extremes of altitude, temperature, vibration, shock, and centrifugal force.

"Then G-E engineers were called in. They came through with a basic motor design that not only met Curtiss-Wright's toughest specifications but, with variations, has been used in 55 different Curtiss Propeller applications

since—on such planes as the B-50 Superfortresses, C-124 Globemasters, and DC-6, CV-240, and Constellation transports."

IN SERVING YOU, G-E engineers can draw on unmatched experience gained in solving this and many hundreds of other aircraft motor problems. In addition, they'll have at their disposal complete aircraft motor development and testing facilities.

To take full advantage of this service, contact your local G-E Apparatus Sales Office *early in your planning*. And, for more information, write today to Section 704-30, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

meet



a NEW-FASHIONED PATTERN for automation!

Automation is a sought-for goal today—but, for the electrical and electronic manufacturer, hand wiring and assembly are the stumbling blocks in its achievement. But now a bright entrant in the field, *printed circuitry*, overcomes this obstacle—and provides other equally great gains in addition!

Complicated manual wiring is replaced by a pattern of conductors, coils, resistors, and other components "printed" on a sheet of laminated plastic. Low in cost, uniform in performance, and free of wiring "bugs," such assemblies are speedily mass-produced. Labor costs are drastically cut two ways—far fewer personnel are needed, and lesser-skilled workers can easily assemble (and service) complex devices with less chance of error. Since exact wiring duplication is achieved, inspection is greatly simplified. Assemblies grow small in size, overhead is reduced, less floor space is needed . . . the whole problem takes a big "easy-does-it" step toward complete automation.

National Vulcanized Fibre Co. is a pace-setter in the development of foil-clad laminates—the basic materials for most printed circuitry. Copper-Clad Phenolite—by National—is recognized as the standard by fabricators everywhere. For Phenolite is a high-quality base laminate that can be *engineered* to fit your conditions. It has the high insulation resistance, low electrical loss, and low moisture absorption required in the *right* base material for printed circuits. It is light in weight, easily punched and worked, and withstands effects of the various circuit-printing processes.

No matter which method you use to produce printed circuits, Phenolite clad laminates are the ideal base materials. Whether clad with metal foils, or non-metallic materials (such as rubber, vulcanized fibre, etc.) there is a Phenolite laminate for your particular job.

Ask any of our district offices or Wilmington headquarters for details.



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Vul-Cot Waste Baskets, Peerless Insulation,
Materials Handling Equipment and Textile Bobbins



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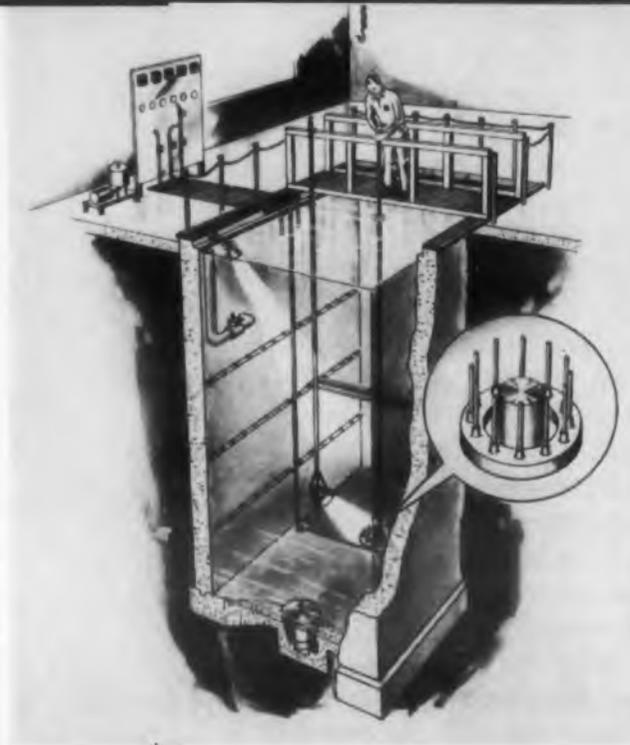
VULCANIZED FIBRE CO.

WILMINGTON 99, DELAWARE

CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

PHENOLITE
Laminated PLASTIC

HERE'S HELP FOR YOU—our new, fact-filled, 12-page bulletin entitled "Mechanize Your Wiring With Copper-Clad Phenolite." Contains full information and application data on Copper-Clad Phenolite and other metal and non-metal clads. Write for it today! Address Dept. AG-2.



The water in this tank shields research workers preparing materials for irradiation by the 2000-curie cobalt-60 source at the bottom of the tank.

Gamma-Radiation Source . . . The effects of radiation on electronic components, lubricants, and construction materials will be studied by means of a new gamma-radiation source. Installed at Battelle Institute, 505 King Ave., Columbus 1, Ohio, the source is available to industry for contract studies.

Initially the source will consist of 2000 curies of cobalt-60, which is equivalent to \$24,000,000 worth of radium. The installation has a planned capacity for 10,000 curies of the atomic energy by-product. The source is also expected to play an important role in furthering progress on the radiation sterilization of certain foods, drugs, and medical supplies which are difficult, too costly, or impossible to sterilize by conventional methods.

The source will be housed in a water tank 14' deep, as shown in the cutaway sketch. The cobalt-60 is contained in the stainless steel tubes illustrated in the inset. Materials to be irradiated are placed in containers inside the circular arrangement of tubes. The cobalt-60 and the materials to be subjected to radiation are handled by 18' long manipulators. In the foreground at the bottom of the tank may be seen a pit with an 800-lb lead plug. This pit is used for safe storage of the cobalt-60 when cleaning, repairing, or other servicing of the tank is necessary.

Long-Distance Diagnosis by TV . . . The possibility of a medical specialist making immediate diagnoses by color TV while hundreds or even thousands of miles away from the patient was demonstrated last month. Pathologists in Washington, D. C., and Baltimore, Md., observed tissue removed from a patient undergoing surgery at the University of Pennsylvania

Hospital, Philadelphia, Pa. The examination was followed by a discussion of the case by an eminent pathologist at the hospital.

The closed-circuit compatible-color links and equipment were provided by Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y., cooperating with the Armed Forces Institute of Pathology. The Baltimore group saw the presentation at WBAL-TV.

Electronic Mining . . . The probe on a newly developed geiger counter can be dropped as much as 1000' down a drill hole by cable for sub-surface uranium exploration. The probe, containing the detecting tube, is waterproofed and tapered so that it will not catch on obstructions.

The battery operated counter has three indicators: a meter, earphones, and a flashing neon light. Known as the DG-9 Drill Hole Geiger Counter, the instrument is made by Radiac Co., 489 Fifth Ave., New York 17, N. Y. Standard models are equipped with a hand probe in addition to the deep-hole probe and cable. The unit can also be used for scanning the sides of gulches and rock walls for uranium.

Portable Depth Sounder . . . A portable electronic depth sounder reading to 240' has been developed for use by foresters, fish and game wardens, construction firms, and other groups who find it necessary to chart the bottoms of inland waters. Known as the DE119 Fathometer, the device, illustrated below, weighs only 40 lb and runs for 8hr on a standard storage battery.

The instrument has four ranges covering depths from 0 to 240'. In operation the ultrasonic transducer is lowered into the water a few feet on the end of a pipe. The depths are recorded on chart paper visible through a glass window in the case. Made by Raytheon Manufacturing Co., Waltham, Mass., the instrument can also be used for finding fish.

The operator of this portable "Fathometer" is just about to lower the ultrasonic transducer into the water. The depths are read through the window.



*To help you meet
the Tolerance Squeeze*

QUALITY CAPACITORS BUILT BY HAMMARLUND

Performance requirements for electronic products — commercial, industrial and military — are becoming more difficult to meet. Specifications call for the finest quality components available to fulfill exacting equipment tolerances.

Hammarlund variable capacitors have been designed and built for more than 25 years to meet the most demanding of requirements. Check the general characteristics of these outstanding variables:

- Rotor and stator plates of brass stock soldered, not staked, to their supports to permanently insure perfect contact and prevent loosening of plates.
- Stator supports soldered into eyelets assembled to steatite insulators.
- Terminals hot-tinned for ease in soldering.
- Insulators of low-loss steatite, impregnated with DC 200 silicone fluid to prevent absorption of moisture.
- Rotor and stator assemblies nickel or silver-plated.
- Rotor contact springs of beryllium copper or phosphor bronze, and nickel or silver-plated.
- Precision soldering fixtures and assembly jigs used in fabricating to assure absolute uniformity of plate spacing.

These are basic reasons why Hammarlund capacitors should be used where highest dependability is required. Convince yourself in your engineering models and you will specify them for production.

For detailed information on Hammarlund variable capacitors write for this latest catalog. It includes complete drawings and specifications on all standard units. Ask for bulletin CD-2



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CIRCLE ED-12 ON READER-SERVICE CARD FOR MORE INFORMATION



Miniature "MAC"
Variable Capacitor



"VU" Capacitor
For Up to 500 Mc



Special 3-Gang
Precision Capacitor



Precision Frequency
Meter Capacitor

Meetings

February 17-18: *Transistor Circuits Conference*, Univ. of Pennsylvania, Philadelphia, Pa. Sponsored by IRE Professional Group on Circuit Theory, and AIEE Science and Electronics Division. For information, write to IRE, 1 E. 79 St., New York 21, N. Y.

March 1-3: *Western Computer Conference*, Hotel Statler, Los Angeles, Calif. Sponsored by IRE, AIEE, and Association for Computing Machinery. Will include exhibits by computer manufacturers. For information, write to William Gunning, International Telemetering Corp., 2000 Stoner Ave., Los Angeles 25, Calif.

March 21-24: *Radio Engineering Show and IRE National Convention*, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

March 22: *ECDA (Electronic Commercial Development Association) Spring Meeting*, New York, N. Y. For information write to J. S. Mulholland, Jr., Secretary, ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.

April 6-10: *World Plastics Fair and Trade Exposition*, National Guard Armory, Los Angeles, Calif.

April 12-15: *Symposium on Modern Network Synthesis*, Engineering Societies Building, New York City, N. Y. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

April 29-30: *New England Radio-Electronics Meeting*, Sheraton Plaza Hotel, Boston, Mass. Sponsored by the Boston and Connecticut Valley Sections of the IRE. For information, write to Robert A. Waters, Robert A. Waters, Inc., 4 Gordon St., Waltham, Mass.

May 2-5: *Semiconductor Symposium*, Cincinnati, Ohio. For information, write to F. J. Biondi, Bell Telephone Laboratories, Murray Hill, N. J.

May 4-6: *International Aviation Trade Show*, 69th Regiment Armory, New York, N. Y. For information, write to Aircraft Trade Shows, Inc., Hotel McAlpin, New York 1, N. Y.

May 9-11: *National Aeronautical Electronics Conference*, Biltmore Hotel, Dayton, Ohio.

May 10-12: *Metal Powder Show and Metal Powder Association Annual Meeting*, Bellevue-Stratford Hotel, Philadelphia, Pa. For informa-

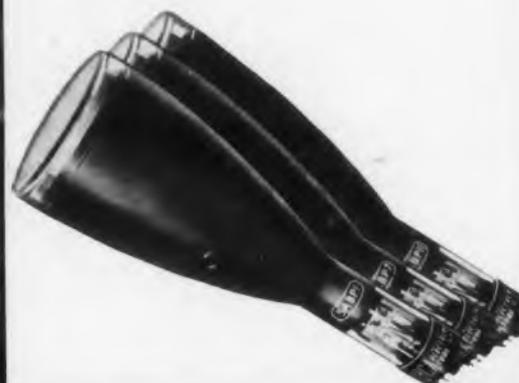


DATA FORD



NEW—RCA-6BQ6-GTB/6CU6, 12BQ6-GTB/12CU6, and 25BQ6-GTB/25CU6 are directly interchangeable with similar types in the 6BQ6 family. In comparison with previous versions, these types retain the same desirable characteristics, but feature a modified mount design to provide higher perveance and to permit higher ratings.

RCA OSCILLOGRAPH TUBES—RCA-5ABP1, 5ABP7 and 5ABP11 flat-faced cathode-ray tubes feature electrostatic focus, electrostatic deflection, and post-deflection acceleration. These 5-inch oscillograph tubes differ only in spectral-energy emission and persistence characteristics of their respective phosphors. Outstanding features: very high deflection sensitivity, high spot intensity, and high grid-modulation sensitivity. The exceptionally high deflection sensitivity and low capacitance of the pair of deflecting electrodes provided for vertical-deflection, make this pair of electrodes especially suited for operation from wide-band amplifiers. The small size and high brilliance of the fluorescent spot gives finer detail in oscillographic traces . . . even with high-speed phenomena.



NEW—RCA-5U4-GB is the "heavy duty" version of the 5U4-G. The improved design permits operation at higher peak and average currents, especially desirable when used in power supplies of TV receivers and radio equipment having high dc requirements. Additional important features of the RCA-5U4-GB include: double-wing plate design (for more plate area and increased heat conduction) . . . increased plate thickness (for more uniform heating) . . . double mica spacers (which provide better support, more resistance to shock, vibration) . . . flared base which engages button stem (eliminates need for cementing, reduces possible loose bases) . . . button stem (reduces electrolysis and leakage).



RCA WG-298A UHF DEMODULATOR—connects between the output of the WR-86A sweep generator and a 300-ohm termination for use in measuring the approximate standing-wave ratio of a 300-ohm-transmission line throughout the UHF range of 300-950 Mc. The WG-298A may also be used with other instruments such as the WR-40A, WR-41B or any UHF sweep generators using a 50-ohm BNC type output connector.



RCA WR-86A UHF SWEEP GENERATOR—recommended for continuous production line testing and general service applications on color and black-and-white TV. This instrument is also useful for checking converters, tuners, filters and other equipment operating in the 300 to 950 Mc range. The WR-86A provides wide sweep range continuously adjustable to 10% of indicated dial frequency up to 850 Mc; up to 85 Mc for frequencies from 850-950 Mc; flat output with a max. voltage amplitude variation of 0.1 db per megacycle over the swept range, high output voltage at least 0.6 v across 50 or 300 ohms, and wide range attenuation continuously adjustable over a range of 60 db.

For technical data, write RCA, Commercial Engineering, Section B-18-R, Harrison, N. J.
ELECTRON TUBES—SEMICONDUCTOR DEVICES—BATTERIES—TEST EQUIPMENT—ELECTRONIC COMPONENTS

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

DESIGNERS

RCA-2D21—a sensitive, four-electrode thyatron, of the indirectly heated cathode type for use in relay applications. It has a high control ratio (essentially independent of ambient temperature over a wide range), extremely small pre-conduction or gas-leakage currents right up to the beginning of conduction, very low grid-anode capacitance and grid current. The 2D21 is not affected appreciably by line-voltage surges and, in a high-sensitivity circuit, can be operated directly from a vacuum phototube.



RCA-5879—is a sharp-cutoff pentode of the 9-pin miniature type intended for use as an audio amplifier in applications requiring reduced microphonics, leakage, noise, and hum. It is especially well-suited for input stages of medium-gain public address systems, home sound recorders, and general-purpose audio systems.

RCA MULTIPLIER PHOTOTUBES—RCA-6342, 5819 and 6199 multiplier phototubes are "head-on" types for use in applications involving low-level, large area light sources. Coupled with suitable phosphors, these tubes are especially useful in scintillation counters for detecting and measuring nuclear particle radiation. Spectral response of these types covers the range from 3000 to 6200 angstroms with maximum response at about 4000 angstroms. Types 6199 and 5819 have luminous sensitivity values of 24 and 25 amperes per lumen respectively when operated with a supply voltage of 1000 volts. Type 6342 has a luminous sensitivity value of 7.5 amperes per lumen with a supply voltage of 1250 volts, or 35 amperes per lumen with 1500 volts.



RCA-4X150-A—a very small and compact forced-air-cooled beam power tube for use in power amplifier or oscillator service at frequencies up to 500 megacycles and also as a wideband amplifier in video applications. The 4X150-A has a maximum plate dissipation of 150 watts. Terminal arrangements of this power tube facilitate its use with tank circuits of the coaxial type. Additional features: unipotential cathode . . . integral radiator . . . coaxial-electrode structure. Max. length: 2.468". max. diameter: 1.645".



RCA WP-25A TV ISOTAP—designed for use as either an adjustable isolation transformer or as an adjustable autotransformer to facilitate testing and trouble-shooting of series string circuits in radio and TV receivers, and other electronic equipment. Seven-position selector switch permits adjustment of primary voltage in 5-volt steps for operation from any supply-line voltage from 105 to 130 v. Output voltages of approximately 105, 115, and 130 v are provided throughout the supply-line voltage range.

RCA RADIO CORPORATION of AMERICA
TUBE DIVISION
HARRISON, N. J.

CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

tion, write to Metal Powder Association, 420 Lexington Ave., New York 17, N. Y.

May 16-19: *Electronics Parts Distributor Show*, Conrad Hilton Hotel, Chicago, Ill. For information, write to S. I. Neiman, 1 N. La Salle, Chicago 2, Ill.

May 18-20: *National Telemetry Conference*, Hotel Morrison, Chicago, Ill. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

May 19-21: *Global Communications Conference*, Hotel Commodore, New York, N. Y. Sponsored by the Armed Forces Communication Association.

May 26-27: *Electronic Components Conference*, Ambassador Hotel, Los Angeles, Calif. Abstracts of papers and requests for information should be addressed to Dr. Lester M. Field, 8820 Bellanca St., Los Angeles, Calif.

May 31-June 3: *Basic Materials Exposition*, Convention Hall, Philadelphia, Pa. For information, write to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

May 31: *Symposium on Elementary Particles*, Pisa, Italy. Sponsored by the International Union of Pure and Applied Physics. For information, write to Dr. H. A. Barton, Secretary, U. S. National Committee, International Union of Pure and Applied Physics, 57 E. 55th St., New York 22, N. Y.

June 20-25: *International Symposium on Electromagnetic Wave Theory*, Univ. of Michigan, Ann Arbor, Mich. Sponsored by Commission VI of URSI. For information, write to J. W. Crispin, Jr., Univ. of Michigan, Ann Arbor, Mich.

June 27-July 1: *AIEE Summer General Meeting*, New Ocean House, Swampscott, Mass. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

August 24-26: *Western Electronics Show and Convention*, Civic Auditorium, San Francisco, Calif. Sponsored by the West Coast Electronic Manufacturers' Association and the Seventh Region of the IRE. For information write to Mal Mobley, Jr., 344 N. La Brea Ave., Los Angeles 36, Calif.

September 12-16: *10th Annual Instrument Conference*, Shrine Exposition Hall, Los Angeles, Calif. For information, write to Fred Tabery, Exhibit Manager, 3443 S. Hill St., Los Angeles, Calif.

Human-Engineered Oscilloscope Panel

By Milton Sol Weiss

Hycon Mfg. Co., Pasadena, Calif.

Ideas for
Design

THE HYPOTHETICAL oscilloscope control panel shown at the right was designed according to the principles of human engineering. I believe that it would be particularly easy and natural to operate, especially for the operator who would not have used the instrument before.

Let us analyze the oscilloscope. Here we have two forms of input information; signal leads from the observed circuit and input controls on the oscilloscope face (frequency, amplification, and position). These input controls may be subdivided into the vertical group, the horizontal group and the functional group. The output information is displayed on the screen of the cathode ray tube.

In attempting to arrive at a logical panel layout for the face of an oscilloscope, the input and output information must be organized to operate naturally. That is, to be psychologically acceptable. For example, let us consider the vertical centering control. It may be located anywhere around the cathode-ray-tube screen shown in Fig. 1. The controls are located directly on the centerlines of the screen for maximum effect. If located at *A*, a clockwise rotation of the control would move the signal display down. A counterclockwise rotation would move the display up. If located at *C*, these relative motions would be reversed. That is, a clockwise rotation would move the display

up. Locations *B* and *D* offer no natural rotational direction for a vertical control. A horizontal centering control would work in a similar manner, having natural positions at *B* and *D*, but not at *A* or *C*.

In the hypothetical design illustrated, the vertical centering control has been placed at *C* and the horizontal control has been placed at *D*. These positions were picked over their alternates, because for the average right-handed operator, the hand would not cover the tube screen while making adjustments. The related horizontal and vertical controls (gain, sensitivity, and attenuation) are aligned on both sides of their respective centering controls: the horizontal controls aligned horizontally and the vertical controls are aligned vertically. The centering controls are directly aligned with their respective centerlines of the tube screen.

The cathode ray tube controls (focus and intensity) are placed directly on the bezel of the tube. These locations immediately associate these controls with the tube. The remaining functional controls are placed below and to the side of the horizontal controls, in a balanced, though not necessarily in a symmetrical arrangement. The input jacks are placed across the bottom of the panel. This allows the input leads to lie flat on the work table, where they cannot be disconnected accidentally.

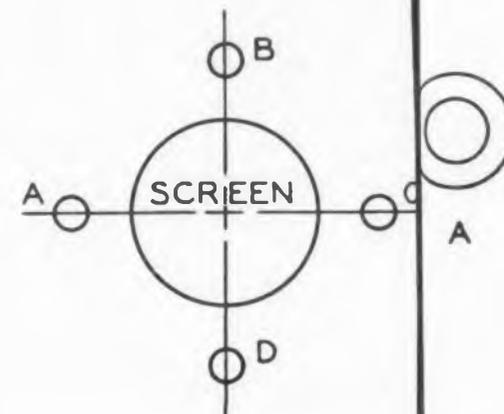
Tube Position

With the oscilloscope on the right side of the work table, which is the natural side for note taking by a right-handed observer, the offset (nonsymmetrical) arrangement places the output display closer to the observer. A further improvement, shown in Fig. 3, would be to place the tube diagonally in the cabinet, thus allowing the observer to always have a head-on, undistorted view of the screen, even though the os-

illoscope is not directly in front of the observer.

The knob dials are of three types, as illustrated in Fig. 2. Type *A* has no markings and is used only for visual positioning of another display. In this case observing the screen while making the adjustment

Fig. 1. This diagram helps demonstrate that the "natural" positions for vertical centering controls are at *A* and *C*, and at *B* and *D* for horizontal centering.



for centering. Type *B* has an arrow on the knob and terminal markings on the face panel. This is used for relative adjustments. That is, a "more or less" type of adjustment without a particular quantity needed. Type *C* has an arrow on the knob and a full range of subdivision markings on the face panel. In the case of selector switches, each position should be marked. For continuously adjustable controls, we divide the range into ten parts. It has been found that, no matter what the size of a dial, we get the best relative accuracy when the distance between markers is about 0.6".

The principles of human engineering on which this design is based can be extended to all electronic devices, while some of the features of this oscilloscope can be incorporated directly in other instruments. For example, meter faces could be placed near one side or another of a panel face, and are even more easily mounted diagonally or on pivots than CR tubes.

observer
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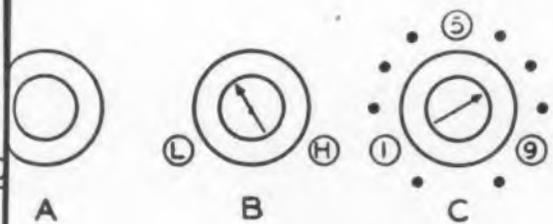


Fig. 2. These three types of "human-engineered" rotational knobs have different functions.

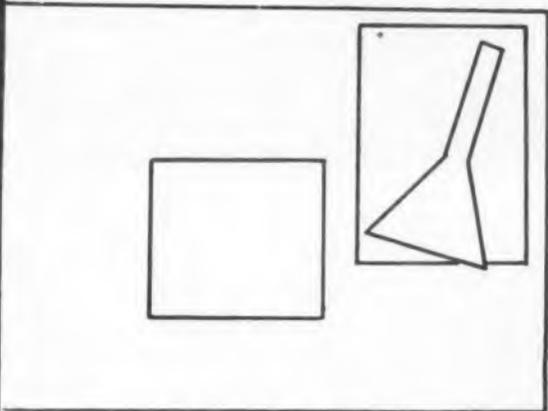


Fig. 3. The observer (bottom) can see the scope display much easier if the tube is mounted diagonally.

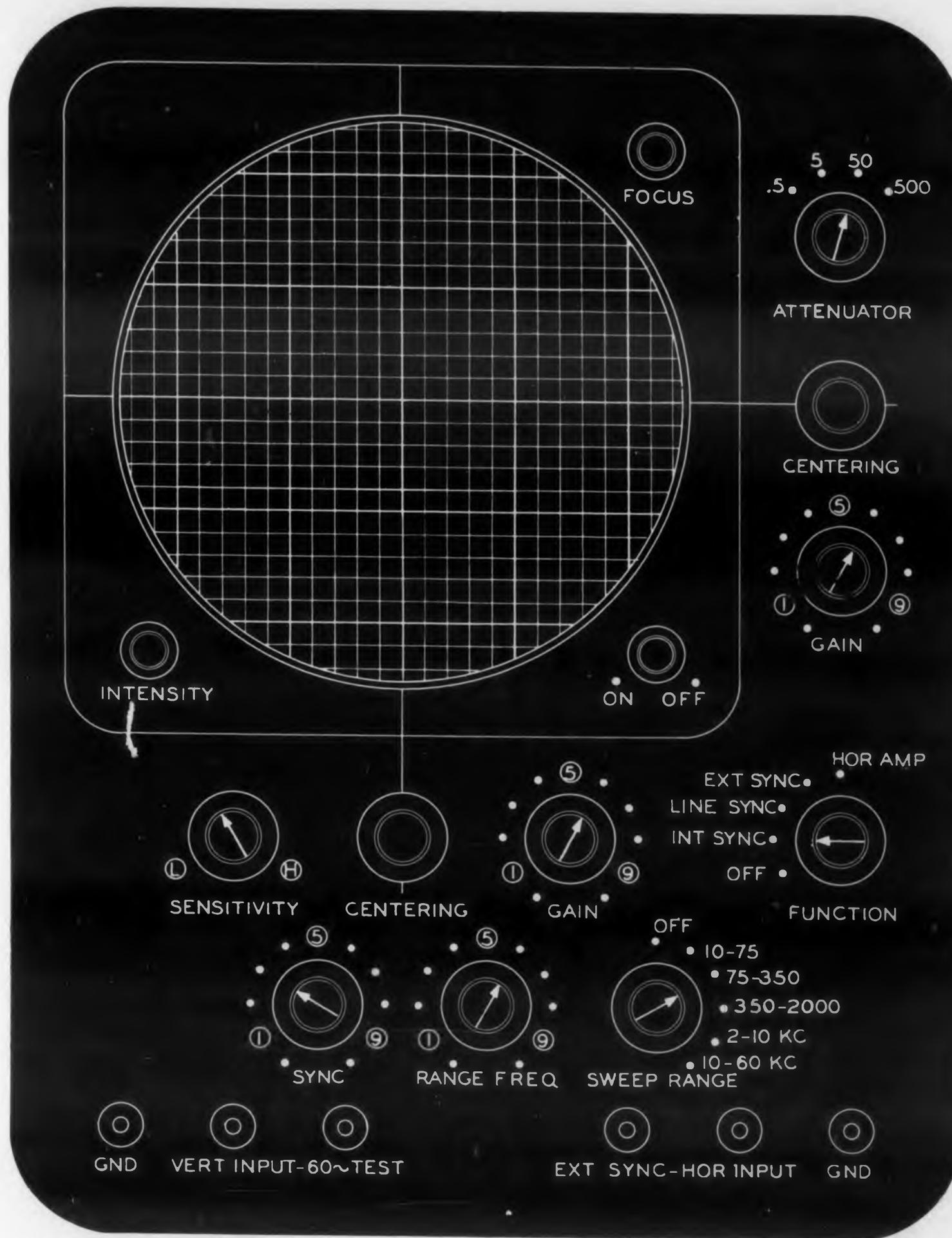


Fig. 4. This hypothetical oscilloscope panel was designed according to human engineering methods.

TO THE FINE ENGINEERING MIND
SEEKING THE CHALLENGING PROJECTS IN



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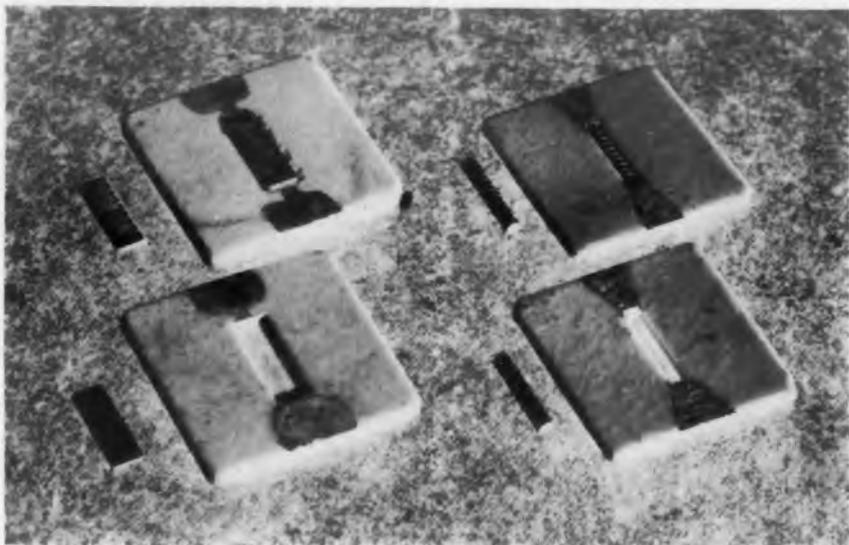
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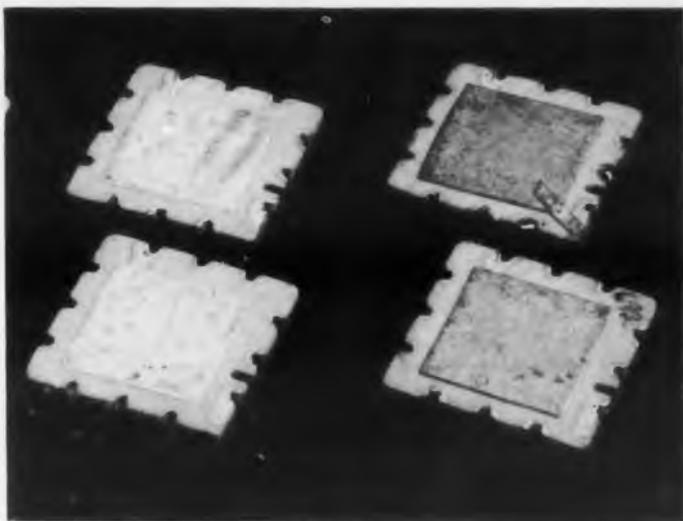
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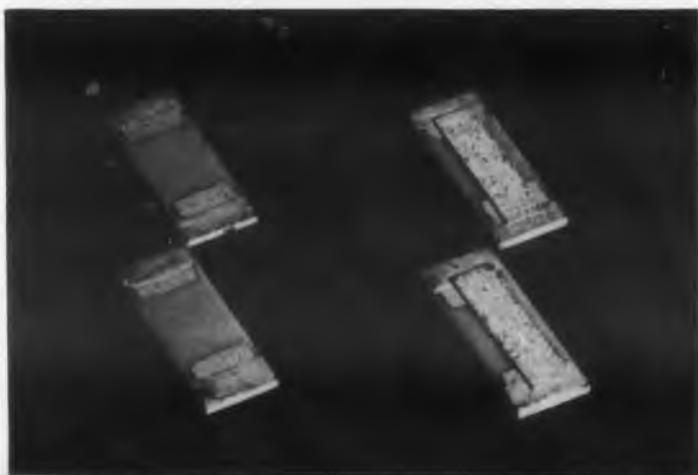
"Tinkertoy" Components



Four stages in the manufacture of a tape capacitor. The conductive plate is applied by screen pressing (upper left); silver plate after firing (lower left); dielectric coated metalized tape covering plate (lower right); and a conductive tape strip connects the metalized tape to the edge of the ceramic wafer.



Two stages in the making of chip resistors. The adhesive resistor tape has been added (right) to the ceramic chips (left), which already have their tinned and silvered tabs.



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CONTINUING development of the mechanized method of producing electronic equipment popularly known as "Project Tinkertoy" (*ED*, October, 1953, p. 5) has resulted in the three new components illustrated on these pages. They are the Pyrolytic Carbon Resistor, the Tape Capacitor, and the "Chip" Resistor. The last unit is only for use in the "breadboard" stage of development of a new ceramic-wafer module. All three components were conceived by Dr. B. L. Davis of the National Bureau of Standards, Washington 25, D. C.

The pyrolytic carbon resistor is made by a process developed by Bell Telephone Laboratories. The NBS has adapted it to Tinkertoy methods by inserting it in the illustrated "grooved" wafer to produce a unit that can be utilized like the other wafers. The groove in the wafer has printed conducting paths on each end to provide connection from the resistor terminals to the riser wires of the completed module. After the resistor is inserted into the wafer, it is terminated with a silver thermosetting resin mixture. The resistors are either flat or cylindrical and are about 5/8" long x 1/8" in width or 1/16" in diameter, respectively.

The tape capacitor is manufactured in much the same manner as the NBS adhesive-tape resistor. A conducting tape, coated on one side with a dielectric, provides one plate of the capacitor. The other plate is a silver pattern printed and fired on the basic steatite wafer. The dielectric formulation is composed of high-K titanate. An adhesive-tape resistor can be added to the wafer's other side.

Capacitors of higher values can be manufactured by applying a number of layers of tape, one on top of another with appropriate connections to the edges of the wafer. Smaller capacitors can be made by reducing the area of the silver pattern printed on the wafer, or by increasing the thickness of the dielectric layer.

Shelf life tests indicate that the capacitance changes no more than 1% during the first month after manufacture, and that there is no change in the dissipation factor, which averages 0.7% at 1kc. However, the capacitance does change somewhat with temperature: -3% from 25°C to 85°C; and -15% from 25°C to -55°C.

The "chip" resistor is made by applying self-adhesive resistor tape to a small chip of ceramic material. This resistor is not for use in the regular quantity production of modules, but aids the electronic designer in studying new modular circuits that are still in the "breadboard" stage or in producing prototype equipments for evaluation. The chip is inserted into a circuit simply by soldering it to the proper connections on a standard wafer.

Project Tinkertoy has now been officially renamed the "MDE-MPE" system. "MDE" stands for "Modular Design of Electronics", and "MPE" means "Mechanized Production of Electronics".

WHEN YOU SPECIFY...

TAPE WOUND CORES

SPECIFY

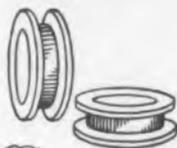
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Performance - Guaranteed **BOBBIN CORES, TOO**

Tiny Bobbin Cores made with ultra-thin tape down to 0.000125" in thickness, and possessing very rectangular hysteresis loops under pulse conditions, are now available for the first time with the famous Performance-Guarantee. If temperature stability, low coercive value, high saturation density, and ability to switch from positive to negative saturation in a very few microseconds, are of value to you, it will pay you to investigate Magnetix, Inc. Bobbin Cores.

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MAGNETICS inc.

DEPT. ED-15, BUTLER, PENNSYLVANIA



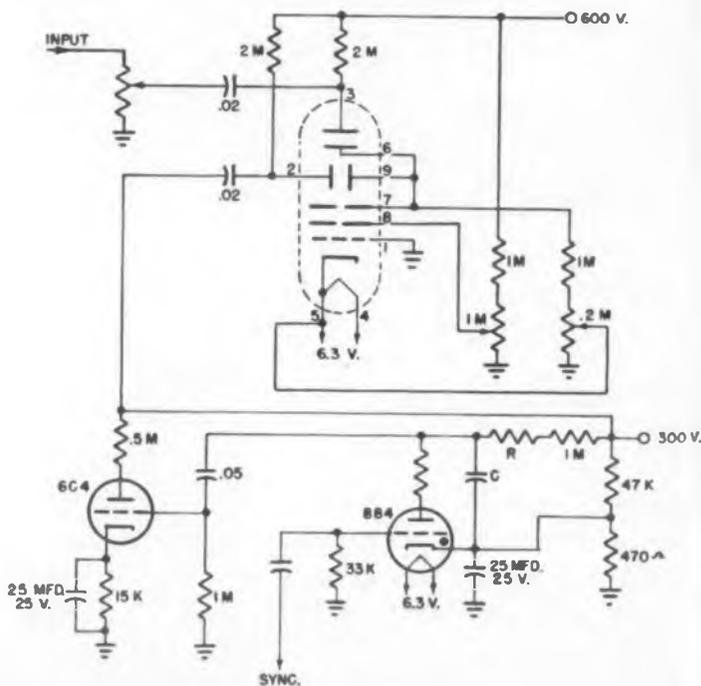
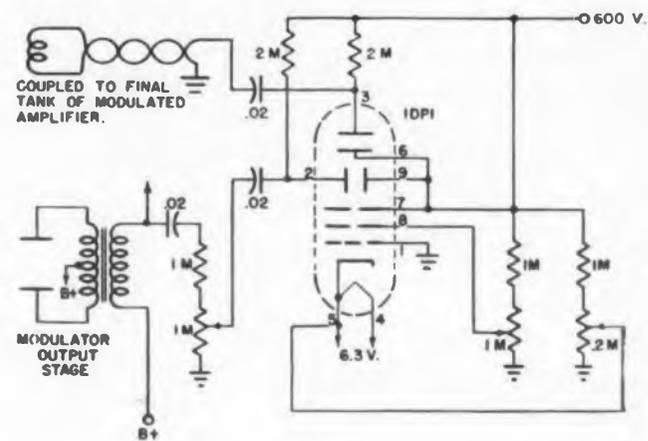
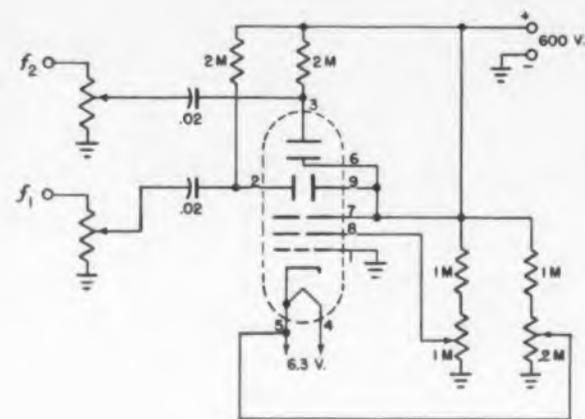
The face diameter is only 0.875" on this 3" long cathode-ray tube.

Miniature Cathode-Ray Tube

MONITORING displays can be added at low cost to the control panels of many instruments and equipments by utilizing the miniature cathode-ray tube shown on these pages and the cover. With a face only 0.875" in diameter, the tubes take up little panel space. Banks of these tubes could display digital information for checking the operation of computers, and they can also help designers make complicated control panels more compact.

Only three inches long, the tubes can be mounted in many places where larger cathode-ray tubes can not be utilized. An example is in probes for displaying the signal developed at the point where the probe is applied. Manufactured by National Union Electric Corp., 350 Scotland Rd., Orange, N. J., the tube is available in four types with various phosphors and persistences. Typical operating conditions call for 6.3v heater voltage, a cathode current of 500micro-amp, and first and second anode voltages of 600 and 300v, respectively. The tubes require a deflection signal of about ± 110 v to sweep the useful screen diameter.

The tube is enclosed in a T6-1/2 bulb on a 9-pin miniature base. There is no exposed exhaust tip. Affording excellent light output, the tubes feature electrostatic focus and deflection. They withstand standard shock and vibration tests and can be mounted in any position. For more information, turn to the Reader's Service Card and circle **ED-17**.





The frequency comparison circuit at the left requires no sweep oscillator. A typical display in which $f_1/f_2 = 3/1$ is shown above.



No sweep oscillator is necessary with this circuit to produce the modulation checking display shown above.



In this wave-shape-and-amplitude-checking circuit, R and C depend on the frequency of the applied signal.



“God: Give me the strength to smile...”

Smile, and hold back your tears: SHE must not see them.

Keep secret the voice that is crying inside of you: SHE must not hear it.

Smile... that she may sense no echo of the voice you heard this morning—the surgeon's voice, gentle and hopeless. “I'm sorry. I'm afraid we're too late.”

“Too late...” Cancer, the most terrible scourge of all, last year killed 70,000 Americans who would have lived if treated in time. Few indeed are the Americans whose lives will never be shadowed by this monstrous and implacable enemy. It may be you. Your wife, your parents. Your children...

“Too late...” The bitter, pitiful truth

is that we Americans—the most generous people on earth—have not yet contributed adequately to the war against cancer. And some are paying immeasurably in agony and grief, because there is not enough money.

Is there hope—? Hope of a final, certain cure for cancer—?

Yes, there is hope. Night and day our medical laboratories are forging the swords of knowledge. But not as fast as we all wish and pray they were—there is not enough money...

Far from enough! Last year, the American Cancer Society was able to allocate only \$4,100,000 for cancer research—less than three cents per American per year! Yet, as things stand today, 22 million Americans will die of cancer—for cancer strikes

one out of five. How long can we remain so indifferent to this monstrous thing—how many lives can we afford to throw away—?

Won't you please contribute—now, before you forget again? Please let your contribution be as large as your faith, and as heartfelt as your prayer... that, working together, we can lift this sorrow not only from our own time and nation, but from all the ages of man to come...

AMERICAN CANCER SOCIETY

GENTLEMEN: Please send me free literature about cancer.

Enclosed is my contribution of \$..... to the cancer crusade.

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CITY..... STATE.....

Simply address the envelope:
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for
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**RECORDING
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or **ANY MAGNETIC MATERIALS JOB ...**

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This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free.

ADDRESS DEPT. ED-62

You can rely on core materials like the Allegheny 4750 components illustrated above, in your receivers, recording heads or microphone assemblies.

In fact, whether your equipment is small or large, the extra-broad line of A-L magnetic materials will solve your magnetic core problems. It includes all grades of silicon steel sheets or coil strip, as well as Allegheny Silectron (grain-oriented silicon steel), and a wide selection of high-permea-

bility alloys such as 4750, Mumetal, Permendur, etc.

Our service on these materials also includes complete facilities for the fabrication and heat treatment of laminations. (For users of electrical sheets and strip, our lamination know-how is a real bonus value!) Either way, we'll welcome the chance to serve you. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry

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UNLOADED

Constant-Force Springs

EXERTING virtually constant forces in compression, the "Flex'ator" compression spring has possible application in any electronic component depending on mechanical displacement. Such components include: relays, circuit breakers, contacts, switches, pen-recording devices, potentiometers, motors, recording devices, and simple servomechanisms and automatic controls.

While the loads of conventional extension and compression springs inherently increase with deflection, the force output of these new springs may be either increasing, decreasing, or substantially constant—a constant force independent of deflection being its most significant characteristic. Unlike a compression spring, the Flex'ator itself is not located between the points of load application (as illustrated above), so that it is possible to have another part in this area without affecting operation. Available in a number of sizes and wire



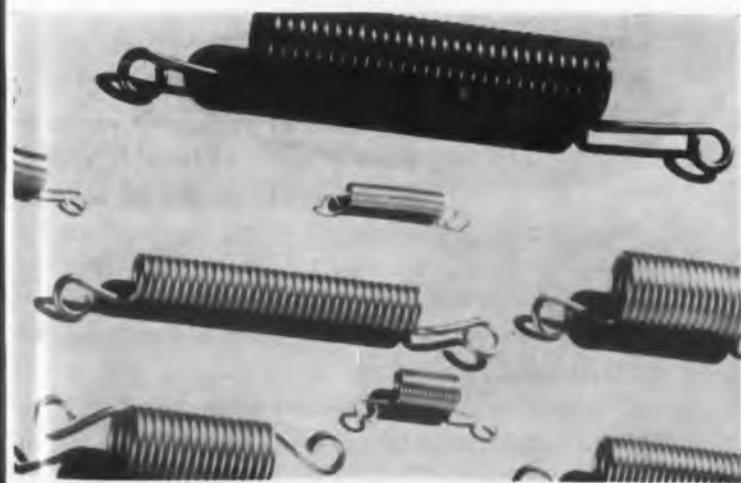
LOADED

In compression the Flex'ator is displaced in an arc instead of remaining between the points of load application.

diameters, the springs are manufactured by Hunter Spring Co., Lansdale, Pa.

Accurate formulas for load and deflection of the spring in terms of its six basic dimensional variables have been developed. For more information, turn to the Reader's Service Card and circle **ED-20**.

Flex'ators are available in a variety of sizes to exert a wide range of deflection forces.



Convenient

ACCURATE POWER MEASUREMENTS . . .

FROM 500 to 11,000 MC

This versatile FXR Universal Power Meter, and rugged Matched Coaxial Thermistor Mount, make an unbeatable laboratory or production line team. Here is your assurance of faster, more reliable c-w or pulsed power measurements . . . over broad frequency ranges. These are instruments of proven dependability . . . designed, engineered and built with the specialized know-how for which FXR is recognized in Precision Microwave Test Equipment.

UNIVERSAL POWER METER
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- Extend range 0.1 to 100 milliwatts full scale
- Accommodates any resistance within $\pm 10\%$ of 50, 100, 150, 200 or 250 ohms
- Positive or negative temperature coefficient
- Bias ranges from 3 to 40 milliamperes
- Bias can be pre-set on meter
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MATCHED COAXIAL THERMISTOR MOUNT
FXR MODEL NO. N215A

- VSWR less than 1.5 from 500 to 11,000 mc
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- Two rugged thermistors used as detecting elements
- Exceptionally high burn-out level
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A leader in the design and application of electrical relays for nearly a quarter of a century, Potter & Brumfield combines with Sterling Engineering to offer you the finest engineering, production, and testing facilities in the relay industry.

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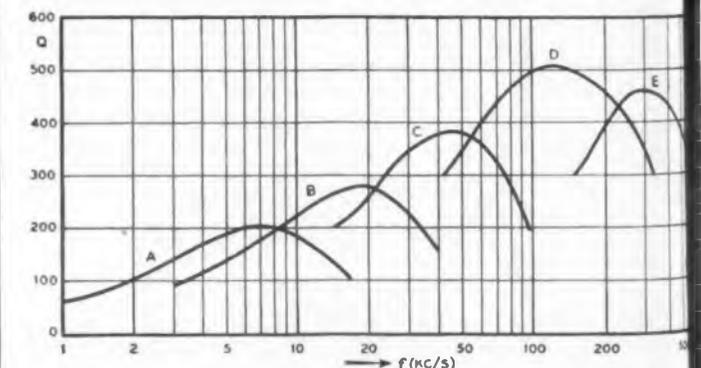
all types . . . all sizes . . .

for all applications



Cores for Adjustable Inductances

EXACT inductance values can be set for inductances utilizing these ferrite core assemblies. As illustrated above, the inductance adjustment is made by inserting strips composed of ferrite powder bonded to a plastic into a slot in the core. The ferrite layer gradually increases in thickness as the strip is pulled through the air gap, thereby



Examples of various Q versus frequency curves obtainable with different ferrite cores and coils.

decreasing the air gap. After the final adjustment, the strip is cemented in place and the unused ends are cut off.

Designated Pot Core Assemblies D-36/22 and D-25/16, these assemblies each consist of a ferrite

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The inductance of this assembly is being adjusted by moving the ferrite-coated trimmer strip.

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PLUG-IN CAPACITORS

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Sangamo now offers you production quantities of plug-in paper tubular and dry electrolytic capacitors for use in your automated pro-

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PLUG-IN TUBULAR PAPER CAPACITORS

These plug-in paper tubulars incorporate all the internal design features of the famous Sangamo Telechief. They come in a molded bakelite case with a moisture resistant end fill, and leads cut and properly spaced to fit. They are available in a range of popular sizes for almost any application.

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Leads will not contaminate solder pots during the printed circuitry dipping process... heat created when leads are soldered will not injure Sangamo plug-ins because terminals are designed so that the unit stands off from the circuit board... this "stand-off" feature also permits the designer to run additional circuits under the capacitor.

Write for complete information.



SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

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SC55-1

ring, a ferrite slug, two cover plates, and associated hardware. The top side of the ring is notched to receive the wiring and the trimmer strip. The slug may be purchased slightly shorter than the ring, leaving an air gap in the otherwise closed circuit. The length of the slug determines the magnetic reluctance of the circuit and thus the effective permeability. All mating surfaces are very carefully ground for perfect matching.

Manufactured by Ferroxcube Corp. of America, 347 E. Bridge St., Saugerties, N. Y., these cores are available in three different materials: formulations IIB1, IIB2, and IIB3, respectively. Molded bobbins of synthetic resin, specifically designed for each pot core type, are available if needed. The trimmer strips are stocked in three thicknesses: 88486/00 (green) for air gaps of 0.35 to 0.65mm; 88486/01 (red) for gaps of 1mm; and 88486/02 (yellow) for 2mm gaps. Inductance adjustments of 5 to 10% are possible with these trimmer strips.

The compact inductances constructed with these assemblies can be mounted close together with negligible intercoupling because the copper windings are entirely surrounded by material of high permeability. For data on the various sizes and shapes of ferrite cores available and characteristics of the three types of ferrite formulations, turn to the Reader's Service Card and circle **ED-23**.

Rating Transistors to Prevent "Runaway"

By Nicholas DeWolf

Transitron Electronic Corp., Melrose, Mass.

TRANSISTOR "runaway" occurs when power dissipation materially increases collector current through self-heating, thereby further increasing dissipation, leading eventually to an unstable equilibrium and runaway of collector current. This article presents a method of rating transistors to avoid their destruction by this phenomenon, which is common to all germanium transistors.

A mathematical analysis of runaway shows very close correlation with actual performance tests, and has been simplified for use in this rating system. It is assumed that the increase of collector current with temperature is essentially due to the increase of the collector cutoff current, which doubles approximately every 11°C.

In order to determine the runaway limitations, it is

necessary to know the circuit stability (S) defined as the change in collector current per unit change in the collector cutoff current. This parameter is affected by the degree of d-c degeneration or compensation that is employed in the circuit^{1, 2}. For grounded-base circuits, S generally equals 1, while for uncompensated grounded-emitter circuits S will equal the common emitter current gain, oftentimes as high as 100. For stable operation, particularly in circuits where the ambient temperature may vary widely, it is highly recommended that S be held to as low a value as possible through degeneration.

It can be shown that:

$$I_{cr} V_{cr} = \frac{15}{D} \ln \frac{V_{crit}}{V_{cr}}, \text{ where } V_{crit} = \frac{15}{D S I_{co}}$$

and where each symbol has the below listed meaning:

- I_{cr} is the collector current at runaway
- V_{cr} is the collector voltage at runaway
- D is the dissipation constant in °C/Watt
- S is the circuit stability, dI_c/dI_{co} (approximately the d-c circuit current gain)
- I_{co} is the collector cutoff current.

These equations are the basis for the determination of maximum allowable dissipation under runaway conditions.

Fig. 2 is a graph that may be used to calculate V_{crit} , and is plotted in terms of the dissipation rating, the rated dissipation limit for a 75°C rise in junction temperature above 25°C ambient. The derating curve for maximum allowable dissipation is shown in Fig. 3, and includes further derating for temperature up to the maximum allowable junction temperature.

In order to use the curves, the maximum circuit stability and I_{co} at 25°C must be determined and used with Fig. 2 to determine V_{crit} . This is the voltage at which the transistor would run away at negligible dissipation. V_{crit} and V_{cr} , the applied collector voltage, are applied to Fig. 3 to determine the allowable percentage of the dissipation rating that may be tolerated at the maximum ambient temperature. A safe operating margin is included in the dissipation rating and I_{co} invariably is well below the specification value.

Example

It is desired to use a Z8 transistor* with a heat sink at 55°C and 30v collector voltage in a circuit with sufficient degeneration to give a maximum stability factor, S , of 10. The dissipation rating of this transistor is 750mw and the maximum collector cutoff current, I_{co} , is 10µa. V_{crit} is calculated from Fig. 2 using S , I_{co} , and the dissipation rating as 1500 volts.

* Z8 is a newly developed power transistor with a heat sink. The unit's container, exclusive of the heat sink, has the same physical dimensions as most small-signal transistors, but the transistor is rated at 750mw.

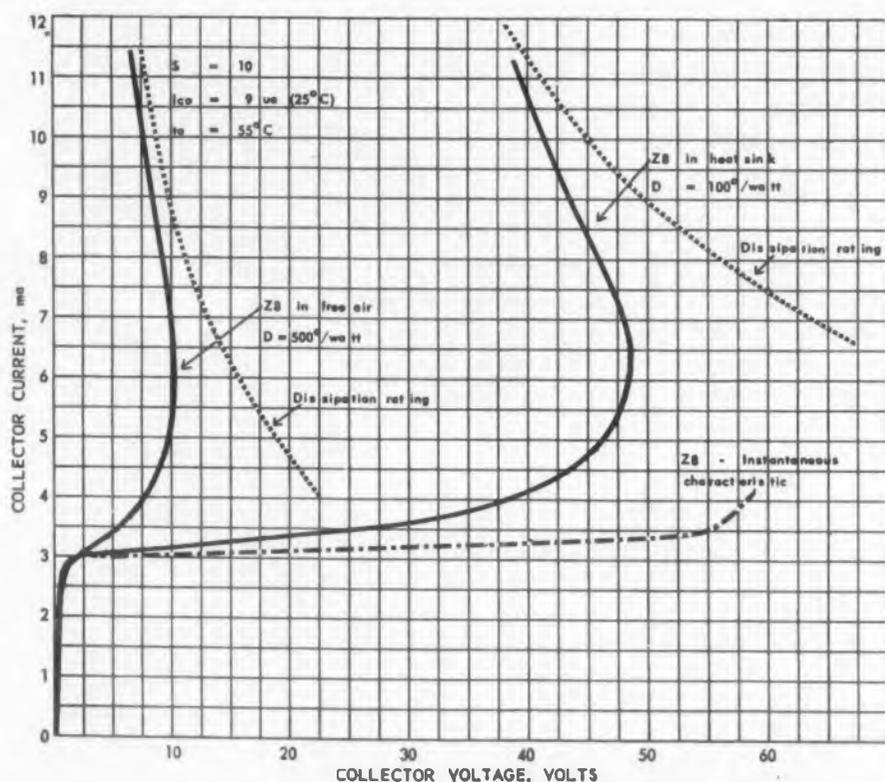


Fig. 1. Curves illustrating the "runaway" phenomenon for the same transistor with and without a heat sink. The effect of a heat sink in preventing runaway is apparent.

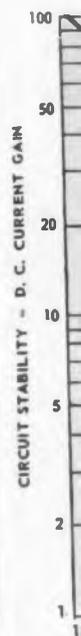


Fig. 2. Graph of circuit stability vs. collector current.

V_{cr}/V_{crit} ambient temperature. To determine the maximum allowable junction temperature, given the ambient temperature, the necessary derating factor can be determined from the significant junction temperature change. A limit is imposed to avoid runaway.

Fig. 3. The maximum dissipation of any transistor as a function of its rating at 25°C can be determined by this graph in conjunction with a value based on the curves in Fig. 2.

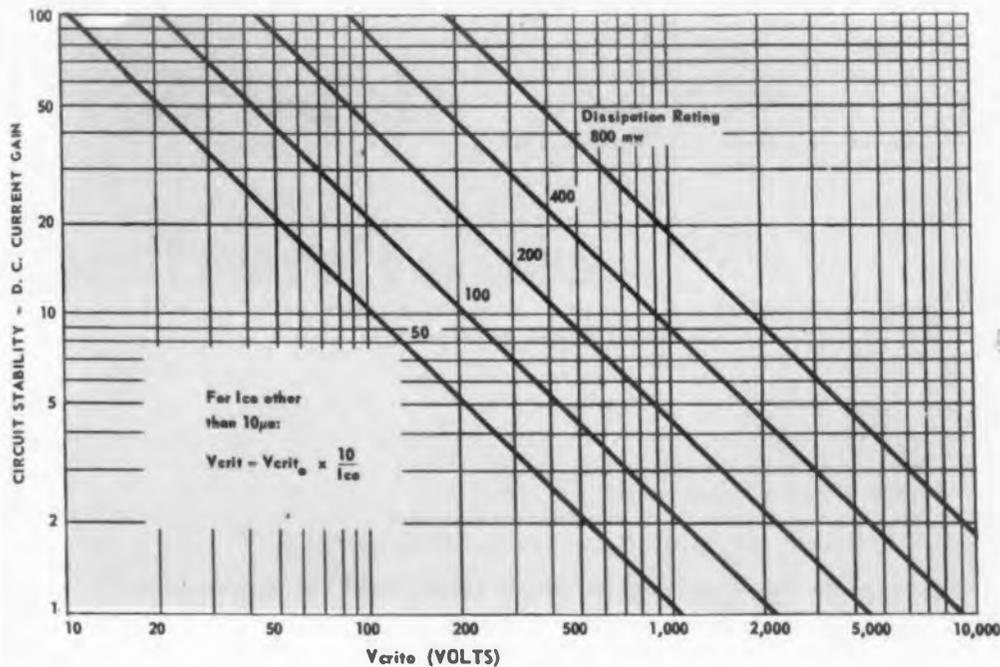
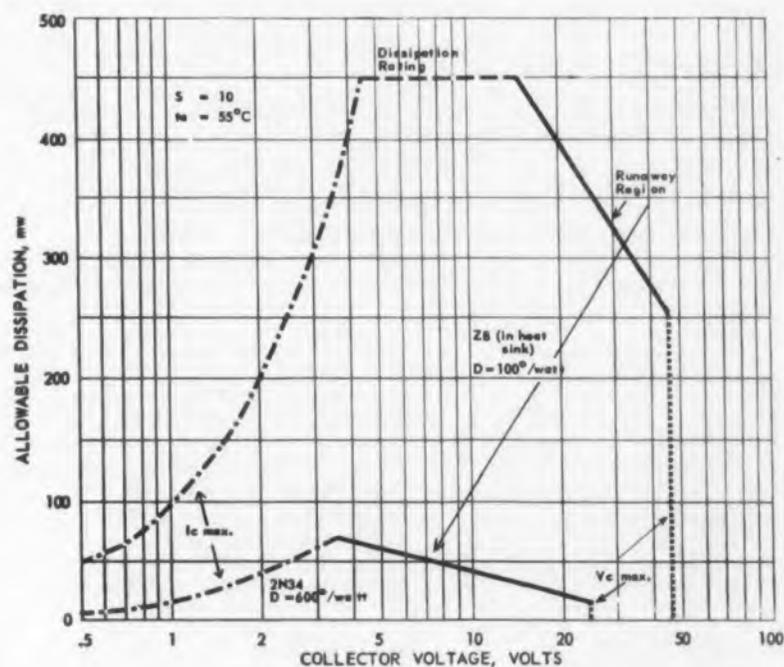
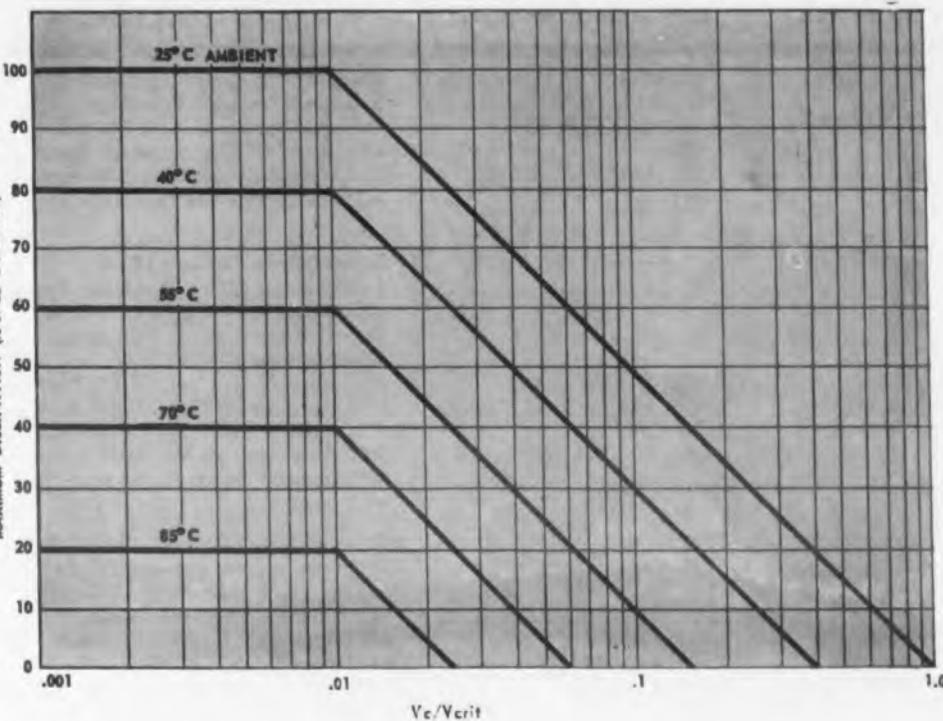


Fig. 2. Critical runaway voltage as a function of stability, S , and dissipation rating. The values determined here are carried to Fig. 3 following further calculation.

Fig. 4. These rating curves, which are within the runaway limitation, were determined by the calculations based on Figs. 2 and 3.



V_c/V_{crit} is then 30/1500, or 0.02. This value and the ambient temperature are applied to Fig. 3 to determine that the maximum allowable dissipation for the given parameters is 44% of the rating, or 330mw.

These two graphs readily permit a calculation of the necessary derating of maximum allowable dissipation at collector voltages where the runaway phenomenon becomes a limiting factor in operation. Other significant rating factors include the maximum allowable junction temperature above which irreversible changes in transistor characteristics may take place. A limit is also placed on maximum collector current to avoid operation at a collector current where current gain and collector resistance have dropped to

low values. A maximum rating is given for collector voltage to limit operation within the breakdown voltage of the transistor. On some transistor types a maximum inverse emitter voltage rating is given to avoid loading of driving sources when the transistor is driven beyond cutoff, commonly the case in Class B amplifiers and in switching circuits.

This rating method has been applied to various transistors. Fig. 4 is one example of a graphical compilation of the dissipation limitations on types 2N34 and Z8 transistors determined by this method.

Due to the extreme temperature dependence of runaway, this phenomena is often not encountered until testing at high ambient temperatures. This new

rating system, although somewhat more complicated than a dissipation rating alone, offers the advantage of preventing prototype designs of transistorized equipment from suffering from runaway. Because of its wider scope this rating system permits operation of transistors with safe margins under conditions that would be prohibited by a dissipation rating sufficiently conservative to be employed as the only rating standard.

References

1. Transistor Operation: Stabilization of Operating Points, R. F. Shea. Proc. IRE, Vol. 40, Nov. 1952, No. 11, p. 1435.
2. Principles of Transistor Circuits, R. F. Shea, John Wiley & Sons, New York, pp. 97-131.

Reliable Type No.	Standard Receiving Tube Counterparts	Description
0A2WA	0A2, 6073	Miniature Voltage Regulator
0B2WA	0B2, 6074	Miniature Voltage Regulator
6AK5WA	6AK5, 6AK5W	Miniature Sharp Cut-off Pentode
*6AU6WA	6AU6	Miniature RF Sharp Cut-off Pentode
6SK7WA	6SK7, 6SK7W	Octal RF Remote Cut-off Pentode
*12AT7WA	12AT7	Miniature High-Mu Twin Triode
*5636	.....	Subminiature Pentode Mixer
*5639	.....	Subminiature Video Amplifier Pentode
*5641	.....	Subminiature Half-Wave Rectifier
*5644	.....	Subminiature Voltage Regulator
5647	.....	Subminiature Diode
*5654/6AK5W	6AK5, 6AK5W, 6AK5WA	Miniature Sharp Cut-off RF Pentode
5654/6AK5W/L 196	6AK5, 6AK5W, 6AK5WA	Miniature Sharp Cut-off RF Pentode
*5670	2C51	Miniature Medium-Mu Twin Triode
5670WA	2C51	Miniature Medium-Mu Twin Triode
*5686	.....	Miniature RF Beam Power Pentode
*5702WA	5702	Subminiature RF Sharp Cut-off Pentode
*5703WA	5703	Subminiature Medium-Mu Triode
*5718	.....	Subminiature Medium-Mu Triode
*5719	.....	Subminiature High-Mu Triode
*5725/6AS6W	6AS6, 6AS6W	Miniature Dual Control RF Pentode
*5726/6AL5W	6AL5, 6AL5W	Miniature Double Diode
5726/6AL5W/6097	6AL5, 6AL5W	Miniature Double Diode
*5727/2D21W	2D21	Miniature Thyatron Gas Tetrode
*5744WA	5744	Subminiature High-Mu Triode
*5749/6BA6W	6BA6	Miniature RF Remote Cut-off Pentode
*5750/6BE6W	6BE6	Miniature Pentagrid Converter
*5751	12AX7	Miniature High-Mu Twin Triode
5751WA	12AX7	Miniature High-Mu Twin Triode
*5783WA	5783	Subminiature Voltage Reference Tube
*5784WA	.....	Subminiature Dual Control RF Pentode
5787WA	.....	Subminiature Voltage Regulator
*5814A	12AU7, 5814	Miniature Medium-Mu Twin Triode
5814WA	12AU7, 5814	Miniature Medium-Mu Twin Triode
*5829WA	5829	Subminiature Double Diode
5839	(26v), 6X5GT, 6X5WGT	Octal, Full-Wave Rectifier
*5840	.....	Subminiature RF Sharp Cut-off Pentode
5852	6X5GT, 6X5WGT	Octal, Full-Wave Rectifier
*5896	.....	Subminiature Double Diode
*5899	.....	Submin. Semi Remote Cut-off Pentode
*5902	.....	Subminiature Audio Beam Power Pentode
5903	.....	Subminiature Double Diode
5904	.....	Subminiature Medium-Mu Triode
5905	.....	Subminiature RF Sharp Cut-off Pentode
5906	.....	Subminiature RF Sharp Cut-off Pentode
5907	.....	Submin. RF Semi-Remote Cut-off Pentode
5908	.....	Subminiature Pentode Mixer
5916	.....	Subminiature Pentode Mixer
5977	.....	Subminiature Low-Mu Triode
5992	6V6GT, 6V6GTY, 6V6Y	Octal Beam Power Pentode
5993	6X4, 6X4W	Miniature Full-Wave Rectifier
*6005/6AQ5W	6AQ5, 6AQ5W	Miniature Beam Power Amplifier
6005/6AQ5W/6095	6AQ5, 6AQ5W	Miniature Beam Power Amplifier
*6021	6BF7, 6BF7W	Subminiature Medium-Mu Twin Triode
6072	12AY7	Min. Medium-Mu Low Noise Twin Triode
6094	6AQ5, 6AQ5W	Miniature Beam Power Amplifier
6098/6AR6WA	6AR6	Octal Beam Power Amplifier
6099	6J6, 6J6W	Miniature Medium-Mu Twin Triode
6100/6C4WA	6C4, 6C4W	Miniature Medium-Mu Triode
6101/6J6WA	6J6, 6J6W	Miniature Medium-Mu Twin Triode
6106	5Y3GT, 5Y3WGT, 5Y3WGTA	Octal Full-Wave Rectifier
6110	.....	Subminiature Double Diode
*6111	.....	Subminiature Medium-Mu Twin Triode
*6112	.....	Subminiature High-Mu Twin Triode
6135	6C4, 6C4W	Miniature Medium-Mu Triode
6184	.....	Subminiature Double Diode
6186/6AG5WA	6AG5	Miniature Sharp Cut-off Pentode
6188/6SU7WGT	6SU7GT, 6SU7GTY, 6SL7GT, 6SL7WGT	Octal High-Mu Twin Triode
6189/12AU7WA	12AU7	Miniature Medium-Mu Twin Triode
6205	.....	Subminiature RF Sharp Cut-off Pentode
6206	.....	Submin. Semi-Remote Cut-off Pentode

Comments on Use of Tubes

None
None
None
None
None
None

None
None
None
None
None
Higher Input Capacitance
Higher Input Capacitance
5670 draws 1/6 more heater current than 2C51
5670WA draws 1/6 more heater current than 2C51
None

None
None
None
None
5725/6AS6W has 10% lower plate and screen dissipation than 6AS6, 6AS6W
None
None
None
None
None
None
None
5751 draws 1/6 more heater current and has lower Mu than 12AX7
5751WA draws 1/6 more heater current and has lower Mu than 12AX7
5783WA has shorter bulb than 5783
None
None

5814A draws 1/6 more heater current than 12AU7
5814WA draws 1/6 more heater current than 12AU7
5829WA has different inter-electrode capacitances than 5829
5839 has 26.5V filament and has longer envelope than 6X5GT, 6X5WGT
None
5952 draws twice the heater current of 6X5GT and 6X5WGT and has longer envelope
None
None

None
None
None
None
None
None
None
None
None
None
5992 draws 1/3 more heater current than 6V6GT family and has higher transconductance
5993 draws 1/3 more heater current and has different base and larger envelope than 6X4, 6X4W

None
None
6021 is slightly shorter and has 14% higher transconductance than 6BF7, 6BF7W
6072 draws 1/6 more heater current than 12AY7
6094 has a 9-pin base, larger envelope and draws 1/3 more heater current than 6AQ5, 6AQ5W
None
6099 has slightly higher transconductance than 6J6, 6J6W

6100/6C4WA envelope is 3/8 inch longer than 6C4W
6101/6J6WA has slightly higher transconductance than 6J6, 6J6W
6106 draws 5% less heater current than 5Y3GT family. 6106 is a heater-cathode type

None
None
None
6135 draws 1/6 more heater current than 6C4, 6C4W and has 3/8 inch longer envelope than 6C4W
None
None
6188/6SU7WGT envelope has larger max. height

None

None
None

DOW CORNING
CORPORATION

Silicone News

FOR DESIGN ENGINEERS

Armed Services Reliable Electron Tubes

RELIABLE electron tubes included in military specification MIL-E-1B were tabulated in a recent Information Bulletin of the Armed Services Electro-Standards Agency (ASESA). The entire list is reproduced here for the convenience of ELECTRONIC DESIGN readers. This compilation is complete as of October, 1954. The bulletin reminds the reader that the listing of reliable tube types is for information only, and that requirements of contract specifications should be consulted before selecting tubes for government equipment.

Commercial counterparts for each reliable-type electron tube are also included. Again, ASESA cautions the military equipment designer that the list is not to be confused with an interchangeability table. The proper specifications should be consulted when contemplating a substitution.

Note that in many instances the reliable type differs physically from its standard receiving tube counterparts. Tube types marked with an asterisk are also included in MIL-STD-200A.

Silicone Grease Saves Money; Increases Life of Alloy-to-Plastic Gears in Precision Gearmotor

Using the best organic lubricants, maximum life of the gear set in a test model of a new precision gearmotor designed by Lee Engineering Company of Milwaukee, was only 100 hours. Temperature at point of contact between the nickel alloy worm and phenolic gears was so high that organic lubricants were rapidly separated and thrown out, even though the gearbox was fully packed.



Before major alterations in design were undertaken, Lee engineers tried Dow Corning 33 Grease, light consistency. A first trial run of 1200 hours showed no appreciable gear wear. Further tests proved that a basically sound design had been made practical by a stable lubricant.

With only enough Dow Corning 33 to fill the teeth required to give long service, Lee engineers found that even the initial cost of the silicone grease was less than that of a gear box-full of the organic grease previously tried.

Now in commercial production, these silicone lubricated precision gearmotors are put to many uses. For example, the 1/8 hp unit shown here with a 40 to 1 gear ratio and a speed range of 10 to 200 rpm on the phenolic gear, is used to feed wire in an automatic welding machine. No. 24

New 1955 Reference Guide to Dow Corning silicone products gives in 8 pages a brief but comprehensive summary of the properties and applications for the silicone products that are most widely used. Products are indexed by type of application. With increasing effort devoted to product improvement and cost reduction, such a reference guide to this remarkably stable group of engineering materials becomes increasingly important to design engineers. No. 25



RF Transformers Impregnated with Silicone Fluid Exceed Humidity Specs

The RF transformers in radio compasses made by LearCal Division of Lear, Incorporated, passed Ordnance tests for moisture resistance and extreme thermal shock. Lear felt, however, that for permanent protection, the transformers should be potted to come as close to forming a true hermetic seal as possible.

After potting with mica-filled epoxy resins, the transformers are, therefore, vacuum impregnated with Dow Corning 200 Fluid. Silicone treated transformers easily pass the humidity tests of SC-D-1594 and MIL-E-5400. They may be immersed in water for 30 minutes with no change in electrical properties. No. 26

Westinghouse Seals New Switches With Silastic for Sub-zero Service

Sealed, top and bottom, with Silastic gaskets, the new Westinghouse gas-filled, load interrupter switches remain operable at temperatures as low as -65 F. Organic rubber seals were originally tried, but sub-zero weather caused the seals to harden and shrink, allowing the sulfur hexafluoride gas to escape.



On testing, Westinghouse engineers found that Silastic gaskets easily passed all pressure, vacuum, and temperature requirements, and were not affected by the gas. The Silastic gaskets provide such a tight seal that Westinghouse expects the units to hold gas pressures of 30 psi indefinitely without recharging. No. 27

Silicone Aluminum Paint Protects Jet Engine Combustion Chambers

The materials used in many of the combustion chambers and burner supports manufactured for J-35 jet engines by Solar Aircraft of Des Moines, must remain unaffected by abnormally high temperatures. Aluminum clad steel solves the problem satisfactorily with exception of various fusion welds. These must be re-coated with aluminum or a noncorrosive coating that will withstand up to 800 F.

Solar engineers have the answer to that problem, too. They simply spray or dip the welded part with two coats of Sicon, an aluminum paint formulated with Dow Corning silicone resins by Midland Industrial Finishes.



After a one hour bake at 400 F, the silicone based coating provides the required protection. According to Solar, this is one of the most satisfactory paints for use on jet engine parts. No. 28

Design Edition 6

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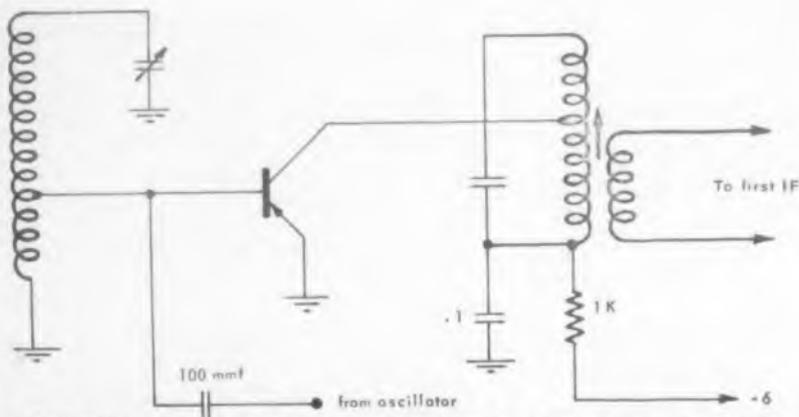
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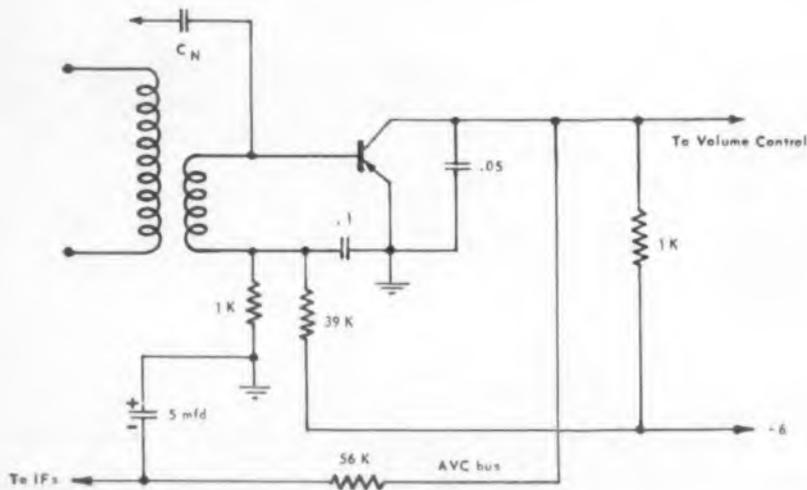
Canada: Dow Corning Silicones Ltd., Toronto; England: Midland Silicones Ltd., London; France: St. Gobain, Paris

CIRCLE ED-25 ON READER-SERVICE CARD FOR MORE INFORMATION

High Frequency Transistors



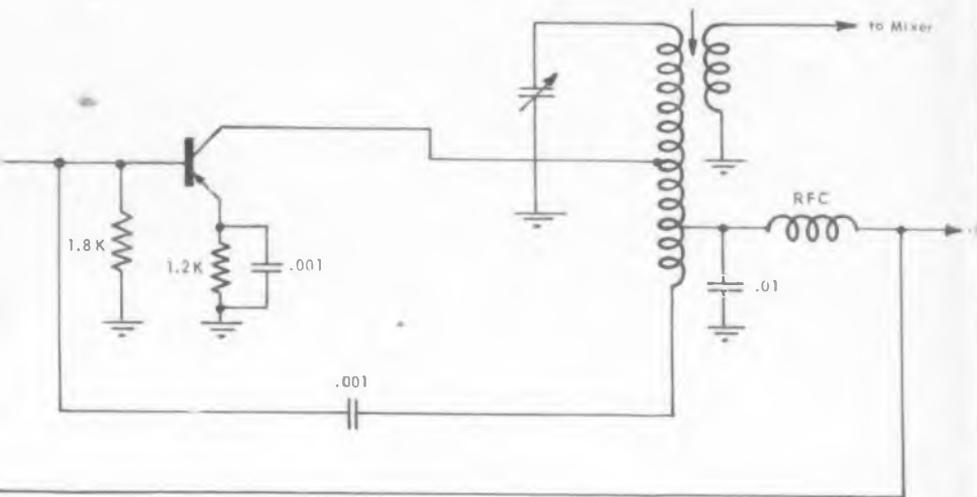
Collector current of mixer is set by size of coupling capacitor.



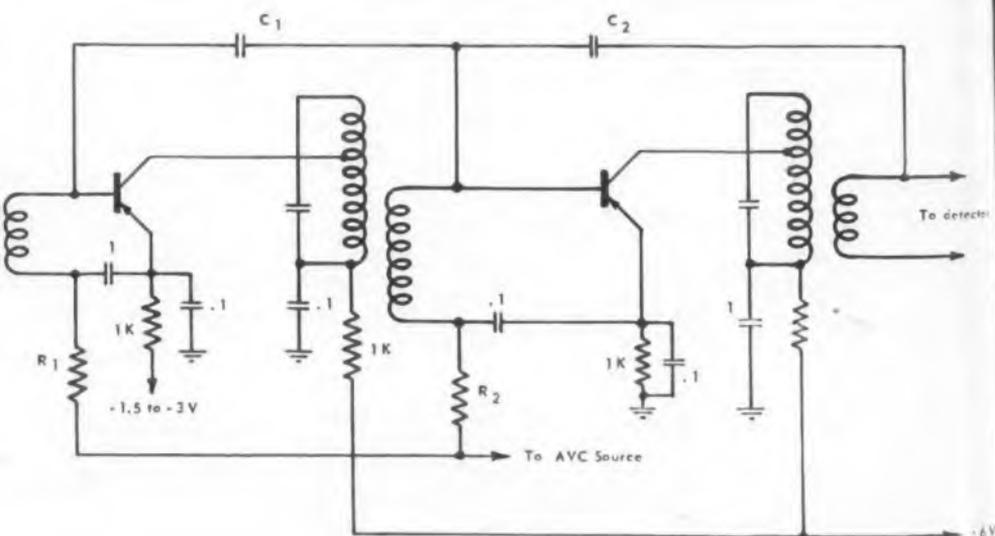
The second detector is power gain type with avc

ALPHA cut-off frequencies up to 20Mc from the germanium transistors discussed on these pages bring closer the day of complete transistorization of home and car radios, TV sets, mobile communication equipment, and other industrial and scientific instruments operating at high frequencies. The fast rise and decay times of the CK762 type make it a logical choice for switching, pulse forming, and clipping circuits.

The p-n-p fused-junction types CK760, CK761 and CK762 (with 5, 10 and 20Mc cut-off frequencies, respectively), made by Raytheon Mfg. Co., Newton 58, Mass., have the following maximum ratings: V_c of $-10v$; I_c of $-5ma$; I_e of $5ma$; W_c (at $30^\circ C$) = $30mw$. Average base current amplifications for the three types are 40, 45, and 65, respectively. Collector capacity for each type averages 14mmfd and extrinsic base resistance is about 75 ohms. I-F gains of 32-33db are typical for the CK760 and CK761 types at input impedances of 600 ohms and output impedances of 25,000 ohms.



Modified Hartley oscillator operates at frequencies of 1 to 2Mc.



Two-stage i-f amplifier has a gain of 60db and operates at 455kc.

Me from
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high frequ
s of the
witching

Examples of circuits using high frequency transistors are shown on these pages. The two-stage i-f amplifier uses either CK760 or CK761 transistors. Over 30db power gain per stage, including transformer losses, may be obtained. The i-f transformers must be designed to have a suitable Q and the proper impedances. Turns ratio and taps of transformers are chosen so that the collector looks into 20,000 ohms, and the secondary looks into 600 ohms. Operating (loaded) Q of the transformers should be at least 25. Because of the inherent regenerativeness of grounded-emitter h-f transistors, neutralization is necessary. Neutralization is provided by capacitors C_1 and C_2 . The value of these capacitors can be approximated by multiplying the collector capacitance by the turns ratio of the transformer (counting only the turns from the primary tap).

Bias voltage for both stages is derived from the detector stage so that ave action can be obtained. At low signal levels, practically the full B-voltage is available to bias the i-f stages for high gain. Resistors R_1 and R_2 are chosen so that for no signal conditions, about 250microamp of collector current flows in the first stage and 500microamp flows in the second stage. To prevent overloading, the gain of the first stage is reduced by returning the emitter to negative voltage.

The second detector circuit is essentially a class "B" power type. Gains of 10db or more may be realized using either a CK760 or CK761 type. The 39,000- and 1000-ohm resistor bias network provides a little initial bias to bring the transistor out of the low-gain region. The ave voltage is available across the 1000-ohm resistor since the d-c potential at the collector of the detector becomes less negative as the rectified carrier current increases.

The frequency range of the oscillator circuit may be from 1 to 2Mc. Outputs more than adequate for use in a superhet receiver can be obtained using CK760 or CK761 transistors. Frequency stability as the voltage or temperature varies is good. Tracking is no problem.

Mixer conversion gain of 10 to 15db may be realized in a circuit using CK760 or CK761 transistors. Both oscillator and signal voltages can be injected on the base. This method of connection offers the advantage of directly grounding the emitter, thereby providing a direct path from ground for the signal, oscillator, and i-f frequencies. The oscillator voltage can be injected on the emitter with equally good results.

These 700 Series transistors are hermetically sealed and have tinned, flexible leads that can be soldered or welded to other components, or cut to fit standard subminiature transistor sockets. For more information and operating characteristics, turn to the Reader's Service Card and circle ED-13.

maintenance free precision regulated

- NO TUBES
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- 0.2% REGULATION
- ULTRA-FAST
- SHORT CIRCUIT PROOF
- FLUX OSCILLATOR CONTROLLED
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- PROVEN IN CONTINUED SERVICE
- GUARANTEED



STABVOLT TYPE A

APPLICATIONS

INDUSTRIAL... in production test equipment, where accuracy is essential and where production changes must be minimized or eliminated.

LABORATORY... as stable voltage references or bias supplies, as regulated filament supplies, as strain gauges or instrumentation supplies, etc.

ORIGINAL EQUIPMENT... as precision regulated and maintenance-free power source in automation, computer, communication and instrumentation equipment.

SPECIFICATIONS

TYPE A: 200 WATT OUTPUT

MODEL	DC OUTPUT RANGE	
	VOLTS	AMPERES
MR 6 20	4 8	0 20
MR 12 10	6 15	0 10
MR 28 5	16 32	0 5
MR 150 1	130 175	0 1
MR 300 0 5	270 330	0 0 5

TYPE A: 1000 WATT OUTPUT

MODEL	DC OUTPUT RANGE	
	VOLTS	AMPERES
MR 6 100	4 8	0 100
MR 12 50	6 15	0 50
MR 28 20	16 32	0 20
MR 150 5	135 175	0 5
MR 300 3	270 330	0 3

DYNAMIC REGULATION AND RESPONSE TIME

+2% for $\pm 10\%$ line voltage transient

Response Time: 50 milliseconds

+5% for $\pm 10\%$ load current transient

Response Time: Max. 100 milliseconds under most average conditions of loading

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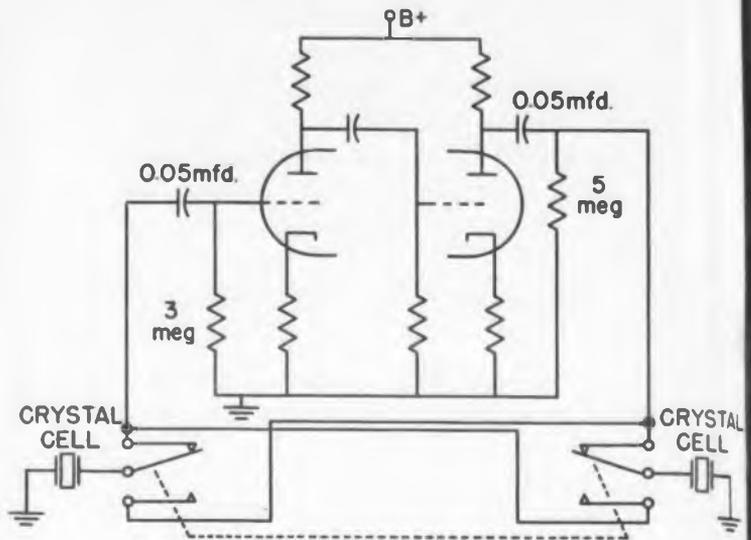
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130th St. & 90th Ave.

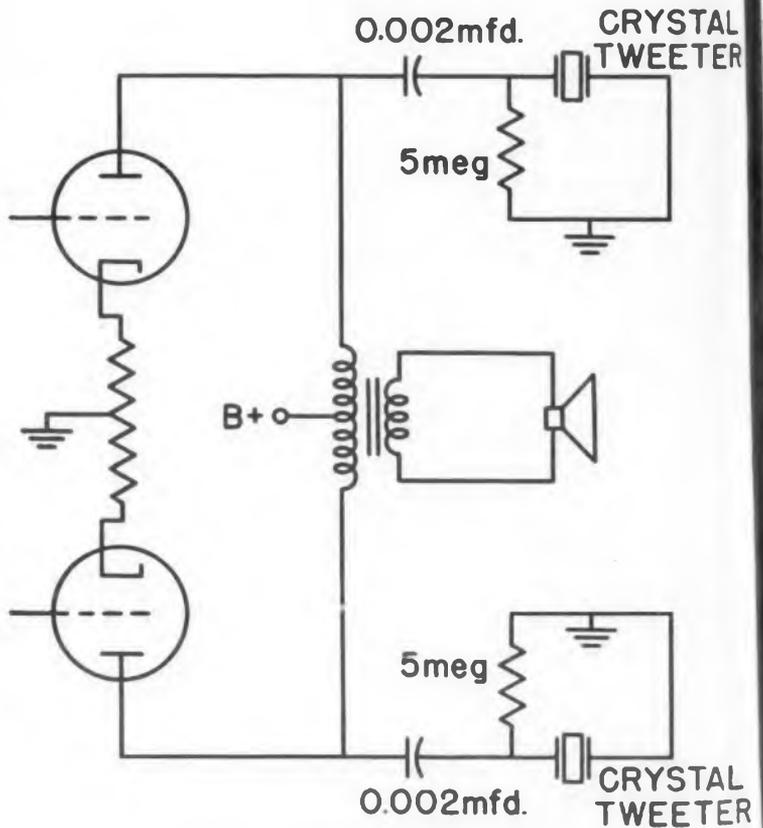
Queens 18, N. Y.

CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION

Filtercels double as mike and speaker. High output makes one-tube intercom practical.



Dual - Purpose Crystals



Filtercels function as crystal tweeters. The capacitor blocks lower frequencies.

COMB
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idual-c
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applying
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COMBINING broad response, higher output, and increased temperature and humidity stability, these low-cost Rochelle salt crystals simplify the audio equipment designer's task. Known as "Filtercells", these units damp the inherent low-resonant frequency of crystals without decreasing the sensitivity at other frequencies. No amplifier frequency correction is necessary.

Pre-amplifiers are not necessary because the output from these crystals is high. Frequency compensation is achieved without resorting to individual-cell networks, and they deliver as much as 3.5v to the input of an amplifier. Conversely, by applying voltage to the crystals, acoustical power equaling loudspeaker performance is developed.

Two crystals and one tube can make a two-way intercom system. A pair of crystals can be used as balanced tweeters in high fidelity equipment. As high-output microphones, these crystals, which are made in Holland and distributed by Ronette Acoustical Corp., 135 Front St., New York 5, N. Y., can feed directly into a medium-gain amplifier. If a peaked response is desired, microphones can be specified with any one of five different response curves. As speakers, they reproduce a wide frequency band—up to 19kc. Outputs of 2w are possible. The crystal speaker is coupled directly to the tube's plate via a capacitor. When used as tweeters, low frequency is cut off by a 0.002mfd series capacitor.

The cells are extremely rugged and sealed against humidity. They are able to operate at 110°F continuously. For more data on using the crystals, turn to the Reader's Service Card and circle **ED-28**.



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2½" APPROVED



3½" APPROVED



4½" APPROVED

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WESTON INSTRUMENTS

CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW DEVELOPMENTS

NEW Fixed Pad Attenuators

FROM 0-1000 MCS.



Pat. Pend.

Here is another major advance in the continuing development, by ARI, of inexpensive, electronic components that measure-up to the most exacting specifications. It's the brand new HFA-50, and HFA-75 fixed pad attenuators for the 0-1000 Mc. frequency range.

Important: BNC connectors are used so that the attenuators can be incorporated in virtually all equipment and test set-ups without the need for auxiliary adapters.

CHARACTERISTICS

	HFA-50	HFA-75
Input and Output Impedance	52.5 ohms	75 ohms
Nominal Attenuation	3, 6, 10 or 20 db.	3, 6, 10 or 20 db.
Accuracy	± 5 db.	± 5 db.
Max. VSWR	1.2	1.2
Frequency Range	0-1000 Mcs.	0-1000 Mcs.
Connectors As specified	UG-88/U and/or UG-89/U	UG-260/U and/or UG-261/U
Polarity	None	None

NEW Matching Coaxial Termination

FROM 0-1000 MCS.

The HFT-50 and HFT-75, ARI coaxial terminations are designed for use with the new ARI fixed pad attenuators. Here too, BNC connectors are used.

The unit costs of the ARI fixed attenuators and coaxial terminators have been kept within the practical price range of the large and small equipment producer, as well as the research and experimental user.



CHARACTERISTICS

	HFT-50	HFT-75
Impedance	52.5 ohms	75 ohms
Connectors	UG-88/U	UG-260/U
Max. VSWR		1.2
Frequency Range		0-1000 Mcs.
Power Rating (CW)		1 Watt

Applied  Research

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WRITE TODAY for full information, and latest prices.

MANUFACTURERS OF: BNC Attenuators and Coaxial Terminations, Bandpass and Bandreject Filters; Broadband Sweep Generators, Community TV Components; Crystal Mode Indicators

CIRCLE ED-30 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial F-M Tuning Assembly

DEVELOPMENT of a tuning assembly of simple construction was one of the steps that contributed to the design of the inexpensive f-m radio illustrated on these pages. This two-gang coaxial assembly is also very compact. The table-model radio is made by Granco Products, Inc., 36-17 20th Ave., Long Island City 5, N. Y.

The basic element in the tuning assembly is a low-loss glass dielectric tube with cylindrical end sleeves which are capacity coupled by means of a metallic plunger traveling inside the tube. The plunger serves only as a transfer medium, and does not physically contact the capacitor.

Since the glass dielectric has practically a zero temperature coefficient, oscillator frequency stability of better than 10ke is maintained over the entire f-m band. The

precise fit of the plunger within the dielectric tube completely eliminates microphonics, and the wide spacing between the end sleeves allows for a very small minimum capacity.

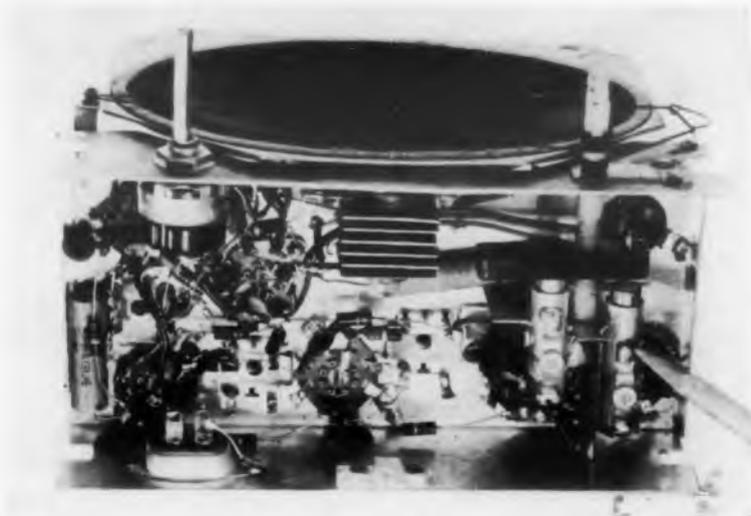
In the two-gang version of this assembly, the plungers are fastened to a plastic yoke. The yoke is positively driven by a lead screw, which eliminates backlash. Tuning across the entire band is accomplished by five turns of the screw.

The radio itself features a frequency stability of ± 5 ke over the entire band. Its tube complement is as follows: a 12BA6 r-f amplifier; a 12AT7 mixer-oscillator; two 12BA6 i-f amplifiers; a 19T8 detector-audio amplifier; a 35C5 audio amplifier; and a selenium rectifier power supply. Output to the speaker is 1-1/2w.

The Granco radio is 7-1/2" x 4-3/4" x 4-1/2" in dimension.



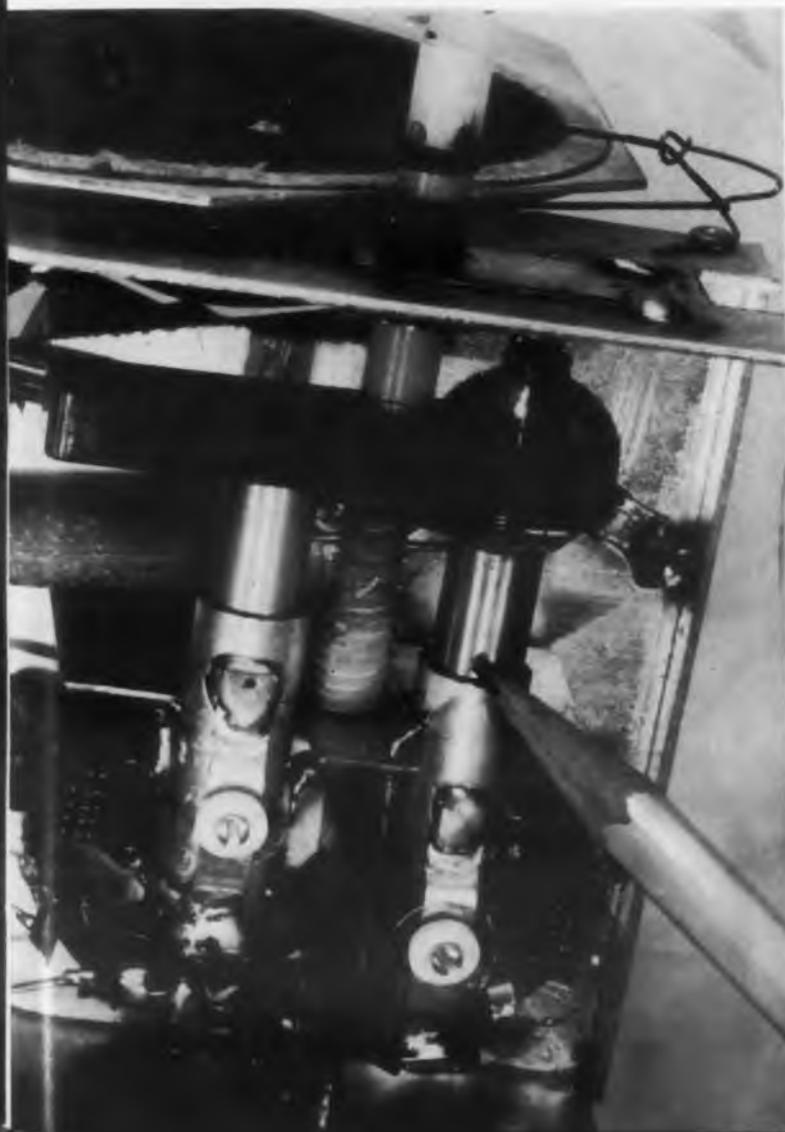
The pencil indicates
the location of the
coaxial tuning unit.



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lio am-
power
-1/2w.



The metal plunger
of the tuning as-
sembly is indicated
by the pencil.



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for a **BETTER** instrument

Doelcam

D-C Indicating Amplifier



Type
2HLA-3

Write for Bulletin 1A10

- ▶ **High Stability**
Less than 10 microvolts long term drift
 - ▶ **Wide Dynamic Response**
Flat from 0 to greater than 20 cps
 - ▶ **Magnetic Input**
Second-Harmonic Magnetic Converter for input stage
- Linearity within 1 %**
- High input impedance**
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as mechanical choppers, makes this instrument ideally suited for applications where accuracy, reliability and insensitivity to changing ambient conditions are of prime importance.

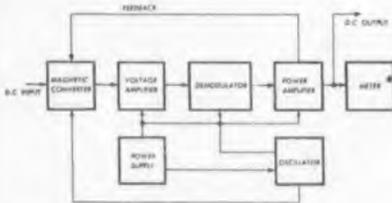
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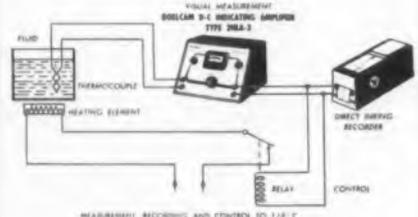
A DIVISION OF MINNEAPOLIS-HONEYWELL
SOLDIERS FIELD ROAD • BOSTON 35, MASS.

Instruments for Measurement and Control

Synchros • Gyros • Servos • Microsyns • Servo Motors

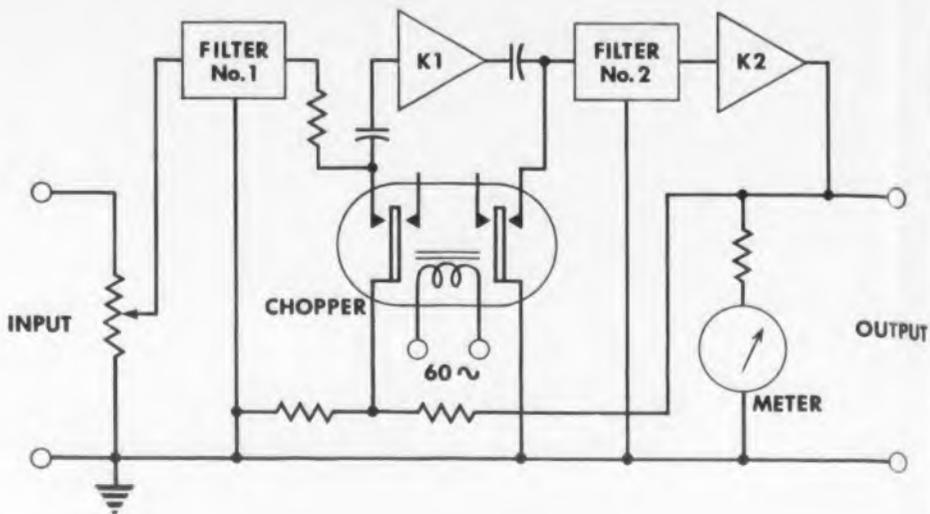


MAGNETIC INPUT . . . Block Diagram showing DOELCAM Second Harmonic Magnetic Converter as input stage . . . a new design concept



MEASUREMENT - RECORDING - CONTROL to $1/5^{\circ}$ C. A typical Process Control application showing high accuracy of DOELCAM Type 2HLA-3

CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION



Microvoltmeter and Preamplifier



Simplified
Microv
r-c amp
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SILICONDUCTORS*

TRADE-MARK

MAXIMUM REVERSE
WORKING VOLTAGE

e_b max V

TYPES

IN138A.....	18
IN137A.....	36
A3B.....	3.3
A4B.....	3.9
A5B.....	4.7
A6B.....	5.6
IN200.....	6.8
IN201.....	8.2
IN202.....	10
IN203.....	12
IN204.....	15
IN205.....	18
IN206.....	22
IN207.....	27
IN208.....	33
IN209.....	39
IN210.....	47
IN211.....	56
IN212.....	68
IN213.....	82
IN214.....	100
IN215.....	120
IN216.....	150
IN217.....	180
IN218.....	220
IN219.....	270
IN220.....	330
IN221.....	390
IN222.....	470

ENLARGED FIVE TIMES
ACTUAL SIZE

Simplified block diagram of Microvoltmeter. K1 is 4-stage r-c amplifier. K2 is d-c amplifier. Chopper converts d-c input to a-c, and rectifies amplified a-c signal.

FULL-SCALE readings of 300 microvolts with less than 15 microvolts drift error make this instrument useful as either a sensitive voltmeter or d-c preamplifier. This high sensitivity and low drift make it valuable for measuring voltage from thermocouples, photocells, strain gages, and other low-output devices. The meter provides a maximum output of 1v across 2000 ohms.

The new meter uses a high-gain chopper-type amplifier with a large amount of negative feedback to achieve low drift. The complete instrument consists of an input divider, a dpdt d-c to a-c converter (chopper), a 4-stage r-c coupled 60-cy amplifier (K1), a 2-stage direct-coupled amplifier with an output cathode follower (K2), and a zero-center meter. Filters reduce chopper ripple and add compensating phase shift to the feedback signal. To achieve the maximum degree of stability, the negative feedback loop encompasses everything apart from the input divider and meter.

Forward amplifier gain is 124db. Since maximum gain is needed only for the most sensitive range, feedback is increased up to 74db as the range switch is changed. Negative feedback also makes it possible to achieve a very high apparent input impedance; therefore, the chopper's shunting effects are no problem.

Temperature variations do not affect the meter movement significantly because the meter is in series with a low temperature coefficient resistor ten times larger than its own internal resistance. The microvoltmeter, which is made by Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif., does not require rezeroing once it is set.

The instrument maintains a minimum input impedance of 10 megohms. Voltage ranges cover from 0-300 microvolts to 0-300v. The power supply is VR-tube regulated. Probe includes 1 megohm resistor. For more data on this instrument, turn to the Reader's Service Card and circle ED-33.

* SINGLE CRYSTAL SILICON JUNCTION DIODES

LICENSED BY WESTERN ELECTRIC CO., INC.

NATIONAL SEMICONDUCTOR PRODUCTS

DIVISION OF NATIONAL FABRICATED PRODUCTS, INC.

930 PITNER AVENUE

DAvis 8-0800

EVANSTON, ILLINOIS

CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION

IMPORTANT NEWS

For the Electrical and Electronic Industries

... a New HARDENABLE SILVER ALLOY



SILVER-MAG-NICKEL is its name. As you receive it, it is soft and ductile, like fine silver. Fabricate your most intricate parts, then oxidation harden them and this new alloy will hold its temper permanently. This hardness is not disturbed even when subsequent elevated temperatures are encountered.

SILVER-MAG-NICKEL has excellent thermal and electrical conductivity. Its corrosion resistance is equal to that of fine silver. It is available in wire and strip in thicknesses down to .002".

Have you an application where SILVER-MAG-NICKEL can be used to advantage? See the list of properties below. Write giving full details of your potential application. Our engineers will be glad to discuss these properties with you.

Important Properties of SILVER-MAG-NICKEL

- ✓ Oxidation Hardenable
- ✓ High Electrical Conductivity — 70%
- ✓ High Thermal Conductivity
- ✓ Hardnesses to 70 — Rockwell 30T
- ✓ Tensile Strengths to 70,000 psi
- ✓ Corrosion Resistance Like Fine Silver
- ✓ Hardness Unaffected by Silver Brazing



HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

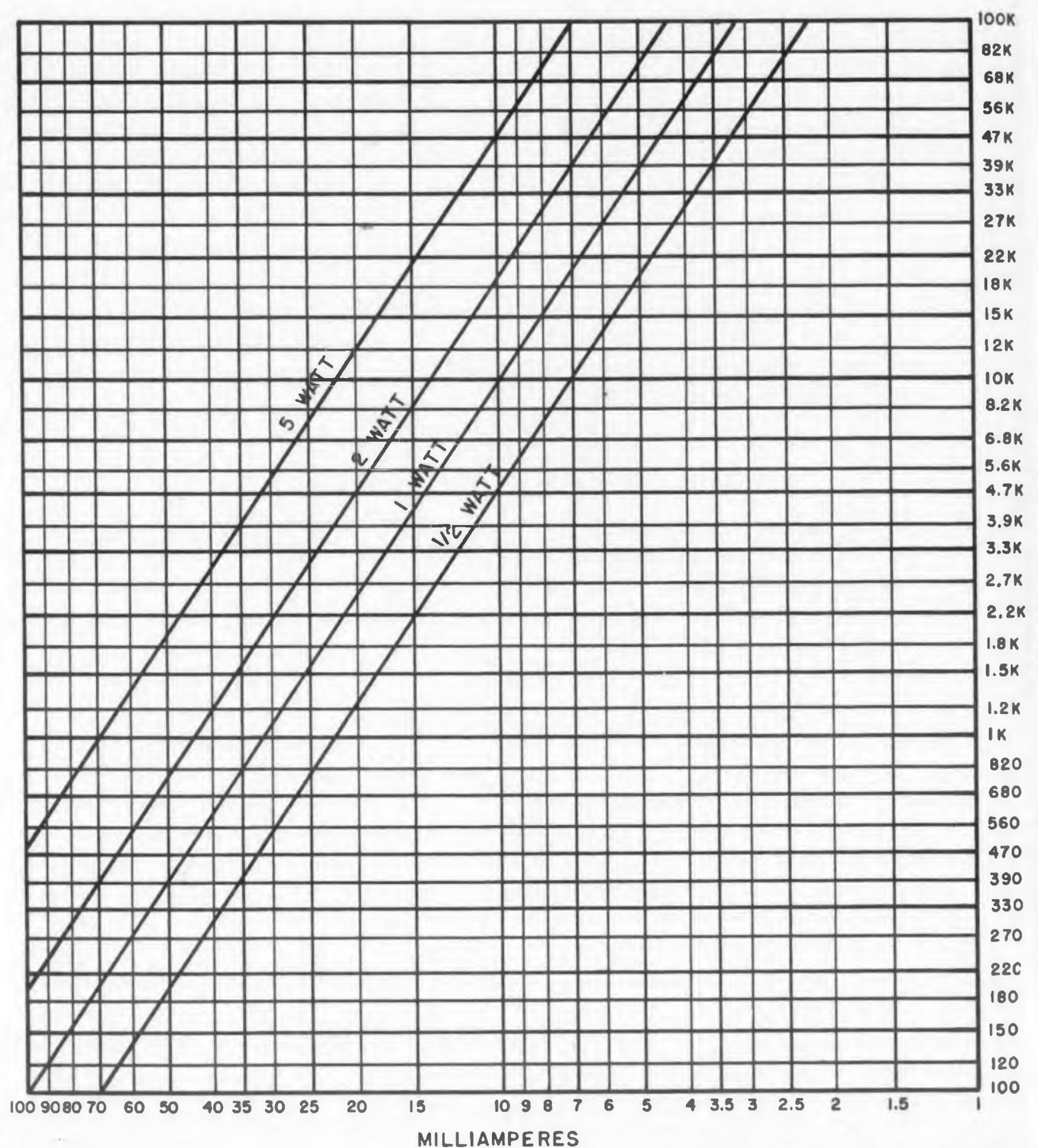
OFFICES and PLANTS: Bridgeport, Conn.; Providence, R. I.; Chicago, Ill. Cleveland, Ohio; Detroit, Mich.; Los Angeles, Calif.; Toronto, Canada; Montreal, Canada

CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor-Selection Charts

By R. G. Lindstrom, Standards Department
Farnsworth Electronics Co., Fort Wayne, Ind.

Resistance is plotted in standard RETMA values for four wattage ratings in this useful chart.

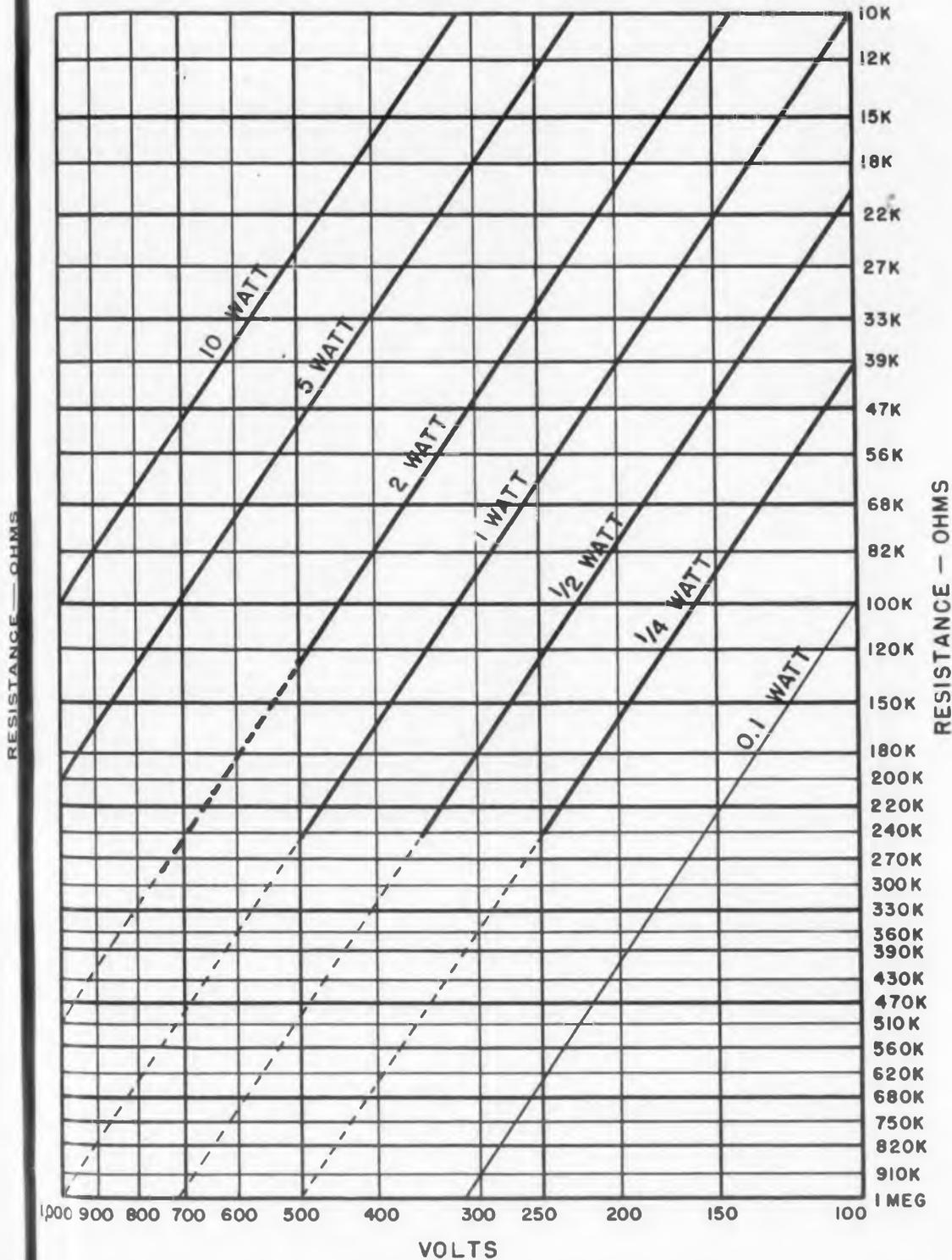


RESISTORS can be rapidly selected by means of the charts shown on these pages because resistance values are plotted in RETMA standard values instead of the usual decimal system. The charts are of

current carried and voltage applied, respectively, versus resistance for the standard wattage ratings. One example of use would be in the quick selection of "bleeder" resistors, where values are not critical.

values chart.

Standard RETMA values can be selected directly by means of this chart of voltage vs resistance.



Manufacturers of Specialty Rotating Equipment

FANS • MOTORS • BLOWERS



A15BD-8—115 Volt 60 cycle Double Blower. 46 CFM at .28" static pressure.

Variable frequency blower for operation on 115 Volt single phase. Available with axial fan or centrifugal blower. A15BF-15—50 to 800 cycles—single winding available with axial fan or centrifugal blower. A15AB-2 — 50-60 cycle and 400 cycle operation single winding. A15CF10 — 50-60 and 320-1000 cycle operation dual winding.



A15AD3—Axial blower unit for operation on 115 Volt 60 cycle single phase supply at 3300 RPM delivering 35 CFM at 0.2 S.P. This unit has special mounting bracket.



E Frame—Totally enclosed induction motor. 400 cycle 2, 4, 6 or 8 poles. 60 cycle 2 or 4 poles. 2-5/16" dia. H.P. up to 1/25 (up to 1/10 H.P. for axial vane blower application)



Synchronous Motors—Hysteresis or Reluctance type. 60 or 400 cycle. Available single or dual speeds.



B20B-7 — 115 Volt 60 cycle. 50 CFM at 1.5" static pressure. Metal housing, L type bracket. Also available in 400 cycle.



631 x 1—115 Volt, 60 cycle, 3450 RPM 100 CFM @ 2 1/2" water gauge. Fits in space 9 1/2" long, 8 3/4" wide, 7 3/4" high.

631 x 35—115 Volt, 60 cycle or 220 Volt, 60 cycle, 1 or 3 phase. 3450 RPM continuous duty. 250 CFM at 2 1/2" water gauge. Used in microwave generators, unattended repeater stations. Fits in space 13 1/2" long, 8 3/4" wide, 7 3/4" high.



The features of all AIR MARINE motors include Stainless steel thru-bolts, Rigid die-cast aluminum housings, and Riveted stator to insure Extra-Rigid Construction.

Positive bearing alignment and uniform air gap. Motors are protected against humidity and fungus growth — can be mounted in any position— are equipped with ball bearings using lubricants for high and low temperatures—meet all AN specifications.

The motors and blowers on this page are representative of the many varied models available. Detailed information specifications and performance data on all units available on request.



Showing comparison between our large and small blowers

Send for our new Catalog AM-20

Constantly developing
to meet your exacting needs . . .

air-marine motors Inc.

369 Bayview Avenue
Amityville, L. I., N. Y.
AMITYVILLE 4-6122

West Coast Factory
2055 Pentius Avenue
Los Angeles 25, Calif.

CIRCLE ED-36 ON READER-SERVICE CARD FOR MORE INFORMATION

Hughes

high temperature operation

Silicon

extremely high back resistance

Junction

exceptionally stable characteristics

Diodes

Now you can take advantage of silicon's operating temperature range and obtain, at the same time, a semiconductor device with phenomenally high back resistance. Actually, many of the types of the new Hughes Silicon Junction Diodes provide essentially an open circuit in the back direction. This means that many entirely new circuit applications are now made possible.

The entire line of these new Silicon Junction Diodes is packaged in the one-piece, fusion-sealed glass body, originated and developed at Hughes. This now-famous construction is impervious to moisture penetration—ensures electrical and mechanical stability. With their axial leads and subminiature size, Hughes diodes are easier to mount, easier to spot-weld or solder. So, when temperature or high back

resistance requirements call for silicon, be sure to specify *Hughes Silicon Junction Diodes*.

Electrical features: Good forward conductance . . . very sharp back voltage breakdown . . . extremely high back resistance.

Physical features: One-piece, fusion-sealed glass body . . . axial leads for easy mounting . . . subminiature size.



Actual size,
diode glass body:
0.265 by 0.103
inches, maximum.
Body is coated
with opaque
silicone enamel to
shield crystal from
light. Color-coded
on cathode end.
Ambient operating
temperature range:
-80° to +200° C.

		SEMICONDUCTOR SALES DEPARTMENT	
<i>Aircraft Company, Culver City, Calif.</i>			
		New York Philadelphia	Syracuse Chicago

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

Packaged Switching Unit



COMPACT magnetic circuit design permits four germanium diodes to fit inside the standard relay can of this AC-DC Relay. The bridge-connected diodes rectify a-c inputs to produce chatter-free switching. By substituting other circuit elements for the germanium diodes, complete switching networks can be sealed in one envelope. Installation and replacement time is thereby reduced. The magnetic circuit can drive a contact arm ganged to as many as 6 poles. Low contact resistance makes the relay ideal for signal circuits.

The unit, shown in cutaway, has a balanced rotating armature. This feature permits the relay to withstand shock accelerations in excess of 100g's and vibration accelerations in excess of 20g's over the frequency range of 2cy to 2000cy.

Contact life exceeds 100,000 operations at 4amp resistive load. Reduced interference noise meets requirements of MIL-E-6181. Hi-G, Inc., Bradley Field, Windsor Locks, Conn., manufactures these relays, which are sealed with dry air or nitrogen. For more data about this relay's characteristics, turn to the Reader's Service Card and circle **ED-38**.

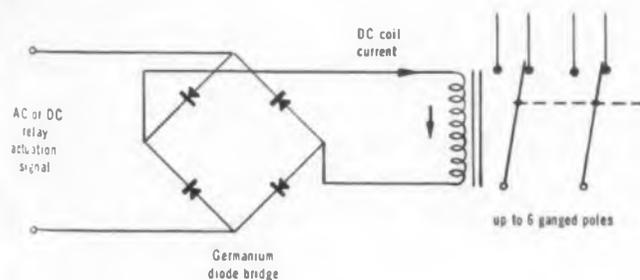
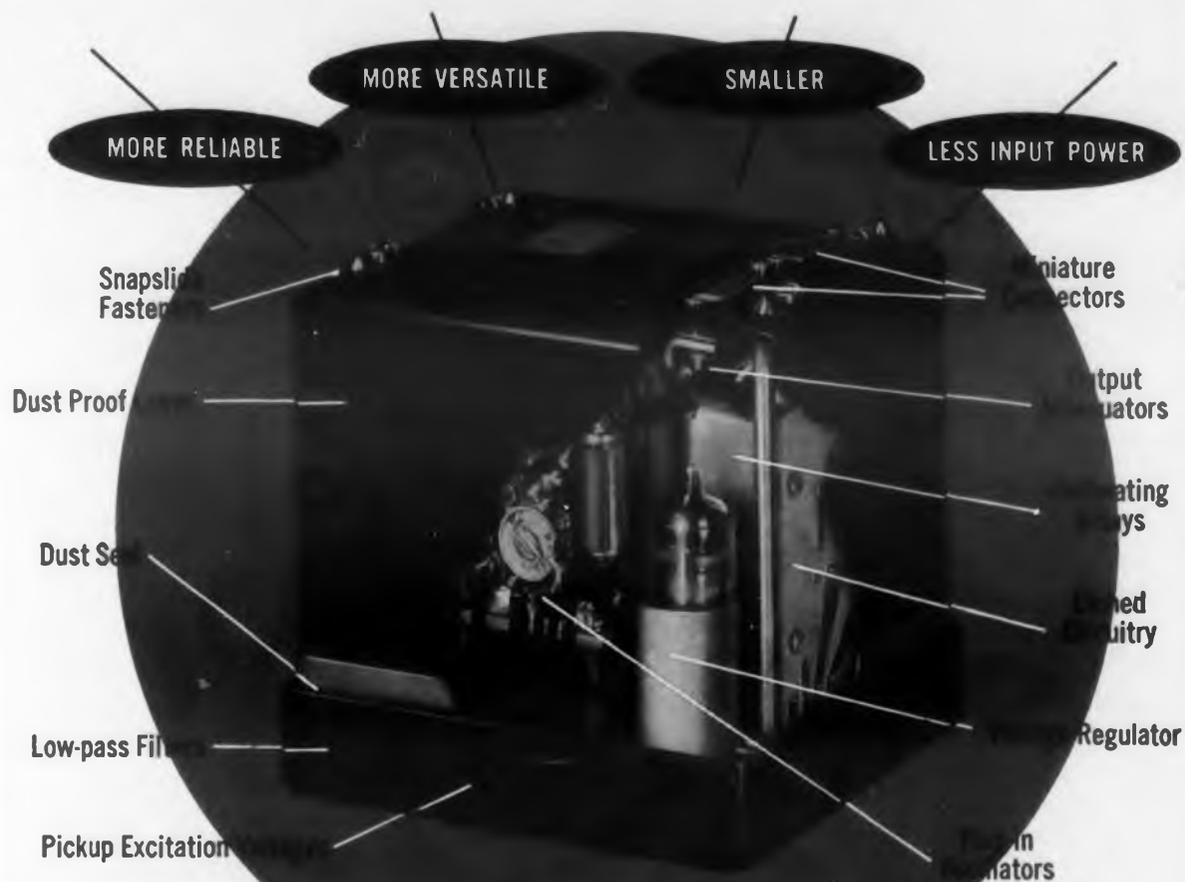


Diagram of full-wave bridge rectifier circuit and relay coil for the Hi-G AC-DC Relay.

A NEW TELEMETER STANDARD



BENDIX-PACIFIC TATP-4 & 5 PACKAGES

These compact Bendix-Pacific Telemetering Packages offer users of telemetering systems a better means to instrument such quantities as pressure, force, temperature, voltage, acceleration and vibration.

The units are smaller and various combinations may be used to provide compact multi-channel systems of up to 18 subcarrier bands. Each unit operates on unregulated +150 VDC and 28 VDC since it contains its own voltage regulating circuits. Each unit may be provided with individual relays for switching oscillator inputs from signal to calibrate position. Model TATP-4 contains four and Model TATP-5 contains six separate and independent regulated +5 VDC excitation voltage

for use with resistance type pickups. No vacuum tubes are required in mixing the outputs of the individual subcarrier oscillators to the composite audio signal for direct modulation of the RF transmitter, thus greatly improving the reliability of the system at a point where a tube failure would affect all subcarrier channels.

Standard Bendix Model TPP-6 Power Supplies are available to handle from one to three of these telemetering packages plus a 2 watt crystal controlled RF transmitter. Many types of interchangeable subcarrier oscillators are also available. RF amplifiers are available for increased power outputs up to 100 watts.

CHARACTERISTICS

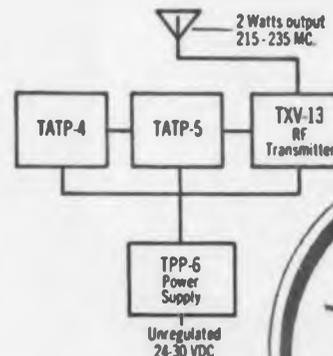
	TATP-4	TATP-5
No. of bands	4	6
Subcarrier bands	1.7 kc. to 70 kc.	1.7 kc. to 70.0 kc.
Oscillator Types	TOE-30V, TOE-31V, TOR-8V, TOR-9V, TOL-9V	Same as TATP-4
Input Voltages	6, 12, or 24 VDC ±10% 150 VDC ±10%	6, 12, or 24 VDC ±10% 150 VDC ±10%
Weight (Less Oscillators)	Approx. 2 lbs.	Approx. 3 lbs.
Dimensions	5.0" x 5.0" x 4.5"	5.0" x 7.5" x 4.5"

Write for Complete Information

PACIFIC DIVISION • Bendix Aviation Corporation
11600 Sherman Way, North Hollywood, California

East Coast Office: 475 5th Ave., N. Y. 17	Export Division: Bendix International 205 E. 42nd St., N. Y. 17	Canadian Distributors: Aviation Electric, Ltd., Montreal 9	Dayton, Ohio 1444 Cory Drive, Dayton 6, Ohio	Washington, D. C. Suite 803, 1701 "K" St., N. W.
--------------------------------------------------------	------------------------------------------------------------------------------	-------------------------------------------------------------------------	-----------------------------------------------------------	---------------------------------------------------------------

TYPICAL 10 BAND SYSTEM



RADAR



SONAR



HYDRAULICS



TELEMETERING



ELECTRO-MECHANICAL



ULTRASONICS



The New **SHURE** "TWIN-LEVER"

CERAMIC PICKUP CARTRIDGE

for High Fidelity phonographs



PC Series for 33 $\frac{1}{3}$, 45, 78 r.p.m.

AN "AB" LISTENING TEST WILL PROVE THAT THIS CARTRIDGE SURPASSES ANY OTHER HIGH QUALITY COMMERCIAL CARTRIDGE FOR EQUIPMENT MANUFACTURERS!

Here is a "Balanced-Fidelity" cartridge designed for the equipment manufacturer to give you the maximum quality possible within your cost objectives.

A new frontier for the Ceramic principle has been crossed by the development of this cartridge. Designers of high fidelity phonographs and hi-fi radio or tv phono combinations, who have been "test piloting" this new "Twin-Lever" ceramic development, report an amazing superiority in tone quality that can be easily heard before the cartridge is even measured!

This "Twin-Lever" ceramic cartridge represents the ultimate in commercial high fidelity reproduction—**without compensating preamplifiers!** Smooth, wide range response from 30 to 13,500 c.p.s. Other features which help to make this new cartridge so outstanding in performance are: high compliance that virtually eliminates tracking distortion . . . extremely low effective mass provided by new specially-designed needles and new coupling . . . tailored needles on separate needle shafts, functioning independently for best 78 rpm response, too—as well as the superior micro-groove performance.

The new unique design eliminates "turnover" of either the cartridge or the needles. Both needles are in the same plane, and an ingenious, lever-operated shift mechanism gently moves each needle in and out of position.

RADICAL NEW DESIGN FOR NEEDLE REPLACEMENT!

Needle replacement is now so simple it can be done blindfolded!! This is a feature that will be of special interest to the ultimate users of your original equipment. Anybody can replace the needle, without tools, in a few seconds—while the cartridge remains in the pickup arm!

MODELS PC4 and PC5

Output Level at 1,000 c.p.s.	.40 volts (33 $\frac{1}{3}$, 45 rpm)
Output Level at 1,000 c.p.s.	.60 volts (78 rpm)
Frequency Response	30 to 13,500 c.p.s.
Compliance	1.30 x 10 ⁻⁶ cm/dyne
Tracking Force	5 gr. min.
Net Weight	7 grams
Dimensions	1 $\frac{1}{4}$ " overall length; $\frac{1}{8}$ " wide $\frac{3}{8}$ high

ALSO . . .

New High Output Ceramic Cartridges NO LESS OUTSTANDING IN THEIR CONTRIBUTION TO LOW COST, FINE QUALITY REPRODUCTION ARE THE HIGH-OUTPUT CARTRIDGES, MODELS PC2 and PC3.

SHURE

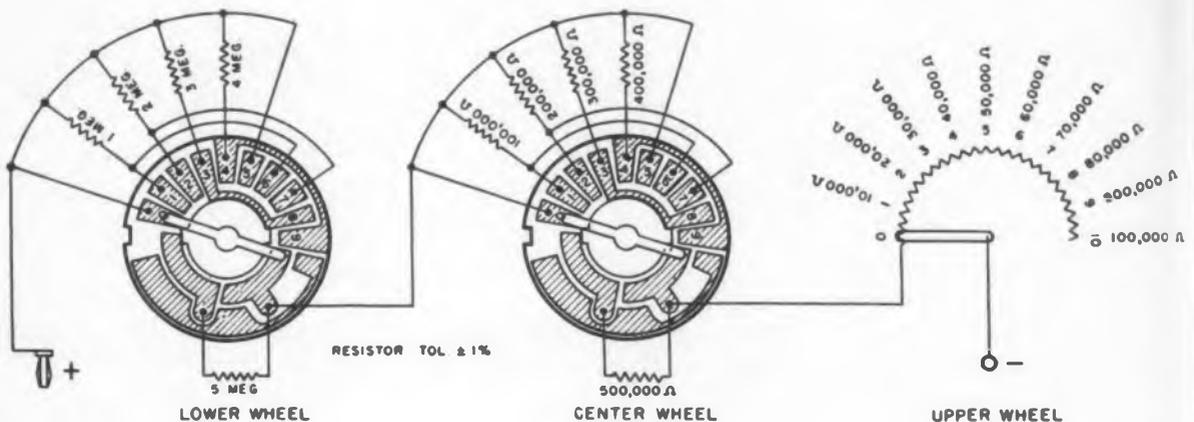
The Mark of Quality

For further information on these remarkable new cartridges, write
SALES DIVISION—SHURE BROTHERS, INC., 225 W. HURON STREET, CHICAGO 10, ILL.

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-In Decade Resistor

RESISTANCE parameters up to 10 megohms can be readily inserted or changed in analog computers and other instruments by means of the plug-in decade resistor shown at the right. It can also be employed in the design and development of new circuits. Two banana plugs on standard 3/4" centers occupy one end of the unit, and a female jack is mounted in the other end. The circuit can



Circuit diagram for the 10-megohm model of the decade resistor. The switching circuitry is printed.

either go between the two plugs or between one of the plugs and the jack on the top, which is built to hold patch cords or molded precision resistors.

As shown by the circuit diagram, the resistor consists of three ranges, each controlled by a wheel encircling the body of the device. The first two wheels insert increments of fixed resistance, while the third controls a wire-wound potentiometer calibrated on decade increments. Use of a bridge enables the user to set any value between these standard increments. With this arrangement, any value of resistance within the entire range of the unit can be set up within 0.1% accuracy. The resistors are 1% carbon-film types.

Developed jointly by Goodyear Aircraft Corp.,

1210
Inc.,
mark
avail
10-m
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of b
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The compact Telex plug-in decade resistor is easily adjusted by its three control wheels.

1210 Massillon Rd., Akron 15, Ohio, and Telex, Inc., Telex Park, St. Paul 1, Minn., the units are marketed by the latter firm. The resistors are available in two models: a 1-megohm type and a 10-megohm type. Seated height of the former is 3-1/4" and 3-19/32" for the latter. The diameter of both versions is 1-13/32". Special units can be ordered in addition to the two stock models.

Originally designed by Goodyear as part of their "Geda" analog computer, the unit incorporates printed circuitry as a means of producing it in its present compact enclosure. Two raised plastic pads on the shoulder of the unit may be roughened with emery cloth for temporary pencilled recordings of the resistance value set for a specific problem. For more information on this device, which is useful both as design laboratory equipment or for incorporation into production instruments, turn to the Reader's Service Card and circle **ED-41**.

ELECTRONIC DESIGN • February 1955

"she might have been my kid..."



There was no time to stop, see? She comes running out from behind this parked car right under my wheels. Her hair is in pig-tails, and with the sun shining on it, she might have been *my* kid. We got her to the hospital. It took 3 pints of blood to bring her around. All I have to do is remember the sound of those screaming tires—and I know

why I'm giving blood."

Yes, all kinds of people give blood—truck drivers, office workers, salesmen. And—for all kinds of reasons. But whatever *your* reason, this you can be sure of: Whether your blood goes to a local hospital, a combat area or for Civil Defense needs—this priceless, painless gift will some day save an American life!

Business Executives!

✓ Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- Have you given your employees time off to make blood donations?
- Has your company given any recognition to donors?
- Do you have a Blood Donor Honor Roll in your company?
- Have you arranged to have a Bloodmobile make regular visits?
- Has your management endorsed the local Blood Donor Program?
- Have you informed your employees of your company's plan of co-operation?
- Was this information given through Plant Bulletin or House Magazine?
- Have you conducted a Donor Pledge Campaign in your company?
- Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

Give Blood Now
CALL YOUR RED CROSS TODAY!
NATIONAL BLOOD PROGRAM



New Products . . .

Gas-Filled Tubes

For Regulation and Reference Purposes



These dual-purpose tubes provide stable operation both as voltage regulators and voltage-reference tubes. Designed to be without "pips" (sudden discrete voltage shifts), they are the miniature gaseous voltage-regulator types *USN-OA2WA* and *USN-OB2WA*.

The tubes are directly interchangeable with earlier types *JAN-OA2* and *JAN-OB2*, respectively. However, they are manufactured and tested to new and more rigid military specifications. Four principal features include: flat, smooth, voltage-current characteristics; greatly improved voltage repeatability; stable electrical characteristics; and dependability under test conditions of shock,

vibration, temperature, and altitude. CBS-Hytron, Dept. ED, Danvers, Mass.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

Chopper

Withstands Rough Environments



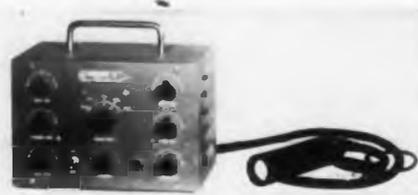
The C102 Precision Chopper has a temperature range of -85° to $+85^{\circ}\text{C}$. It withstands 10g at 10-55cy, 30g of shock, and has a breakdown of 280v d-c. It is designed for 6.3v drive at 380-420cy. Contacts are spdt, rated at 0.002-amp, 100v. Dwell time is 135° ($\pm 20^{\circ}$) and phase lag is 65° ($+15^{\circ}$). Noise is less than 3mv peak-to-peak at 1 megohm.

Size of this unit is $2\frac{5}{8}$ " x $1\frac{9}{16}$ " diam. Hermetically sealed, it weighs less than 6 oz. Rumple, Inc., Dept. ED, 2308 Beloit Ave., Los Angeles 54, Calif.

CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

Probe-Oscilloscope

Portable for Quick Analyses



The "Probe-Scope" Model PO-1 is a portable combination probe and oscilloscope, valuable for quick trouble

shooting and wave-form analyzing. It is an extremely small oscilloscope measuring 6" high x 9" long x 5" deep, taking up less than $\frac{1}{2}$ sq ft on the bench and weighing only 7- $\frac{1}{2}$ lb.

The "Probe-Scope" has a 1" mu-metal shielded cathode ray tube incorporated into a probe small enough to be held in the palm of a hand. The wave-form is sharp and clear. The probe is connected to the control cabinet by a 3- $\frac{1}{2}$ ' shielded cable which can be securely clamped to the back of the cabinet when not in use. Probescope Co., Dept. ED, 44-05 30th Ave., Long Island City 3, N. Y.

CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

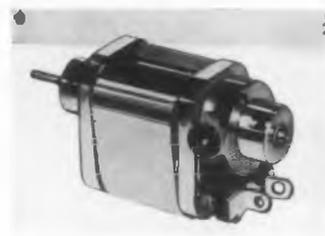
2-Oz. PM Motors

In 1- $\frac{1}{2}$ v to 28v Models

The "PM-O" Motor is a very small, compact, permanent-magnet motor which can be built for voltages ranging from 1- $\frac{1}{2}$ v to 28v d-c. It develops 1/500hp, and the speeds can vary from 5,000rpm to 20,000rpm.

Torque is 0.20oz in, and the current draw is 0.2amp. The actual size of the unit is $\frac{3}{4}$ " x $\frac{7}{8}$ " x $1\frac{3}{8}$ " long, plus shaft extension. The shaft diameter is $\frac{3}{32}$ ". The motor weighs 2oz. It can be made reversible, and it is quiet-running, having sleeve bearings. It can be used in such applications as localized blowers, actuators, automatic cameras, and business machines. Small Motors, Inc., Dept. ED, 2076 Elston Ave., Chicago 14, Ill.

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION



Small Inductive Elements

For Use in Printed Circuits



"Vo-Tron" sub-miniature if transformers and oscillator coils, originally designed for the new Regency all-transistor pocket-radio, are now in volume production by this firm.

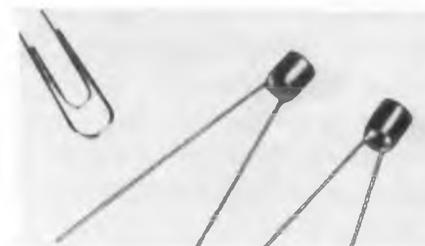
Measuring only $\frac{1}{2}$ " x $\frac{1}{2}$ " x $\frac{1}{2}$ ", they are built to laboratory standards. Each of the three 262ke if transformers is enclosed and shielded. The tiny assembly includes a capacitor of 200mmfd; unloaded Q is 80. Mounting leads are designed for dip-soldering.

The oscillator coil is approximately $\frac{1}{2}$ " long x $\frac{1}{2}$ " diam, with leads also designed for dip-soldering. All of the units are specially impregnated to insure uniformly high performance under all environmental conditions, and are permeability-tuned for high stability. Vokar Corp., Dept. ED, Dexter, Mich.

CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Resistors

Precision, Wire-Wound Types



The type 1273 precision sub-miniature resistors are only $\frac{1}{4}$ " in diameter and $\frac{5}{16}$ " long. These encapsulated, wire-wound units are

rated at 0.1w in ambients ranging from -55°C to $+125^{\circ}\text{C}$, and are available in accuracies to $\pm 0.05\%$. Values to 400,000 ohms are furnished. They can be supplied with any type resistance wire depending upon the temperature characteristic desired. Davenc Co., Dept. ED, 191 Central Ave., Newark 4, N. J.

CIRCLE ED-48 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Servo Design Elements System Readily Changed



A rapid and economical method for designing, testing, and evaluating an infinite variety of experimental instrumentation setups is provided by the "grid plate" system and its associated "Erector Set" components. Light

and rugged, each of the components of the system may be used in final production models as well as test setups.

The "Erector Set" system includes attachment hangers for commonly used servo rotating components, gears, dial assemblies, differentials, component shaft adapters, electrical and mechanical stops, shafts and collars, as well as the grid base plate to which these components may be readily attached, as shown.

Only hand tools were necessary to set up the illustrated computing servo. Experimental changes may be made quickly and when tests are completed, the parts may be stocked for future use. Instrument Components, Inc., Dept. ED, 14-34 112th St., College Point, N. Y.

CIRCLE ED-50 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Junction Diodes Have High Back Resistance



This line of silicon junction diodes provides high forward conductance combined with extremely high back resistance. In several of the diode types, this resistance is in the order of 10,000 megohms. The back resistance makes it possible to use the diodes in many entirely new circuit applications. All types have an ambient operating range from -80° to $+200^{\circ}\text{C}$. Physical features include: one-piece fusion-sealed glass bodies, imperviousness to moisture; flexible dumet leads, tinned for soldering or spot welding; and a diode envelope externally coated with black silicone enamel to shield the crystal from light. Dimensions of the glass body are $0.265'' \times 0.103''$. Semiconductor Div., Hughes Aircraft Co., Dept. ED, Florence Ave. at Teale St., Culver City, Calif.

CIRCLE ED-49 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

PERKIN

New!! Compact!!

28 VOLTS @ 100 AMPERES $\pm 1/2\%$ REGULATION

SPECIFICATIONS

DC OUTPUT: 24-32 Volts at 100 amperes

AC INPUT: 230 or 460V. $\pm 10\%$, 3 phase, 60 cycles

RIPPLE: 1% rms

VOLTAGE REGULATION: $\pm 1/2\%$: (a) from no load to full load; (b) from 24-32 Volts DC; (c) for 230 (or 460) Volts $\pm 10\%$

RESPONSE TIME: 0.2 seconds WEIGHT: 250 lbs.

DIMENSION: 25" long x 15" deep x 15" high

Price: \$1,149.00, including meters & cabinets

PROMPT DELIVERY



MODEL MR532-15

5 to 32 VOLTS @ 15 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: $\pm 1\%$ (a) from 5-32 Volts D.C.; (b) from 1.5 to 15 amps.; (c) from 105-125 Volts A.C. (Single phase, 60 cps.)

RIPPLE: 1% rms @ 32 Volts and full load, increases to max. of 2% rms @ 5 Volts and full load.

RESPONSE: 0.2 seconds

METERS: $4\frac{1}{2}''$ Rectangular AM and VM—2% Accuracy

DIMENSIONS: 22" x 17" x $14\frac{1}{2}''$

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle WEIGHT: 150 lbs.

Price: \$524 w/o cabinet, \$549 w/cabinet

All prices F.O.B. El Segundo. Terms: 1%—10 days, net 30.
Phone collect for quantity discounts.

Write for Bulletin MA154.
Also write (on company letterhead) for Free Subscription to technical periodical "PERKIN," Power Supply Bulletin.



Rectifier Specialists Since 1932

345 KANSAS ST. • EL SEGUNDO, CALIFORNIA

TUBELESS!!! MAGNETIC AMPLIFIER REGULATED DC POWER SUPPLIES



Model MR2432-100X
24 to 32 volts @ 100 amps



MODEL M60VMC

0 to 32 VOLTS @ 25 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: $\pm 1\%$ (a) At 28 Volts D.C.—increases to 2% max. over the range 24-32 V.; does not exceed 2 volts regulation over the range 4-24 volts D.C.; (b) from 1/10 Full Load to Full Load; (c) at a fixed A.C. Input of 115 volts.

RIPPLE: 1% rms @ 32V. and Full Load — 2% rms max. @ any voltage above 4 volts.

A.C. INPUT: 115 Volts, Single Phase, 60 cps

FINISH: Baked Grey Wrinkle

WEIGHT: 130 lbs.

DIMENSIONS: 22" x 15" x $14\frac{1}{2}''$

*This unit is an economical solution to your power supply needs if stabilization for A.C. Voltage changes are not required. If this is required, write for spec. on Model MR1040-30.

Price \$439 w/o cabinet, \$474 w/cabinet

PERKIN ENGINEERING CORP.

PHONE: ORegon 8-7215

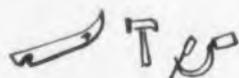
CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

THE VALUE OF HERMETIC SEALING OF RELAYS

The performance of some relays is improved considerably by hermetic sealing. Particularly is this the case on relays which have delicate springs, fine gauge wiring and small physical size.



These types are naturally sensitive to the embarrassing consequences of unsympathetic environments and give much more rhythmic performances when protected by an encompassing metallic membrane from the wanton attacks of pliers, screw drivers, thumbs, or church keys.



On the other hand, relays employing switch contacts which have to make and break electrical circuits have an addiction, when hermetically sealed, to the production of various black deposits in the immediate vicinity of the switch. Some engineers claim these result from traces of volatile hydrocarbons trapped in the insulation.



They suggest that harmful effects of such deposits are avoided by using only materials like granite, soapstone or concrete. Unfortunately, these present certain difficulties in fabrication.



In general, two expedients seem most successful to date. One is to ignore the deposits. They usually only reduce the life expectancy, important only if the relay is placed in service. (Since most sealed relays spend their days on a shelf in a depot warehouse, this consideration may usually be dismissed.)

The other was proposed by an Air Force captain who may as well remain nameless, both because he was actually trying to use equipment and because his most effective solution runs somewhat counter to entrenched government prejudice. He increases the life expectancy of relays (yes — Sigma relays, worse luck) approximately five-fold, by drilling in each carefully pressure-tested enclosure --- one small hole.



SIGMA

SIGMA INSTRUMENTS, INC.

91 Pearl Street, So. Braintree, Boston 85, Mass.

CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors Can Be Adjusted Slightly



This series of polystyrene and "Teflon" dielectric capacitors may be adjusted to values from 1% below to 1% above nominal. Once set, the capacitance will remain constant indefinitely.

These units employ a self-rigid type of winding which is inherently stable without external pressure. The extra pressure necessary to adjust the capacitor is a small fraction of the total pressure in the assembly, thus assuring an extremely high capacitance stability. The winding is completely non-inductive, thus minimizing power factor and soakage.

These capacitors find extensive applications in computers, tuned circuits, and timing circuits, where extreme precision is required. Units are available in all capacity values from 0.01mfd to 1.0mfd. Rated working voltage is 200v, d-c. Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York 56, N. Y.

CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION

Millivolt Meters

Can Also Function as Amplifiers



A series of electronic D-C Millivolt Meters have voltage ranges extending from 100 microvolts, for the most sensitive to 1kv for the highest range models. Input impedance on the low ranges is 6 megohms and 60 megohms on all ranges above 1v full scale. They contain an accurately tuned 120cy d-c, modulator which is driven from its own highly stable 60cy, R/C-tuned oscillator.

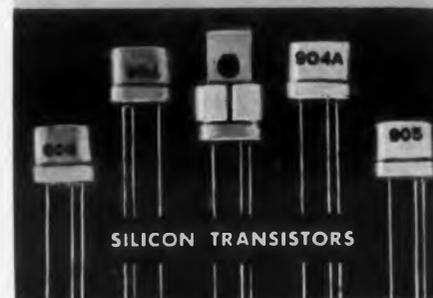
The new meters are available as portable models and in rack mounted form, with or without facilities for operation as highly stable d-c amplifiers. In the latter case they have a gain of 1500 and a d-c drift of less than $50\mu\text{v}$ referred to the input circuit over long periods of time. They may be used over a wide power supply frequency range extending from 40cy to 500cy, and are recommended for all applications where 117v, 59-61cy is not available. Millivac Instrument Corp., Dept. ED, 444 2nd St., Schenectady 6, N. Y.

CIRCLE ED-54 ON READER-SERVICE CARD FOR MORE INFORMATION

silicon

semiconductor devices
available in
production
quantities

high volume production of silicon semiconductor devices enables Texas Instruments to offer you an enlarged line of five types of silicon transistors and many new types of silicon junction diodes... all available for immediate delivery in production quantities!



SILICON TRANSISTORS

silicon transistors — produced commercially by and available only from Texas Instruments — are now available with alpha (current amplification factor) to over 0.975 and with alpha cutoff frequency to over 8 megacycles... stable to 150° Centigrade (302° F)!



SILICON JUNCTION DIODES

silicon junction diodes are also manufactured by Texas Instruments from grown single crystals and feature back currents as low as 0.001 microamp and safe operation to 150° Centigrade! All TI semiconductor devices — silicon or germanium; diodes, triodes and tetrodes — are made with glass-to-metal hermetic seals.



WRITE for literature on semiconductor devices in the widest range available today!

TEXAS INSTRUMENTS

6000 LEMMON AVE. DALLAS 9, TEXAS

CIRCLE ED-55 ON READER-SERVICE CARD

Pulse Transformers

In 19 Miniature Sizes



Two distinct types of miniature pulse transformers have been developed by this firm. One group is available in a series of metal case designs, with approved-

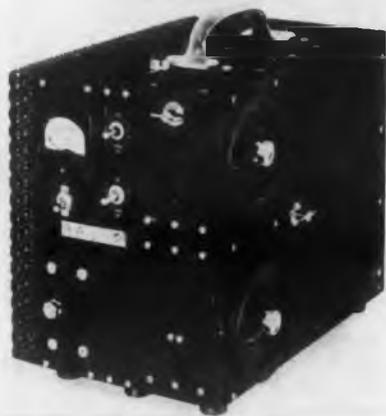
type glass seal terminal header plates. The second group is encapsulated in molded epoxy resin with several types of terminal connections.

The line of transformers was especially developed for triggering and counting circuits, and for d-c isolation, inversion pulse shaping, and pulse transmission circuits. They resist severe temperature changes, shock, and humidity conditions. The manufacturer lists six distinct designs available in 19 sizes with 21 different ratios in each category as stock units. Acme Electric Corp., Dept. ED, 1375 W. Jefferson Blvd., Los Angeles, Calif.

CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION

Recording Oscillograph

Portable, Six Channel Design



The Model 401-6 Portable Recording Oscillograph now has a small, lightweight rectifier unit which replaces the former detachable 8v battery case, permitting operation from 115v 50-400cy power, as well as from an 8v d-c internal

or external source. Conversion from a-c to d-c is made in a matter of minutes, providing an ideal arrangement for both field and laboratory use.

The oscillograph records on 2" wide photosensitive film or paper at speeds up to 12ips. A self-sustaining vibrating reed timing system, independent of line frequency, provides accurate 0.01sec timing lines either across or at the edge of the record. Size, with rectifier or battery pack, 8" x 12-1/4" x 9"; weight is 39lb. The instrument is supplied with the rectifier unit and with six galvanometers having natural frequencies as high as 3300cy. The battery case can be provided separately. Heiland Research Corp., Dept. ED Denver, Colo.

CIRCLE ED-57 ON READER-SERVICE CARD FOR MORE INFORMATION



AMP Taper Tab
receptacles for wire
sizes 26 to 18

AMP Taper Pins
for wire sizes
26 to 16



You are cordially invited
to visit the AMP booth
at the J. R. E. show.
Booths 770 and 772

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.

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Creative Approach to Better Wiring



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our brochure, AMP's Creative
Approach to Better Wiring.

AIRCRAFT-MARINE PRODUCTS, INC., 2100 Paxton Street, Harrisburg, Pa.
In Canada: AIRCRAFT-MARINE PRODUCTS OF CANADA, LTD., 1764 Avenue Road, Toronto 12, Ontario, Canada

CIRCLE ED-58 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Exciting New Development in Printed Circuits!

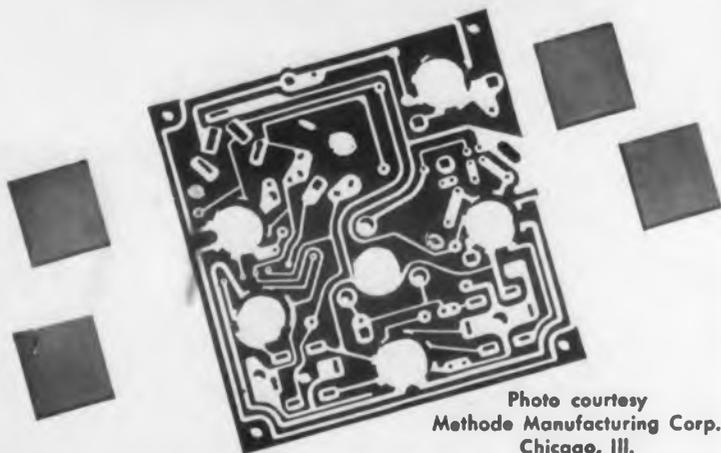


Photo courtesy
Methode Manufacturing Corp.
Chicago, Ill.

New CuCLAD* copper-clad laminate offers unequalled bond strength, heat resistance, solderability, punchability, electrical performance!

Here's the foil-clad laminate you've been waiting for! It's CuCLAD LAMICOID®—made possible by an entirely new concept in bonding material and specially designed equipment developed exclusively by Mica Insulator Company. This new bond and unique bonding method give you unequalled performance that's consistent and dependable from sheet to sheet, lot to lot.

LOOK AT THESE TYPICAL PRODUCTION RUN VALUES ON 6028 XXXP CuCLAD LAMICOID
BOND STRENGTH—Guaranteed min: 6 lb.; avg. 9 lbs. (90° peel at 2 lbs./min.)
SOLDER TEST—Guaranteed no blisters @ 230-240° C. for 10 seconds, 1" square floated on molten solder
HEAT RESISTANCE—Guaranteed no change at 150° C. for ½ hour in air-circulated oven, air flow parallel to specimen
PUNCHABILITY—Excellent
SURFACE RESISTIVITY, megohms
 C-96/35/90 7.3 x 10⁴
VOLUME RESISTIVITY, megohm cm
 C-96/35/90 3.7 x 10⁵
WATER ABSORPTION
 1/16" th., E-1/105 + D-24-23 copper on 0.1%
 1/16" th., E-1/105 + D-24-23 copper removed 0.7%

You get all these advantages:

A Stronger Bond Which Improves With Age and Heat • Better Heat Resistance • Better Reaction to Hot Solder • Bond Electrically Equal to Laminate • Improved Arc Resistance • Superior Punchability • Uniformity

and CuCLAD LAMICOID is competitively priced!

CuCLAD LAMICOID is available NOW, in several grades. Tell us your requirements or problems—or ask to have a MICO Sales Engineer call. *Trade-mark



MICA
Insulator
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LAMICOID® (Laminated Plastic) • MICANITE® (Built-up Mica)
EMPIRE® (Coated Fabrics and Papers) • FABRICATED MICA • ISOMICA®

CIRCLE ED-59 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Set Determines Voltage Coefficient



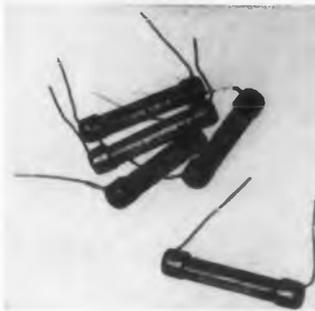
This test set provides a rapid and reliable measurement of the voltage coefficient for composition resistors. It should find application in the study of resistor geometry and materials, contact behavior, and semiconductor phenomena. It can also be used for inspection and quality control of resistors and similar components.

The apparatus applies an adjustable a-c voltage to both a specimen under test and a standard variable linear resistor. Non-ohmic properties of the specimen will generate current harmonics. These harmonics are isolated by cancelling out the fundamental component of current and are measured with a vacuum tube voltmeter and oscilloscope. The measured harmonics can then be directly correlated to voltage coefficient.

Resistance range is 1000 ohms to 1.1 megohms. Test voltage is 0 to 500v. Power dissipation is 2w. Supply is 105-135v a-c, 60cy. Resolution varies with resistance level; 3 x 10⁻⁴% per volt at 10,000 ohms is typical. Brunswick Instruments, Dept. ED, P. O. Box 813, New Brunswick, N. J.

CIRCLE ED-60 ON READER-SERVICE CARD FOR MORE INFORMATION

Film Resistors Withstand Adverse Conditions

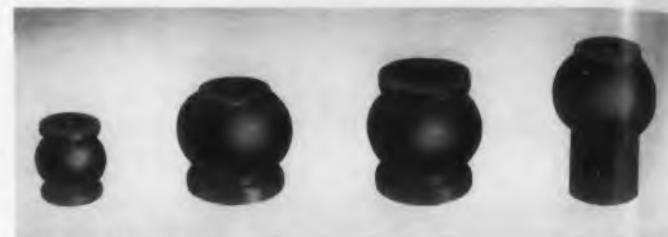


The LP-4 is the first item in a new line of low-power film resistors. It is a 4w unit, available in resistances from 200 to 40,000 ohms. The resistors, which consist of a film of metallic oxides permanently and integrally bonded to Pyrex glass rod at high heat, were expressly designed for applications requiring a low cost power resistor with outstanding performance under adverse operating conditions. Because they are non-inductive and have sufficient resistance range, they serve as replacements for wire-wound types.

Tolerance is ±10%, but ±5% tolerance is available at a slightly higher price. The power rating is based on 40°C ambient temperature and an average hot spot of 225°C. Permanent changes in resistance due to normal soldering techniques are less than 1%. Corning Glass Works, Dept. ED, Corning, N. Y.

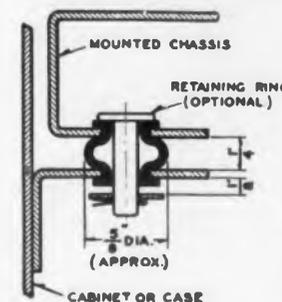
CIRCLE ED-61 ON READER-SERVICE CARD FOR MORE INFORMATION

MINIATURE VIBRATION ISOLATORS protect light-weight components



Type 275 Type 372 Type 302 Type 371

Light-weight *Barrymount Isolators* are extremely easy to use, and require very little space for installation. They provide a high degree of vibration protection for small instruments, sensitive relay assemblies, electronic sub-chassis, small motors, and similar light-



weight units. Available in four types, they will support up to 9 lbs. per unit isolator. Vibration frequencies as low as 30 cps are isolated in all directions, for maximum rated load. For further information, write to The Barry Corporation 775 Pleasant St., Watertown 72, Massachusetts.

CIRCLE ED-62 ON READER-SERVICE CARD FOR MORE INFORMATION



an Even *Better Buy*
in **Slotted Lines**

The New
Type 874LBA \$220
... a radical redesign of
the original G-R Slotted Line.

Its improvements include:

- ★ Higher Accuracy
- ★ Greater Operating Conveniences
- ★ 300 to 5,000 Mc Nominal Range, Can Be Extended In Both Directions
- ★ Improved Driving Mechanism
- ★ Negligible Backlash in Drive
- ★ More Rugged Supporting Structure
- ★ More Constant Probe Coupling — ±1% Along Entire 50 cm Travel
- ★ Improved Center Conductor and Probe Support
- ★ Adaptable To Motor Drive
- ★ NO Increase In Cost

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
90 West St. NEW YORK 6 4055 13th St., Silver Spring, Md. WASHINGTON, D. C.
920 South Michigan Ave. CHICAGO 5 1000 North Seward St. LOS ANGELES 38

CIRCLE ED-63 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

SIMPLYTROL AUTOMATIC PYROMETER



10 temperature ranges cover from -75° to 3000° F.

Several special ranges to -400° F.

Cat. No. 4531 0 2500° F.
Price \$132.00

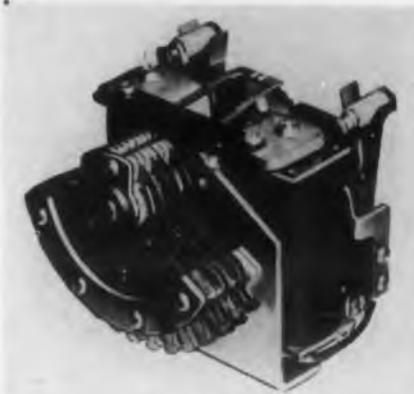
Thermocouple type Automatic Pyrometer for controlling temperature in furnaces, ovens, and processes. The Simplytrol is economical and reliable with few moving parts. There are no vacuum tubes. The regular load relay is S.P.D.T. 5 Amps. Optional heavy duty relays to 40 Amps.

10 temperature ranges cover from -75° to 3000° F. Several special ranges to -400° F. "On & Off" control for holding the desired temperature works on gas, oil or electric heat. Indicating meter-relay is medium high resistance and has bimetal cold junction compensation. For use with all standard thermocouples. Accuracy 2%.

"Auto-Limit" switch changes Simplytrol from automatic controller to limit pyrometer for safety shut down or warning. Cabinet: $6\frac{1}{2} \times 6\frac{1}{2} \times 9\frac{1}{2}$ inches. Also flush panel mount models. Send for new Bulletin G-7 for more data. Assembly Products, Inc., Chesterland 17, Ohio.

CIRCLE ED-64 ON READER-SERVICE CARD FOR MORE INFORMATION

Stepping Switch For Differential Counting



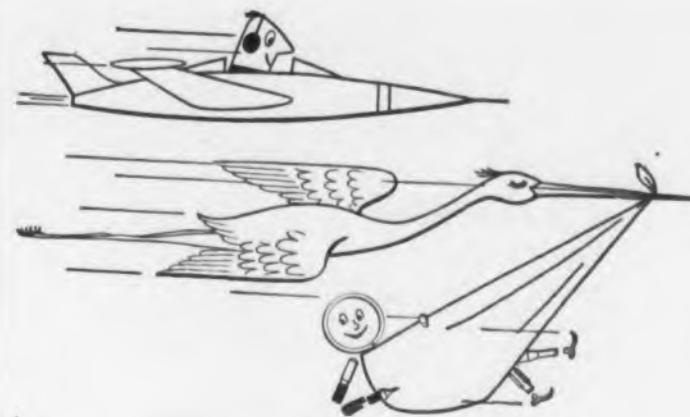
Remote selection, differential counting and digital storage are all possible with the type SS bidirectional stepping switch. The stepping motor may be rotated in either direction in 10° increments under control of two electromagnets

energized by impulses. Positive stepping is provided, and the wipers cannot be positioned between steps of the switch.

Limits are provided to stop the switch at the end of its travel. Interrupter contacts are available for self-stepping and for interlock to protect against partial steps. The motor, without the switch, can be used for positioning servomotors or potentiometers.

Motor coils are available for d-c voltages to 120v. Various contact arrangements can be furnished up to four-level maximum capacity. Sterling Engineering Co., Dept. ED, 54 Mill St., Laconia, N. H.

CIRCLE ED-66 ON READER-SERVICE CARD FOR MORE INFORMATION



When speed
is important—

LET TORRINGTON MAKE YOUR SMALL PRECISION PARTS

You can count on Torrington to deliver your small precision parts *promptly*—and exactly to your specifications of tolerances, temper, hardness and finish.

Whether you order a hundred or a million pieces—we can produce them *faster, better and for less* than you can make them yourself. Send a sample part or your blueprint for our quotation. And ask for our Condensed Catalog which shows many of the parts we can make at significant savings.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street, Torrington, Conn.

TORRINGTON SPECIAL METAL PARTS

Makers of Torrington Needle Bearings

CIRCLE ED-68 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Motor For Aircraft Applications



By making various design changes, a low-cost servo motor with excellent performance characteristics has been produced. Designated the type RDDS-0810 DC Servo Motor, it

features immediate response to minimum input signal. It was designed for aircraft computers and controls.

Among the design changes are substitution of epoxy encapsulation for hermetic sealing of the field structure, reduced commutator diameter to lower brush friction and allow use of carbon instead of silver-graphite brushes, and substitution of four color-coded leads for a terminal with four connections.

Specifications are: 24-29v, d-c, excitation; 0.3 oz-in at 6500rpm for 0.002hp; diameter, 1-5/8"; field current 6.0ma; armature current 0.8amp; duty cycle, four reversals per minute; altitude, 50,000'; and ambient temperature -65° to 72° C. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Amory St., Boston 19, Mass.

CIRCLE ED-67 ON READER-SERVICE CARD FOR MORE INFORMATION

New **LOCKTITE** *
gun-rifled **CLUTCH**
grips like a bull dog



The new improved LOCKTITE Clutch utilizes the gun-rifled principle, with diagonal knife-like ribs, to hold the lead in a vice-like grip. No matter how you sharpen your lead in the holder, the jaws of the clutch keep it from slipping, twisting or turning.

This is just one of many reasons why professionals prefer push-button LOCKTITE. You will like its easy, one-hand operation, which prevents finger-staining and avoids smudging your drawings. Order from your Dealer. For best results use LOCKTITE with Imported CASTELL 9030 lead.

*Pat. appd. for (U.S. Pat. Office)

A. W. FABER-CASTELL
PENCIL COMPANY INC. NEWARK 3, N. J.

CIRCLE ED-65 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

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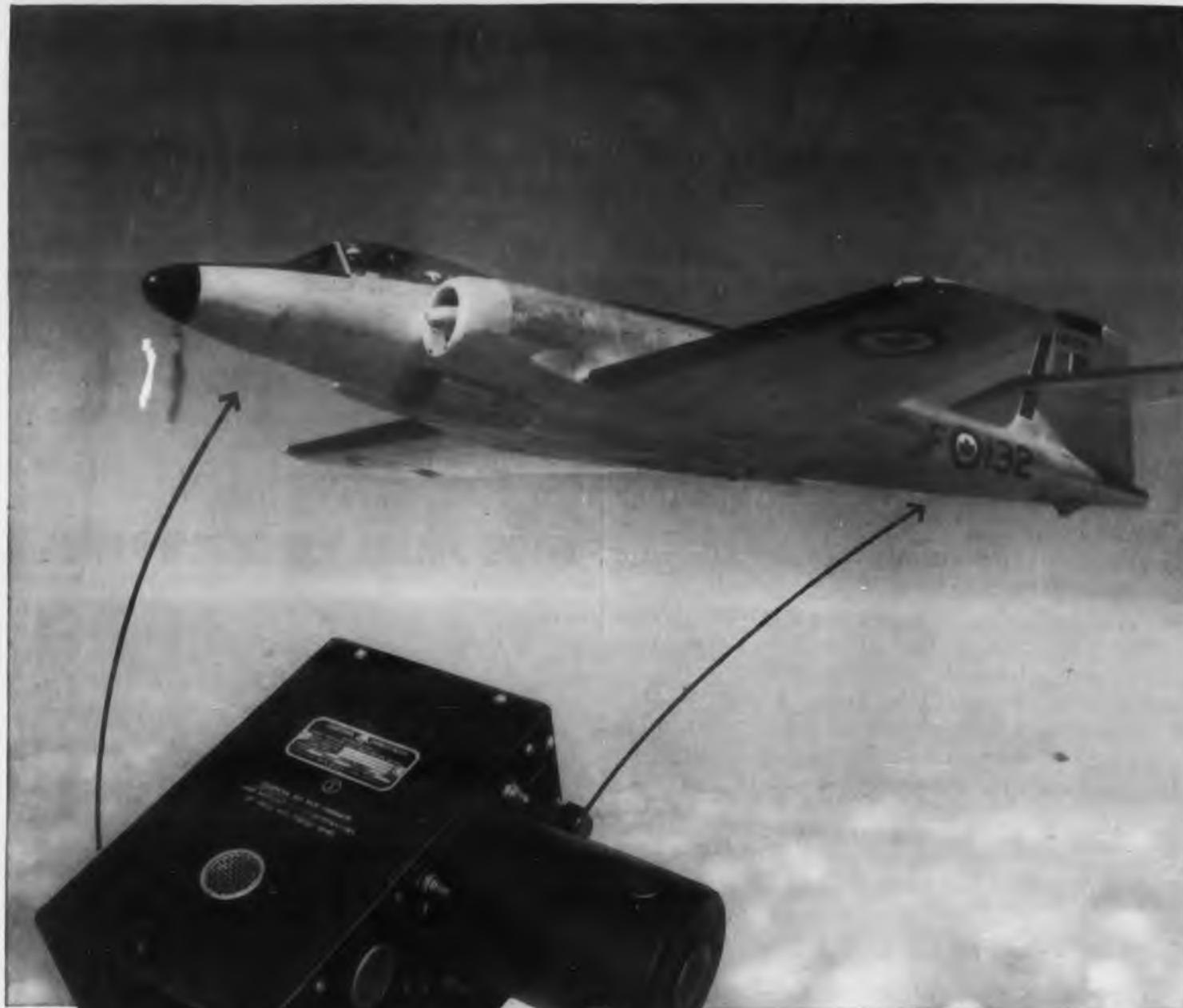
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RELIABLE PRESSURIZATION

for aircraft equipment

The custom job of supplying pressurization units for airborne electronic equipment is Eastern's specialty. Meeting all appropriate government specifications, units can be furnished within the limits shown at right. Dehydrators available. We invite inquiries and specific requests concerning your specifications.

General Requirements:

Altitude: 0-70,000 ft.

Delivery: 0-3600 cu.in./min. free delivery

Discharge Pressure: 0-60 p.s.i.

Temperature: -65°F to $+160^{\circ}\text{F}$

Voltages: any standard voltage.

New Aviation Products Catalog covering Electronic Tube Cooling Units, Hydraulic Equipment, and Pressurization Units sent on request.

Eastern



INDUSTRIES, INC.

100 SKIFF STREET
HAMDEN 14, CONN.

CIRCLE ED-69 ON READER-SERVICE CARD FOR MORE INFORMATION

Heptode and Triode For Computer Applications



Two new types have been added to this firm's line of tubes designed especially for computer applications. The first, the *GL-5915*, is a dual-control heptode, for use primarily as a coincidence-gating tube. Each of the two independent control grids exhibits a sharp-cutoff

characteristic. Electrically and physically, the new type may be used as a replacement for the *5915* type.

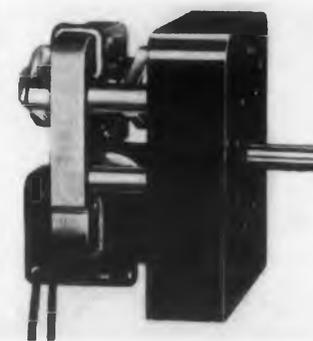
The other tube, the *GL-6211*, is a nine-pin medium-mu twin triode for binary counter or amplifier applications. Its electrical characteristics are essentially equivalent to those of the *GL-5844*, except that each section of the new type is provided with a separate cathode connection.

They feature high permeance and low heater-power requirements. Typical operating conditions for the *GL-5915-A* are: max cathode current, 20ma; max dissipation, 1w; typical plate current in gating service ("on" condition), 5.8ma. Tube Dept., General Electric Co., Dept. ED, Schenectady 5, N. Y.

CIRCLE ED-70 ON READER-SERVICE CARD FOR MORE INFORMATION

Gearmotor

In Variety of Speeds, Torques



This exceptionally quiet, powerful, and inexpensive motor and gear train combination has many uses including business machines and appliances. It can be furnished in a selection of torques ranging from 60 lb-in at 1 rpm to 50 lb-in at

10 rpm (1/300hp to 1/35hp) and in any single speed from 1/4rpm to 426rpm, operating either clockwise or counter-clockwise, as specified.

Built for long life and hard usage, the gears, pinions, and shafts are all hardened steel. Bearings are bronze, and lubrication is provided by a large felt oil reservoir. Provisions are made for either base or panel mounting. The shaded pole motor operates on 115v, 60cy. It has die-cast bearing brackets, internal cooling fan, and self aligning oil-less bearings. New England Gear Works, Dept. ED, 2008 South End Rd., Southington, Conn.

CIRCLE ED-71 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Ultrasonic Generator

Produces Useful Mechanical Energy



The "400" Ultrasonic Generator, for industrial processing and laboratory research, produces mechanical energy in the 10-1200kc band. It

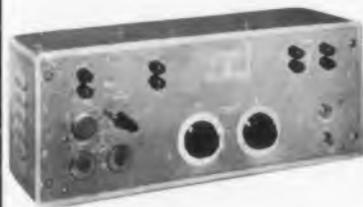
comprises a power unit and a transducer assembly. It has many applications, including cleaning, emulsifying, dispersing, coagulating, fragmenting, extracting, impregnating, degassing, depolymerizing, and accelerating chemical reactions. A broad choice of transducer types and frequencies is available, including "Sonicells" for processing and research.

The power unit proper is a variable frequency high-power electronic generator. It produces approximately 400w of electrical energy, and has an impedance matching control. Housed in a steel portable cabinet, the unit may be placed in any convenient location. It operates from any source of 115v 50/60cy power. Rich-Roth Laboratories, Dept. ED, 1240 Main St., Hartford 3, Conn.

CIRCLE ED-72 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier

For Acoustic Measurements



Model M-185 amplifier has a stabilized, fixed gain of 60db with an accurate attenuator having six 10db steps and one continuous 0-10db

step mounted for convenient use by the operator. The equipment has an input noise level of less than $10\mu\text{v}$ for the entire frequency band of 10cy to 400kc. A set of 2-megohm impedance input terminals is provided, and low impedance output terminals are available for the connection of meters or recorders as the operator desires.

Accurate comparison of sound fields is permitted by means of the calibrated attenuator. Extreme care has been exercised in the circuit development to insure both low noise level and excellent transient response, to permit faithful reproduction of non-recurring phenomena. The unit should have many useful laboratory applications, especially in the field of acoustic and associated measurements.

Various input positions are provided to receive all the standard accelerometers and sound pressure measuring instruments produced by this firm. Massa Laboratories, Inc. Dept. ED, Hingham, Mass.

CIRCLE ED-73 ON READER-SERVICE CARD FOR MORE INFORMATION

IBM News FOR ENGINEERS

THIS MONTH'S BIG CAREER OPPORTUNITIES

DEVELOPMENT ENGINEERING *

Digital computer circuit design—electronic pulse circuits for accounting and data processing machines—arithmetic, switching and logical circuitry—magnetic storage—transistor circuitry—input-output device controls—pulse amplifiers, shapers, gates, etc. **ALSO** excellent openings in systems planning, functional and reliability analysis, electronic component development, packaging, diagnostic and application program development.



MANUFACTURING ENGINEERING *

Design and development of electronic test equipment for digital computer production testing—circuit design—systems planning and analysis—test planning. **ALSO** excellent openings in functional and acceptance testing—test equipment installation and maintenance—automation engineering—manufacturing research.

* Required—a degree in E.E., M.E., or a Physics B.S. or B.A., or equivalent experience.

Desirable—experience in any of the following fields: digital and analog computers, including airborne types, radar, TV, communications equipment, relay circuitry, automation, servo-mechanisms, instrumentation, or data handling systems.

**For information
on these career opportunities
WRITE,**

**giving details of education and experience, to:
William M. Hoyt
IBM, Dept. 686 (9)
590 Madison Ave., New York 22, N.Y.**

Your replies, of course, will be held in strictest confidence.
INTERNATIONAL BUSINESS MACHINES CORPORATION

IBM joins America in saluting all ENGINEERS during
NATIONAL ENGINEERS' WEEK, Feb. 20-26, 1955.

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Electronic
Accounting
Machines
and Computers

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YEARS OF YOUR LIFE

"IBM GREAT PLACE TO WORK"

says development engineer
now in his 8th year
with the company



"Every year with IBM is more challenging than the last," says Max E. Femmer, Development Engineer at Poughkeepsie. "It was a tremendous satisfaction in 1952 to help develop IBM's outstanding 701 Electronic Computer. Today our projects and our work are even more interesting. Both my wife and I think IBM is a wonderful company."

Mr. Femmer is Technical Administrator of the entire Electronic Data Processing Machine Development Program.

MAGNETIC CORE MEMORY DEVELOPED BY IBM STAFF

This is a Microsecond Memory—developed and perfected by IBM engineers—with data transmission in and out of storage at the rate of more than 43,500 characters a second. A random access unit, the IBM magnetic core can locate and move 5 characters to a programmed location in 35 millionths of a second.



electromechanical
ENGINEERS

for research in and development of electro-mechanical radar and computing equipment.

THE MOST ADVANCED DEVELOPMENTS IN ELECTRONICS ARE BEING MADE IN THE SPHERE OF AIRBORNE RADAR AND ALLIED FIRE CONTROL SYSTEMS BECAUSE OF MILITARY EMPHASIS. FURTHER APPLICATIONS OF ELECTROMECHANICAL TECHNIQUES IN THESE FIELDS ARE CREATING NEW OPENINGS IN THE RADAR DIVISION OF HUGHES RESEARCH AND DEVELOPMENT LABORATORIES.

Engineers who have demonstrated ingenuity and inventive ability will find interest in the areas of work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Division.

Equipment includes mechanical, electronic and microwave devices and systems to be manufactured in quantity. The equipment designs require use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and military specifications is useful.

ENGINEERS EXPERIENCED IN THE FIELD OF ELECTROMECHANICAL DESIGN FOR PRODUCTION, OR THOSE INTERESTED IN ENTERING THIS ORBIT, WILL FIND OUTLETS FOR THEIR ABILITIES AND IMAGINATION IN THESE ACTIVE AREAS.

Scientific and Engineering Staff

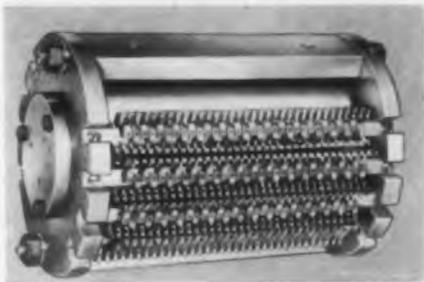
HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

**Magnetic Drum
Has Large Capacity**



The Wharf Mark III Storage unit has capacity for 8193 words of 32 binary digits—over 250,000 bits. It has 256 heads, mounted in eight columns. The heads

have individual adjustments and are removed and replaced separately.

The writing current required is 0.8amp at the head or 15-20ma at the input of the type T3 transformer. Normal writing pulse is 1-2microsec wide. The drum is intended to be driven directly by a 1/6hp induction motor, and the bearing system is designed for a maximum speed of 6000rpm, which gives a digit rate of 1000kc. Drum diameter is 5", and length is 8". Mounting flange diameter is 7.5", and overall length is 12". A vertical mounting position is recommended. Weight is 25 lb (approx). Imtra Corp., Dept. ED, 58 Charles St., Cambridge 41, Mass.

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

**Transistor
Low Cost Unit**



The 2N76 is a low-cost fused junction transistor having high reliability. It covers a broad specification range so that designers interested in developing and experimenting

with transistor circuits will have available a stable, relatively inexpensive component. Shelf life and exposure to full rated temperature will not change the characteristics of the transistor. It is hermetically sealed by means of glass-to-metal seals and resistance welded seams.

The transistor was developed for use in audio and supersonic frequency stages. It has a maximum frequency cutoff at 2.5Mc with the design center at 1.0Mc. Alpha design center of the new transistor is 0.95, while the maximum collector voltage is -20v, and the maximum junction temperature is specified at 60°C. The transistor is capable of dissipating 50mw in 25°C free air. Germanium Products, General Electric Co., Dept. ED, Syracuse, N. Y.

CIRCLE ED-76 ON READER-SERVICE CARD FOR MORE INFORMATION



Designed for portability and low-cost as well as accuracy, the newly developed DS-660 will count and display any electrical or mechanical event which can be converted into a varying voltage of sufficient amplitude—from 10 to 100,000 events per second. Derives its time base from the 60 cycle line—which determines the accuracy—approximately .1%. Here is new and amazing reliability and circuitry available in one unit.

FEATURES:

- SELF CHECKING
- AUTOMATIC and MANUAL RESET
- DISPLAY from 1 to 10 SECONDS
- LIGHTWEIGHT — only 16 lbs.
- UTILIZES STANDARD PLUG-IN DECADES
- BASIC UNIT READS OUT TO 10 KC (4 decades)
- AIR COOLED (Fan)

Write TODAY for full technical information

THE Detectron CORPORATION, Dept. 76-C
5528 Vineland Ave., North Hollywood, Calif.

CIRCLE ED-77 ON READER-SERVICE CARD FOR MORE INFORMATION



10, 15, 20 and 25 watts.

19/32" d. 1 1/2", 2", 2 1/2" and 3" h.

Max. res.: 6000, 9000, 12,000 and 15,000 ohms, respectively.

★ These unique Clarostat power resistors can mount vertically above the chassis. Heat is quickly and safely dissipated in the open. Wire winding sealed in a ceramic tube. A great space-saver—and money-saver, too. ★ Literature, quotations, delivery, schedules, on request.

* Reg. U.S. Pat. Off.



CIRCLE ED-78 ON READER-SERVICE CARD FOR MORE INFORMATION

specify standard

FLEXLOC SELF-LOCKING NUTS

Regular and Thin Types



Regular FLEXLOCs are one-piece, all-metal, standard height nuts that lock securely, even under extreme vibration. Thin nuts have the same one-piece, all-metal construction and the same positive locking principle, but these nuts are approximately 30% thinner. Your FLEXLOC industrial distributor stocks both types: regular FLEXLOCs in sizes from #4 to 2"; thin FLEXLOCs in sizes from #6 to 1 1/2". Ask him for catalog information and samples. Or write STANDARD PRESSED STEEL Co., Jenkintown 12, Pa.

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA

CIRCLE ED-79 ON READER-SERVICE CARD FOR MORE INFORMATION

READ *Torque*
LIKE YOU READ THE *Time*

A COMPLETE
NEW
SET OF

Torque
Watch
GAUGE



A NEW set of "TORQUE-WATCH" gauges
for measuring LOW TORQUE

Four Models: 6000-1 0.010 to 1.2 inch-ounces, clockwise.
6000-2 1.0 to 20 inch-ounces, clockwise.
6000-3 0.010 to 1.2 inch-ounces, counter-clockwise.
6000-4 1.0 to 20 inch-ounces, counter-clockwise.

- **Accurate** — Repeatable accuracy of plus or minus 5% on the 300° watch-face.
 - **Easy to Read** — Linear scale on a one-inch dial.
 - **Compact** — 1 1/4 inch diameter and 3/4 inches long, including the Jacobs chuck for shafts to 1/4 inch diameter.
 - **Two Gauges of rugged construction** in a plush-lined instrument case: Price per set \$99.50 Also available singly, price each \$54.95
- A complete set of gauges for measuring low torque on servomechanisms, variable condensers, potentiometers, and small rotating machinery. Write for detailed information.



WATERS MANUFACTURING, inc.

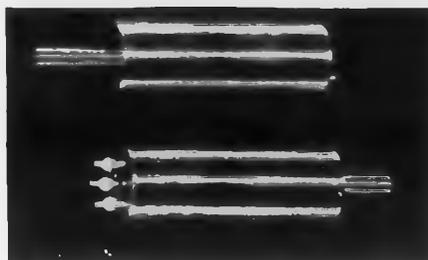
Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-80 ON READER-SERVICE CARD FOR MORE INFORMATION

Linear Transducer

Operates to 1300°F Without Cooling



This transducer measures linear motion, relative displacement, position, and vibration. It may be employed as a remote or local transducer for examination of magnitude or rate of motion, stress tests, and absolute measurement of large or very small dimensions, or relative positions. It may be used in ovens, in hot fluids if tubing cable conductor is used, in radioactive regions, or for other applications where the transducer must be mounted or operated in a region of elevated temperatures. When operated below 1300°F, no cooling is required, and the temperature of the entire instrument may be raised to ambient.

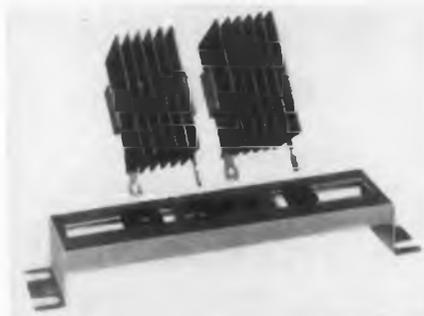
The effects of temperature changes on operational characteristics are reduced to an absolute minimum; temperature range is -160° to +1300°F. Linear ranges are available from 1" to 32". Resolution of all models is 0.000,000,1". Operating sensitivities are 5v per inch. Linearities are to 0.1% linear range.

The simple design of the unit and heavy construction prevent damage from shock or mistreatment. No force is required for displacement of sensing probe. The system operates directly into most laboratory indicators and recorders. The instrument housing measures 1" diam; length is determined by the range required and varies from 3" to 65". Crescent Engineering & Research Co., Dept. ED, 14828 Arrow Highway, Baldwin Park, Calif.

CIRCLE ED-81 ON READER-SERVICE CARD FOR MORE INFORMATION

Conversion Chassis

For TV Rectifiers



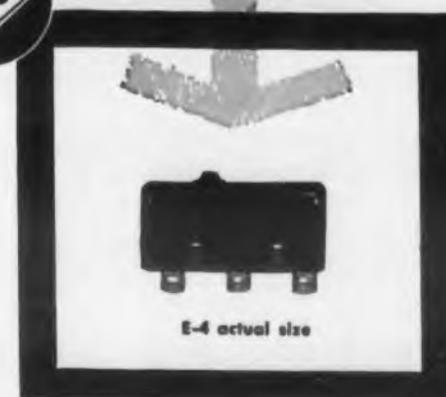
The "Conversion Chassis", when incorporated into television receivers, will allow the use of this firm's plug-in selenium rectifiers. A low cost conversion unit, it should simplify re-

placement of rectifiers and eliminate removing the chassis and soldering. The illustration shows the "Conversion Chassis" with the rectifiers ready to be plugged in. Sarkes Tarzian, Inc., Dept. ED, 415 N. College Ave., Bloomington, Ind.

CIRCLE ED-82 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's the New

BASIC SUB-MINIATURE SWITCH



New Increased Life to 200,000 Operations
Guaranteed

New Greater Stability of Characteristics

New Lower Price

This Electro-Snap Sub-Miniature Basic Switch has been improved to give even better performance —and at less cost. Although no thicker than a lead pencil and only 27/32" long, 23/64" high, it does a man-sized job, handling 5 amps at 125v AC or 4 amps resistive, 2.5 amps inductive at 30v DC. Its small size plus low operating force and small movement differential make it ideal for precision control of "feather touch" devices, business machines, aircraft and instrument circuits. Positive snap action resists vibration and shock, has no dead center. Available in normally open and normally closed single-pole models and in single-pole, double-throw models.



WRITE FOR DETAILS IN DATA SHEET ES-2



**ELECTRO-SNAP
SWITCH & MFG. COMPANY**

4224 West Lake Street
Chicago 24, Illinois

CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

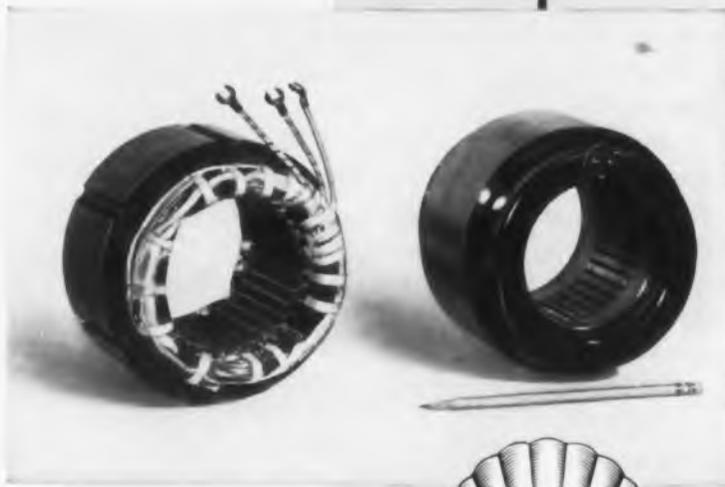
with the help of **EPON RESIN...**

Motor stator becomes pump housing as well— in new, ultra-compact, refrigeration motor-compressor



New Compressor (left) takes only 27% of the space of a conventional unit (right). It has only 10% as many parts, weighs 58% less, and will cost much less to produce.

Assembled stator (left). Finished stator (right) has been potted with Epon resin formulation. New compressor was developed by Wetmore Hodges and Associates, Redwood City, California.



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Los Angeles • Newark • New York
San Francisco • St. Louis

IN CANADA:
Chemical Division, Shell Oil
Company of Canada, Limited
Toronto • Montreal • Vancouver

Why not combine the pump and the motor? Put a gear pump *inside* the motor stator, encase the stator in plastic, and you can build an entire motor-compressor in the space occupied by a conventional motor alone!

Wetmore Hodges and Associates have done just that. But along the way, they ran into an unexpected problem. With the motor stator doubling as the pump housing, it had to be pressure tight . . . free of voids. This was impossible to achieve with standard potting compounds.

After hundreds of plastic formulations were tried, an Epon resin-based compound solved the problem. The Epon-impregnated stator proved to be pressure tight, stable mechanically and fully resistant to Freon at 350 psi, at temperatures as low as -20° F and as high as 250° F. Important too, Epon resin has excellent dielectric properties; is impervious to air, oil and water.

If you, too, are interested in plastics for electrical applications, write for technical bulletin "Epon 828 in Casting Applications."

CIRCLE ED-84 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Operate to 150°C Without Derating



This line of metallized paper capacitors is impregnated with a special formula epoxy resin to improve performance characteristics.

The resin has an operating temperature up to 150°C without derating. It is impervious to moisture, has extremely high insulation resistance which meets MIL specs, and can withstand surge voltages up to 200% of rated voltage.

The capacitors are especially adaptable to potted and printed circuitry. They are being sold under the name of "Epicon", and are available in a wide range of sizes in 200v, 400v, and 600v ratings. Electron Products, Inc., Dept. ED, 1220 E. Green St., Pasadena, Calif.

CIRCLE ED-85 ON READER-SERVICE CARD FOR MORE INFORMATION

Climatic Chamber

For Testing Wire and Cable



This climatic test chamber is for rapid, exact temperature tests, under varying conditions or cycles, of wire and cable. It is equipped with mandrils from 1/16" to 18" in size, with externally mounted turning devices and reduction gears for easy and exact control.

Position locks and hand access ports are also standard equipment.

Temperature cycles can be automatically controlled between -100° and +300°F or held at fixed points within this range, as needed. The chamber is designed for tests in accordance with Signal Corps, Air Force, or CAA requirements. It has sufficient height so that straight lengths of wire can be suspended from the mandrils. Instrumentation and controls can be varied to meet individual requirements.

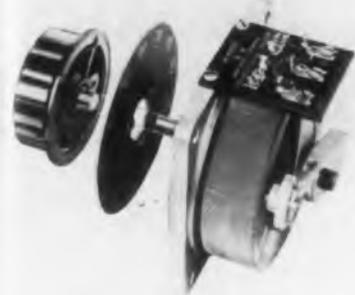
The chamber can be located anywhere in plant or laboratory without the need of special protection or ventilation. Other standard features include all-metal construction; stainless steel chamber interior; and approved safety controls, with operating controls and instruments grouped for easy reading or use. Conrad Inc., Dept. ED, 183 Jefferson Ave., Holland, Mich.

CIRCLE ED-86 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Autotransformers

For Higher Power Uses



The Types M-2 and M-5 "Variac" Autotransformers meet the requirements of the higher power frequencies, used more and more in aeronautical and marine equipment. They have also been

"ruggedized" to withstand shock, vibration, and environmental tests under MIL-T-945-A specifications.

A rectangular base with corner holes allows attachment to walls and bulkheads without rear access. Better thermal contact between base and coil improves the cooling of the units. Back-to-back mounting of two coils on a single base reduced further the weight and size in gaged assemblies.

The M-2 and M-5 are rated at 2amp and 5amp, respectively, for 115v, 350-1200ey input. Output range is 0-115v or 0-135v, depending on connections. For 0-115v connection, maximum output currents are 3amp and 7.5amp, respectively. Two-gang and three-gang assemblies for multiple-circuit, as well as 3-phase controls, are available, in addition to single units. Special requirements can be considered where standard models are unsuitable. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE ED-87 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial Test Plug

Has 1% Precision Resistor



A simplified, low-cost test plug with an integral test terminal provides the comparability and high accuracy necessary in testing amplifier gain and level in color video systems. It also eliminates undesired reflections and temporary expedients.

This compact single unit features a precision, film-type resistor and an accessible and rugged test terminal. Type No. 259-75, illustrated, includes a Type PL-259 plug with 75-ohm resistor, and is tested to 1% tolerance. Other tolerances, resistance values, and plug types are available. Holland Electronics, Dept. ED, 572 Broome St., New York 13, N. Y.

Holland Electronics, Dept. ED, 572 Broome St., New York 13, N. Y.

CIRCLE ED-88 ON READER-SERVICE CARD FOR MORE INFORMATION

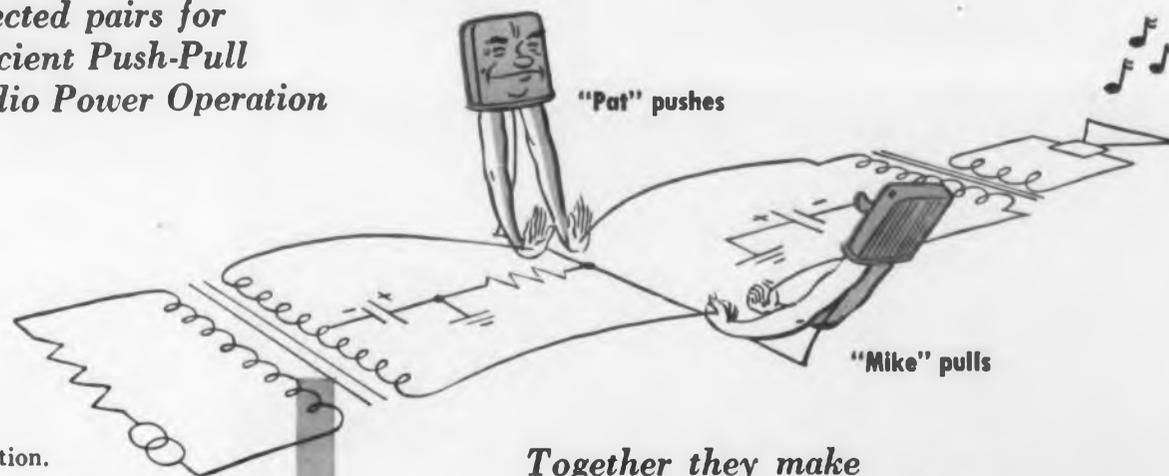
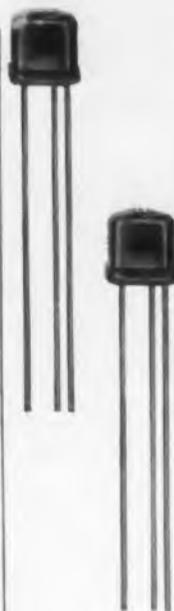
ELECTRONIC DESIGN • February 1955

Radio Receptor

announces the RR106

new type Germanium PNP Transistors

Selected pairs for efficient Push-Pull Audio Power Operation



"Pat" pushes

"Mike" pulls

Together they make "beautiful music"

Featuring:

- ▶ Low distortion.
- ▶ Small, hermetically sealed construction.
- ▶ Low I_{co} .
- ▶ Matched for low distortion and equal current drain.
- ▶ Stable, reliable, long-life performance.

A few of many possible applications:

- ▶ Personal portable receivers
- ▶ Intercoms
- ▶ Servo amplifiers
- ▶ Magamp preamps
- ▶ Portable tape recorders

TYPICAL RR106 OPERATION

See figure 1

collector supply volts	zero signal collector current (total) (1)	max. signal collector current (total) (2)	circuit efficiency (3)	power gain	power output (4)
12	1 ma	25 ma	67%	18 Db	200 mw
9	1 ma	25 ma	67%	17 Db	150 mw
6	1 ma	25 ma	67%	15 Db	100 mw

1. This current level is established by the forward base bias and is essential to minimize distortion at low levels.
2. For rated power output. For normal commercial broadcast service the battery drain averages to approximately 10 ma. A class A amplifier, under similar conditions would drain approximately 37 ma!
3. This is total circuit efficiency and includes transformer losses as well as power dissipated in the emitter stabilization resistor.
4. This rating is established for a maximum harmonic distortion of 10% and for conservative operation at an ambient temperature of 45° C (113° F).

Semi-Conductor Division

RADIO RECEPTOR COMPANY, INC.

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Sales Dept.: D-3 West 19th St., New York 11, N. Y.

Watkins 4-3633

Factories in Brooklyn, N. Y.



We also manufacture Selenium Rectifiers and Silicon and Germanium Diodes.

CIRCLE ED-89 ON READER-SERVICE CARD FOR MORE INFORMATION

30 Years of Leadership

POTTER Capacitors



1955.

... marks the Thirtieth Year that The Potter Company has devoted its efforts to the design and construction of special capacitors to meet specific customer application... so

If your product reputation hinges on dependable performance of quality components —

SPECIFY POTTER CAPACITORS

If you need flexible production facilities for capacitors engineered to fit your needs —

SPECIFY POTTER CAPACITORS

Write today for Free Catalog of the complete Potter Line of Capacitors and Radio Noise Filters. Address Department C.



THE
potter
COMPANY

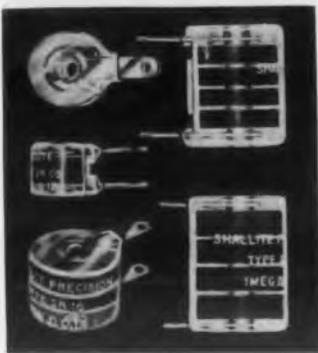
SPECIALISTS IN
FIXED PAPER
CAPACITORS
SINCE 1925

1950 SHERIDAN ROAD
NORTH CHICAGO, ILL.

CIRCLE ED-90 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistors

With Transparent Encapsulation



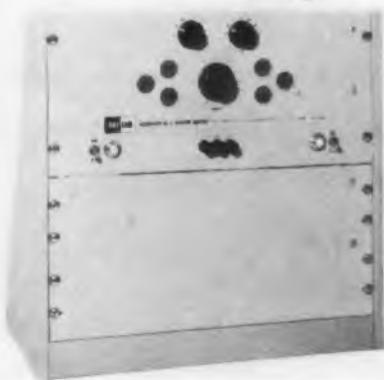
These precision wire wound resistors are encapsulated in a transparent material. The new resistors include such features as mechanical fastening, electric welding of all wire, leads, and the phosphor bronze terminals—all being completely visible through the transparent

encapsulation. They are designed to meet the requirements of Government specifications JAN-R-93 and MIL-R-93A. Shallite, Inc., Dept. ED, 10 Mill St., Paterson 1, N. J.

CIRCLE ED-91 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Replaces Storage Cells



Model 3B-200 d-c power supply is designed to provide a low voltage, high current power source for laboratories. Specifically, it is designed to replace automobile and aircraft-type storage batteries which are normally

used in tests and in various instrumentation applications.

The unit employs this company's absolute d-c power supply circuitry which constantly compares the output voltage against a standard cell and maintains the long time stability and accuracy of a standard cell. It provides an absolutely calibrated, high powered standard cell source from 2v to 30v. Output voltage is varied in calibrated 1 v steps. Between steps, it is varied with a potentiometer. Output current is 2amp. The unit maintains long time stability of 0.01% and short time stability better than 50 parts per million per hour.

Other specifications include: output voltage, 0.02%; output hum and noise, under 0.5mv; line regulation, $\pm 0.002\%$ for a $\pm 10\%$ line voltage change; load regulation, $\pm 0.01\%$; output impedance, 0.1 ohm at d-c, under 0.5 ohm for a-c up to 10ke; input, 105v to 125v, 60cy, single-phase. Kalbfell Laboratories, Inc., Dept. ED, P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.

CIRCLE ED-92 ON READER-SERVICE CARD FOR MORE INFORMATION

Giannini

DIGITAL COMMUTATORS

Codes: Binary, Binary-Grey,
Binary-Decimal with
non-ambiguous outputs



Immediate Delivery from stock
on standard models having
following characteristics:

- 1,000 counts decimal (300° to 360°)
- 1024 counts—binary, grey (300° to 360°)
- torque—0.5 oz. in ball bearings
- inertia—400 gm. cm²
- micrometer zero adjustment
- automatic alignment—no gears

CUSTOM COMMUTATORS

Commutators can be furnished to fit specific applications by either modification of standard models or wholly new designs.

Some variations now available are:

- non-linear coding
- high-count multi-turn units
- ultra low torque models
- miniature size, geared units
- direct decimal coding

G. M. GIANNINI & CO., INC.

LABORATORY APPARATUS DIVISION
PASADENA 1, CALIFORNIA

Offices: New York: Phone Judson 6-7500
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Giannini

CIRCLE ED-93 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 1955

MISSILE SYSTEMS

*Physicists
and
Engineers*

New developments at Lockheed Missile Systems Division have created positions for physicists and engineers of outstanding ability in:

RADAR • COMPUTERS
SYSTEMS ENGINEERING
ANTENNA DESIGN
COMMUNICATIONS
TELEMETERING
MECHANICAL ENGINEERING
ELECTROMECHANICAL DESIGN
TEST EQUIPMENT DESIGN
INSTRUMENTATION
NUCLEAR PHYSICS
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MISSILE SYSTEMS DIVISION

*research
and
engineering
staff*

LOCKHEED AIRCRAFT
CORPORATION

VAN NUYS • CALIFORNIA

CIRCLE ED-94 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 1955

Toroidal Winder Makes Coil Winding Easy



This simple toroidal coil winder is a useful device for the design laboratory. It handles AWG No. 26 to No. 44 wire. Minimum finished hole size is 0.18", with maximum OD of

4". Layer, bank, or scrambled windings can be obtained at will. Speeds up to 1500 turns per minute are selected by either hand or foot control.

It is possible to change wire size and select the required tension in less than 30sec. Any one of the three sizes of winding rings provided can be installed, loaded, and winding can be begun in under one minute.

A separately housed counter has positive escapement action, which eliminates overshoot and partial tripping, even at 1500 counts per minute. Arnold Magnetics Co., Dept. ED, 5962 Smiley Dr., Culver City, Calif.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay Adjustable and Sealed



These time delay relays provide all the features of hermetically-sealed units and also permit adjustment of the time delay period. This feature is accomplished by coupling the standard adjustable type unit to a hermetic rotary seal. The timer is thus totally enclosed in

the hermetic housing and can be adjusted after sealing with a convenient knurled knob.

Time delay periods can be supplied from 2sec to 2hr. The large calibrated dial is read through a glass window and allows settings to be varied over an 8:1 range in small increments. These units are designed to meet military specifications and can be supplied for operation on d-c or a-c power supplies. One or more switches can be incorporated, and electrical connection can be made with either an AN connector or a glass-metal header. Bracket or stud mounting can be supplied. A. W. Haydon Co., Dept. ED, 240 N. Elm St., Waterbury, Conn.

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION

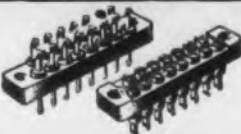
new...
precision

Continental Connectors*

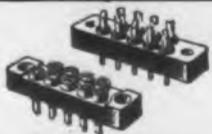
simplify your connector problems



SERIES "E-Z 16" EASY RELEASE

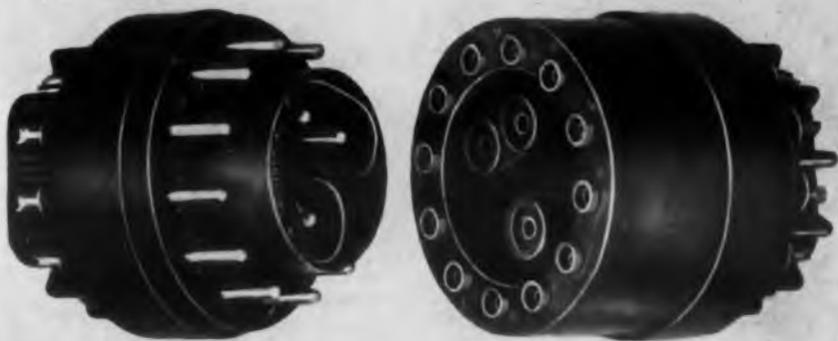


SERIES "16" POWER



SERIES "14" POWER

NEW SERIES 800 HIGH VOLTAGE FOR AN-36 SHELL



High Voltage Connectors with 15 Contacts

This new connector is designed for critical high voltage applications, and use with AN-36 fittings. Three high voltage center contacts are easily removed to permit more convenient wiring. Outside contacts are available in choice of two sizes to accommodate #16 or #20 AWG wire.

Precision machined socket and pin contacts of spring temper phosphor bronze and brass respectively, are gold plated over silver for low contact resistance and easy assembly soldering. Insulating materials are mineral filled Melamine, Plaskon Reinforced (glass) Alkyd 440 or Diallyl Phthalate — mineral or orlon filled.

For complete illustrated engineering literature, and assistance on special or unusual connector problems, write Dept. DNHV9, DeJur Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, New York.

Electronic
Sales
Division

DeJUR

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.

*World's largest manufacturers of miniature precision connectors

CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION

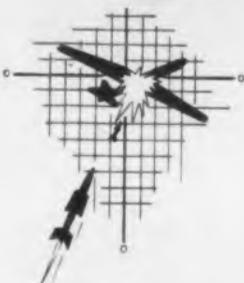
1 component fits 10 exacting applications



Each new military and industrial control system is different, but they all have certain common requirements — precise control performance ... rugged construction to withstand extreme operating conditions ... absolute minimum size and weight ... and complete dependability.

Best answer to the problem is the Keystone "Moto Mag" magnetic amplifier, an unusually flexible component designed to meet unique demands in a wide variety of control applications. Available in 7 standard models ... each can be modified to meet special requirements. All units are made in accordance with MIL specs.

TYPICAL MOTO MAG APPLICATIONS



GUIDED MISSILES



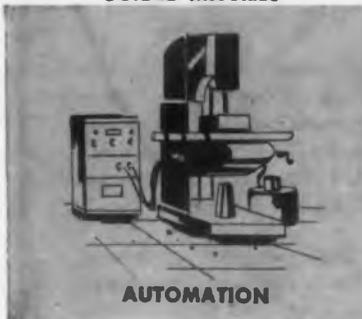
COMPUTERS



AUTOMATIC PILOTS



RADAR CONTROL



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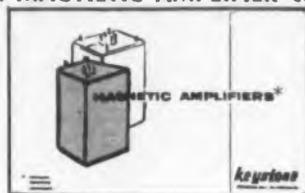
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PRODUCTS COMPANY

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CIRCLE ED-98 ON READER-SERVICE CARD FOR MORE INFORMATION

Integrating Element Analog to Digital Converter



The "Anadige", Model I-101, is an analog-to-digital integrator in which the integral of the analog information is converted to a discrete number of pulses. This digital integrator has a resolution of one part in 60,000 and consequently is capable of a degree of accuracy that electrical or mechanical analog

techniques cannot readily provide.

Maximum integrating rate is 60,000 counts per second, adjustable by a chassis potentiometer. Input and output impedances are nominally 1 megohm. Source impedance may range from 1 ohm to 1 megohm, so that strain gages, photocells, thermocouples, etc. may be accommodated. Maximum input signal is 2v.

Of plug-in base construction, the unit is approximately 4" x 1-1/2" x 5". It requires three d-c supply voltage levels and a regulated 6.3v, 0.9amp a-c supply. Mega Research, Dept. ED, P. O. Box 371, Dover, N. J.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicone Compound For High-Temperature Parts



This glass-filled silicone "301" compound produces parts which may be pulled hot without cooling the mold. Afterbaking is unnecessary except where parts

are to carry a load at high temperatures. Properly molded parts will withstand continuous exposure to 450°F, plus intermittent exposure to as high as 700°F.

Typical properties after molding 10 minutes at 340°F include a tensile strength of 5,000-7,000psi, a compressive strength of 10,000-12,000psi, and an impact strength of 15-22 ft-lb/in. Flexural strength ranges from 12,000-14,000psi at room temperature and 5,000psi at 392°F.

The compound may be molded with conventional equipment by either compression or transfer techniques. Mold shrinkage ranges from zero to 0.0035%. Finished parts may be machined with high speed tools. Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE ED-100 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Bobbin Cores

Offered in Wide Line



A complete line of "Performance Guaranteed" Bobbin Cores, especially suitable for use as memory cells for electronic computers, is offered by this firm. The cores are wound on small ceramic bobbins with ultra-thin magnetic tapes. Tapes generally are made

of 4-79 Mo Permalloy or Orthanol, but may also be made of 48 Alloy or Magnesil. They range in thickness from 0.001" down to 0.000125", and from 1" down to 1/16" in width.

These cores are made of ultra-thin tape, and have very rectangular hysteresis loops under pulse conditions. Because of this characteristic and the ability of the small core to switch from positive to negative saturation in a very few microseconds, they can be used as memory cells. The use may be in the form of a shift-register, a coincident-current matrix, switching cores, a core-diode memory system, harmonic generators, or pulse transformers.

The cores also feature temperature stability, low coercive values, and high saturation densities. Magnetics, Inc. Dept. ED, Box 230-T, Butler, Pa.

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillograph

Records up to 60 Channels



The 700C oscillograph for dynamic data recording is available in two models; one which records up to 36 channels on 8" wide recording media, and another which provides up to 60 channels using 12" wide paper. Record speeds as high as 114ips or as low as 0.030ips are made readily available through

rapid change gears. In addition, any one of four separate record speeds with automatic recording intensity control, may be selected from the operating panel even while a record is in progress. This permits "jump speeds" having 2:1, 4:1 and 8:1 ranges. Remote operation of jump speed is standard.

A new optical system provides more than adequate recording intensity for the highest writing speeds. Provision is made for operation of the same instrument from 28v d-c, 115v, 60cy, or 115v 400cy power. Heiland Research Corp., Dept. ED, 130 E. Fifth Ave., Denver, Colo.

CIRCLE ED-102 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

ANNOUNCING

EXTRA PREMIUM PERFORMANCE

in a new line of reliable tubes built to CLOSE DESIGN CENTERS



SYLVANIA MILITARY CONTROL SUBMINIATURE TUBES

From the leading pioneer in the development of tubes for reliable use comes a new line of extra premium performance tubes—Sylvania Military Control subminiatures. Built to twice-tightened tolerances and tested under sampling plans of high discriminating power, these Sylvania subminiature tubes meet the most stringent specifications for tubes used by the Armed Forces in guided missiles, modern aircraft, and other military equipment.

Ruggedized to withstand shock tests at 500 G, Sylvania extra premium performance subminiatures offer maximum reliability under severe environmental conditions.

Important tube-design advancements im-

proving every critical element have been incorporated in Sylvania Military Control subminiatures. New manufacturing techniques have been developed to produce the most rugged tube ever built, and all-point quality control methods have been innovated to guard against catastrophic failures.

Only Sylvania, with integrated facilities which provide complete control of all parts from raw materials to finished product, could initiate the high quality and performance standard of these extra premium performance tubes.

New technical bulletin reveals complete design details, testing methods and manufacturing facilities for Sylvania Military Control subminiature tubes. Write for it.

Here is the complete line of Sylvania Military Control (extra premium performance) subminiature tubes

5636A..... Pentode Mixer	5840A/6205A..... Sharp Cut-off Pentode
5639A..... Video Output Pentode	5896A..... Double Diode Detector
5641A..... Rectifier	5899A/6206A..... Semi-Remote Cut-off Pentode
5643..... Thyatron	5902A..... Audio Power Pentode
5644A..... Voltage Regulator	5977A..... Low Mu Triode
5647A..... T-1 Detector	6021A..... Medium Mu Double Triode
5718A..... Medium Mu Triode	6110..... Double Diode Detector
5719A..... High Mu Triode	6111A..... Low Mu Double Triode
6112A..... High Mu Double Triode	

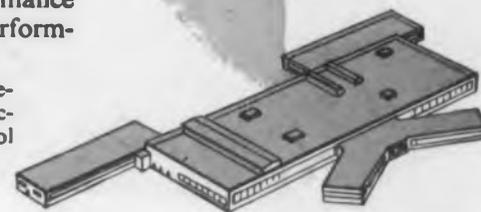


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CIRCLE ED-103 ON READER-SERVICE CARD FOR MORE INFORMATION



Sylvania's new plant in Burlington, Iowa, is devoted exclusively to the design and production of subminiature tubes.

Sylvania Electric Products Inc., Dept. B 22P,
1740 Broadway, New York 19, N. Y.
Please send Technical Bulletin on Sylvania Military Control subminiature tubes.

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CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration Isolators

For Airborne Gear



Miniature "All-Metal" Series M 24 Mounts are vibration isolators for mounting airborne gear. They meet stringent military specifications, including the ability to maintain a damping and isolation effectiveness at temperature extremes (actually tested from -60° to $+175^{\circ}\text{C}$).

Attachable directly to the equipment, saving weight and space, they can be incorporated into mounting bases, or, because of their minute size, used internally.

Designed to protect airborne equipment from vibration, the M-24 measures 1" high, is constructed of metal exclusively, and affords excellent vibration isolation above 15cy. Mounts are available in four series, all of which have the same load ratings (ranges covering from 0.9 lb to 3.0 lb) and performance.

The mount contains a stainless steel spring which supplies the resilience and deflection necessary for isolation. A formed wire mesh snubber cushions those shocks which are large enough to bottom the load-carrying spring. Damping is obtained by the friction between the core's inside and the wire mesh cylinder. Barry Corp., Dept. ED, Watertown, Mass.

CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer

In Linearities to $\pm 0.05\%$



Model 85175 is a low-cost, infinite resolution, slide-wire "Spiralpot". This 1-1/2" diam potentiometer has a standard 3/8" threaded bushing for panel mounting

and a locating pin, and can be used as a direct potentiometer replacement for applications requiring "step-less" potentiometer operation.

The Model 85175 is available in standard 3-turn or 10-turn models, with resistance ranges of 6 ohms to 2500 ohms, and linearities of $\pm 0.1\%$ and $\pm 0.05\%$. These units feature long life with low operation noise because of the true slide wire action. Additional specifications are: power rating, 5w for a 10-turn unit; torque, 2 oz-in or less; and weight, 4 oz. G. M. Giannini & Co., Inc., Dept. ED, 918 E. Green St., Pasadena 1, Calif.

CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

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A.C. servo and computer components



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Induction Resolvers



Size 15

Brushless Induction Potentiometers



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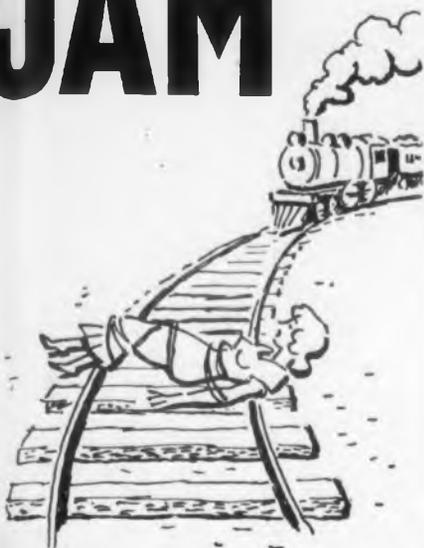


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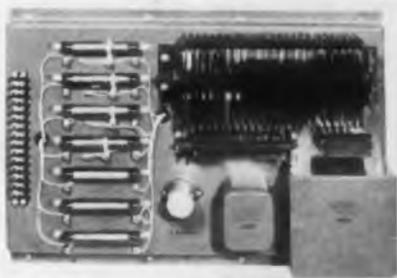
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Telephone Lincoln 4-7220

CIRCLE ED-107 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 1955

Magnetic Amplifiers For Voltage Regulation



This company has introduced a line of magnetic amplifiers for voltage regulation. One unit, Model S-1446, is rated for 10kva, 115v, 400cy, single-phase alternators. It features

1% regulation from no-load to full load, and will withstand 150% overload. Recovery time is 0.3sec. It is encapsulated and hermetically sealed, and is moisture and fungus resistant.

Another unit, Model S-1442, is designed for 115/208v, 400cy, 3-phase alternators. It operates into a high impedance field, and is 3-phase sensing. Other magnetic amplifiers are built to specifications. Acme Electronics, Inc., Dept. ED, 2724 South Peck Rd., Monrovia, Calif.

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Tachometer Generators Weigh Less Than 3 oz



This line of d-c tachometer generators incorporates a permanent-magnet field assembly. These generators feature small size: overall body

length is less than 1-1/2", and they have a weight of less than 3 oz.

Although used principally as a rate generator in servo systems, these units have many other uses. When combined with a standard 1000ohm/v voltmeter, they make an excellent direct-reading tachometer. They can be used as under- or over-speed indicators, speed synchronizing controls, and in similar applications.

The output voltage is controlled to within 1% of the same value for either direction of rotation. Each unit is individually tested prior to shipment, including testing by oscilloscope for minimum ripple component. Models are available with an output of 2.5v per 1000rpm as well as with 7v per 1000rpm. A flange mounting arrangement is usually used, although a synchro type mount is available without additional charge. Servo-Tek Products Co., Inc., Dept. ED, 1086 Goffle Rd., Hawthorne, N. J.

CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION

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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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HE-24-20

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CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

High Fidelity Headphones

With 50-10,000cy Range



S. G. Brown precision headphones are now available in the United States in two types. The first is the High Fidelity Type K or Professional Headphone (illustrated) — actually two miniature high-fidelity dynamic loud-speakers, designed to reproduce the full orchestral range from 50cy to over 10,000cy. The unit can be connected to any sound system, amplifier, radio, phonograph, tape recorder, or similar equipment. It comes complete with foam rubber ear cushions and a highly flexible 6-1/2" one-piece, rubber-covered connecting cord, with molded rubber crotch.

The other design is the Type A headphone, which is especially designed for code reception. A 1000cy high permeability-tuned reed directly coupled to a conical aluminum diaphragm peaks these headphones at the usual modulation frequency, thereby causing a rise in sensitivity to code signals. Each earpiece incorporates an adjustment for sensitivity or power-handling characteristics while the phones are in use. British Industries Corp., Dept. ED, 164 Duane St., New York, N. Y.

CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

Timer

Maintains 1% Accuracy



The Model T2, a precision general purpose electronic timer, is designed for interval timing, timed delay, repeat cycling, programming, or pulsing. Because of its special circuit design, the timer maintains 1% accuracy over line voltage variations of 90-135v. Thus, it is particularly suitable for industrial application where such variations may be present and would normally impair accurate timing.

The timer is designed for use on process timing, sequence control of automatic equipment, induction heating equipment, conveyors, machine tools, injection molding machines, packaging and filling machines, and similar units. Features include three time ranges of 0.1-1sec, 1-10sec, 10-100sec; direct-reading time dial; and two spdt load contacts with 8amp ratings. Ferrara, Inc., Dept. C-3, 8106 W. Nine Mile Rd., Oak Park 37, Mich.

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Insulation Ohmmeters

In Ranges to 500×10^{12} Ohms



A complete line of insulation measuring instruments, "Tera-Ohmmeters", with a maximum sensitivity of 500 teraohms (500×10^{12} ohms), necessary to cover modern insulation materials, has been made

available for laboratories, quality control, and field work. The various types available have sensitivities ranging from 0.2 megohm to 500×10^{12} ohms. They provide fixed test voltages of 10v, 100v, or 500v, one model having a variable test voltage of from 100v to 1000v. Test samples can be measured grounded, ungrounded, or with guard-ring electrodes, and operation is from line or self-contained batteries.

Accuracy is $\pm 3\%$ in center of scale for all ranges. Applications include testing of resistors, capacitors, cables, switches, tube sockets, transformers, and many other components. Surface conditions and hygroscopic behavior of material can also be investigated with this instrument. Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N. J.

CIRCLE ED-114 ON READER-SERVICE CARD FOR MORE INFORMATION

Coupling

Permits Slight Misalignment



Type No. T2 precision Oldham couplings are designed for medium speed operation and permit a slight angularity and misalignment of two shafts. The units have a high torque shaft-to-

shaft coupling with zero backlash. Units are stainless steel throughout, and all parts are clear passivated to military standards.

There are three basic shaft sizes: 1/8", 3/16", and 1/4" diam. The design includes stainless steel set screws for holding, and sub-drill holes for fixed pinning, as desired. As many as six different shaft-to-shaft combinations are available. PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-115 ON READER-SERVICE CARD FOR MORE INFORMATION

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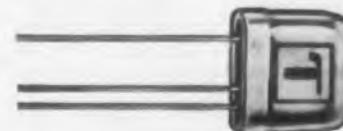
Transitron®

P-N-P JUNCTION TRANSISTORS WITH VACUUM HERMETIC SEALING

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COMPUTER TYPES

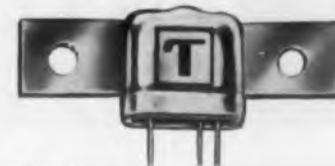
Less than 1 microsecond is required to switch 100 ma collector current with type 2N92. Smaller collector currents can be switched efficiently with type 2N91. Careful manufacturing and conservative ratings insure reliability in excess of vacuum tubes.



1 1/2 x actual size

MEDIUM POWER TYPES

For applications requiring up to 750 milliwatts dissipation and alpha cutoff up to 1 megacycle, the type 2N85 and 2N86 are ideal. They provide a linear transfer characteristic up to 20 ma collector current and can be operated at ambient temperatures up to 75°C.



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HIGH POWER TYPES

The 2N83 and 2N84 are intended for high-power applications and are conservatively rated at 10 watts dissipation. A Class B amplifier using these types would be capable of 5.0 watts output at 60°C. The 2N83 is comparable electrically to the 2N57.



3/4 actual size

SUBMINIATURE TYPES

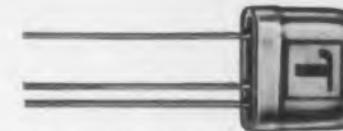
Types 2N88, 2N89, and 2N90 are especially useful where small size and excellent low level performance is desired.



actual size

STANDARD TYPES

A wide variety of RETMA types including the 2N34, 2N43, and 2N65 are available for most general purpose applications.



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Transistors



Power Transistors

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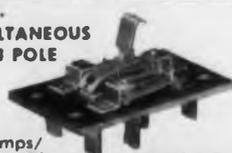
15 amps/125V AC

S3000-MINIATURE



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Write for catalog, price list and the name of your nearest stocking Erie-Chemelec Electronic Parts Distributor.



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CIRCLE ED-118 ON READER-SERVICE CARD FOR MORE INFORMATION

Compact Power Supply Magnetic Amplifier Regulated



The "Stabvolt" Model MRP-15D-0.2 is a tubeless magnetic-amplifier-regulated power supply for airborne application. This d-c power supply has been designed for the compactness, ruggedness, and reliability required in aircraft, drone, and missile applications. For use in servo systems for positioning potentiometer circuits which require a precise center tap, it eliminates the need for batteries and provides an output voltage with a precise differential regulation. By utilizing dual magnetic regulation circuitry, the output voltage is practically free of line transients.

Output is plus and minus 15v at 0.2amp for each channel. The -15v channel is slaved to the +15v channel to provide a precise differential regulation of 0.25% for combined changes in line voltage from 105v to 125v, line frequency from 380cy to 420cy, load change of $\pm 10\%$, and temperature from -55° to $+71^{\circ}\text{C}$. The unit operates from 115v, 400cy line. Ripple is less than 0.1%.

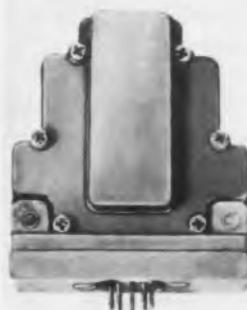
Self-protecting from external overload and short circuits, with no fuses required, the unit is hermetically sealed in a steel can and conforms to MIL-T-27 specifications. Dimensions are 4-5/16" x 3-11/16" x 4-1/2". Magnetic Research Corp., Dept. ED, 200-202 Center St., El Segundo, Calif.

Self-protecting from external overload and short circuits, with no fuses required, the unit is hermetically sealed in a steel can and conforms to MIL-T-27 specifications. Dimensions are 4-5/16" x 3-11/16" x 4-1/2". Magnetic Research Corp., Dept. ED, 200-202 Center St., El Segundo, Calif.

CIRCLE ED-119 ON READER-SERVICE CARD FOR MORE INFORMATION

Chopper

Has Low Residual Noise



modulator/demodulator circuits possible.

Connection is through a nine-pin miniature header. The height of the chopper is 2-15/16"; width 2-5/8"; and depth, 1". James Vibrapowr Co., Dept. ED, 4036 N. Rockwell St., Chicago, Ill.

CIRCLE ED-120 ON READER-SERVICE CARD FOR MORE INFORMATION

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Leakage path is increased—direct shorts from frayed terminal wires prevented by bakelite barriers placed between terminals. Binder screws and terminals brass, nickel-plated. Insulation, BM 120 molded bakelite. Finest construction. Add much to equipment's effect.

Jones Means Proven Quality



Illustrated: Screw Terminals—Screw and Solder Terminals—Screw Terminal above Panel with Solder Terminal below. Every type of connection.

Six series meet every requirement: No. 140, 5-40 screws; No. 141, 6-32 screws; No. 142, 8-32 screws; No. 150, 10-32 screws; No. 151, 12-32 screws; No. 152, 1/4-28 screws.

Catalog No. 20 lists complete line of Barrier Strips, and other Jones Electrical Connecting Devices. Send for your copy.



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CAPACITORS



Capacitances up to 30 mfd. at 6 volts are compressed into sub-miniature case only $\frac{7}{32}$ " in diameter by $\frac{3}{8}$ " long, with temperature range from -55°C. to $+85^{\circ}\text{C.}$ Ultra-miniature Type TAW, rated 1 and 6 mfd. at 4 volts is only 0.145" in diameter by $\frac{3}{8}$ " long.

For complete technical data, write to P. R. MALLORY & CO. INC., Indianapolis 6, Indiana.

*Trade Mark



CIRCLE ED-123 ON READER-SERVICE CARD

Taper Pin Terminals
In Four Types



Four taper pin terminals have been added to the line of electronic hardware of this firm. Included are double-end taper, taper from front, taper from back, and taper from front with blind hole. Sizes are

available for standard terminal board thicknesses; or special terminals may be ordered to specification. The new pins are of half-hard brass bar, with copper flash and electro-tin plate finish. Lynn Electronic Research Co., Dept. ED, 501 South Varney St., Burbank, Calif.

CIRCLE ED-124 ON READER-SERVICE CARD FOR MORE INFORMATION

Electro-Mechanical Amplifier
For Servo Applications



The Series 10 electro-mechanical amplifier, for servo motor applications, is designed for use as a motor control for computers and calculators, guided missiles, radar equipment, aircraft, and numerous other general and precision applications.

By means of this amplifier, a relatively small amount of power (50mw to 100mw) can control a large motor. The device features proportional control of the output shaft, which will rotate clockwise or counterclockwise as desired.

A combination of planetary gearing and stationary dry magnetic clutches eliminates powder packing and slip rings, while the use of commercial gears eliminates the need for costly close tolerance gears. By the choice of various gear ratios, a variety of output shaft characteristics may be obtained.

Zero backlash and high torque to inertia make the unit ideally suited for high speed servomechanisms. It has a minimum of overshooting. Rated at 5 in-lb torque at 60rpm, it is available for most standard line frequencies and voltages as well as in a variety of gear ratios. Size is 2-1/4" diam x 4-7/8" long, and weight about 3 lb. Electomic Designs, Dept. ED, Greenwich, Conn.

CIRCLE ED-125 ON READER-SERVICE CARD FOR MORE INFORMATION

precision instruments by DeJUR



ACTUAL SIZE

There's
"big meter"
precision in
this Series 100

SEALED SUBMINIATURE METER

Now you can specify this tiny, light weight instrument and still get $\pm 3\%$ accuracy over full scale.

Imagine, 9 precision meters take only 3 $\frac{3}{8}$ square inches of space! Yet you do not sacrifice the accuracy of larger meters. The subminiature series 100 uses an extremely accurate external pivot D'Arsonval movement and special "O" ring and locknut for watertight, single hole mounting. (Square model available on special order)

Our Engineering Department can supply prototypes quickly to meet unusual design specifications for tests and approval. Write for complete technical literature. No obligation.

DeJUR

DeJUR sealed and ruggedized panel instruments are also available in 1 $\frac{1}{2}$ " , 2 $\frac{1}{2}$ " , 3 $\frac{1}{2}$ " , and 4 $\frac{1}{2}$ " sizes. Send us your requirements and we will submit our quotations.

ELECTRONIC SALES DIVISION • DeJUR-AMSCO CORPORATION
45-01 Northern Blvd., Long Island City 1, New York

"You're always sure with DeJUR instruments."

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

MORE ~~ACTION~~

IN SMALLER

SNAP-~~ACTION~~

SWITCHES

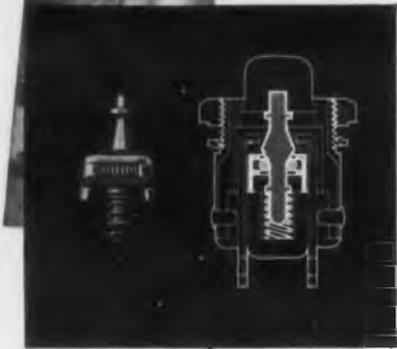
To Hetherington engineers, snap-action in a switch means a whole lot more than a little detent action accompanied by a loud "click". Thus, in every Hetherington snap-action switch, whether for push button, toggle, or rotary operation, the patented beryllium mechanism shown here provides four definite advantages:

... an exceptionally positive snap-action that makes it impossible to "tease" the switch ON or OFF contact.

... lightning-fast contact make or break for reduced arcing. (Hetherington switches are smaller, carry higher ratings because of this unusually fast action.)

... the "snap" and the contact make or break are simultaneous. (Deceptive "clicks" or "snaps" just can't occur with the Hetherington snap-action mechanism).

... highest quality construction—polished taper, beryllium copper springs, contacts and terminals of copper with heavy silver overlay—all designed for a minimum life of 50,000 cycles under rated load.



also...

Indicator lights • Switch-In-
indicator light combinations •
Relays • Aircraft and
Electrical Equipment
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CULVER CITY, CALIF.

Transmission Lines

In Ruggedized, Smaller Versions



Ruggedized versions of the "Uniline" effective unidirectional microwave transmission line are now available. "Unilines" apply

the Faraday rotation properties of ferrites at microwave frequencies. They provide highly effective isolation between source and load without the requirement of external power source or supplementary equipment, and with negligible loss of transmitted microwave power.

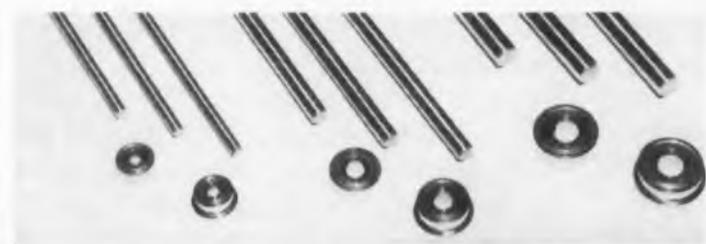
Completely new, ruggedized construction extends the field of utility of this device to applications where severe shock and vibration are prevalent. A substantial reduction in physical size opens up possibilities for installation in existent microwave systems without modification of the latter.

These units are well suited for use in aircraft and missiles, for mobile and fixed microwave communication equipment. Models can be supplied modified for use in pressurized systems. Special design features permit them to be used in high temperature environments, for example, as an effective load isolator in conjunction with klystrons operating in thermally stabilized enclosures. Operating temperature range is -55° to $+180^{\circ}$ F. Five models are available for 9.6-10.4kMc, 8.8-9.6kMc, 6.9-7.4kMc, 6.4-6.9kMc, and 5.9-6.4kMc. Cascade Research Corp., Dept. ED, 53 Victory Lane, Los Gatos, Calif.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

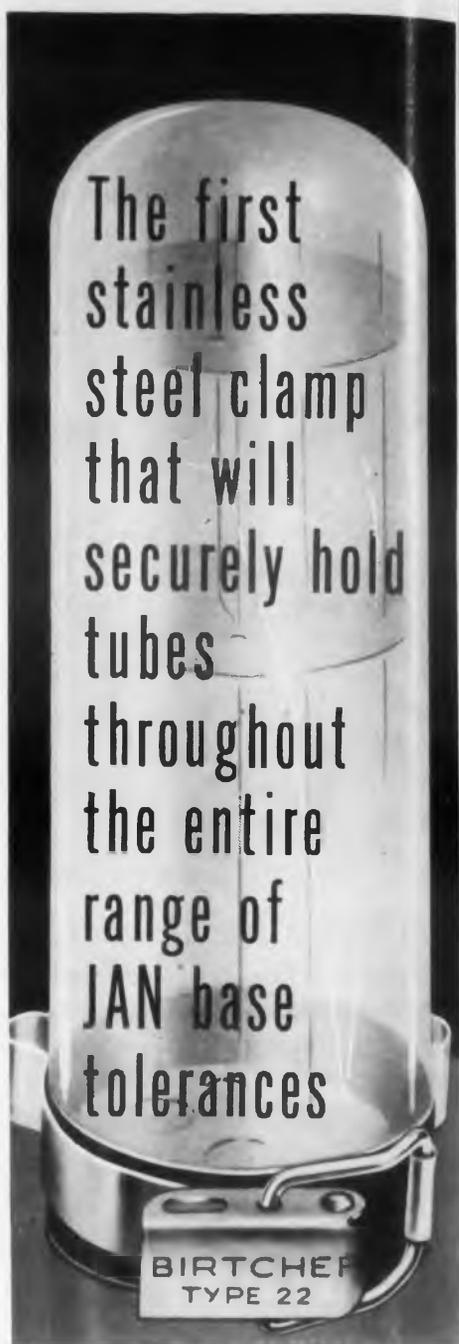
Shafting

Precision Ground to $\pm 0.0001''$



Type "A" precision ground shafting is designed to fit with the inch-series "Barden" precision ball bearings of ABEC-7 quality. This shafting is immediately available from stock in three basic shaft sizes: $1/8''$, $3/16''$, and $1/4''$ diam, and in lengths up to 16" long in $1/8''$ steps. Shafting is centerless, ground to a tolerance of $\pm 0.0001''$. Special shafts can be made on request. PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION



The first stainless steel clamp that will securely hold tubes throughout the entire range of JAN base tolerances

JAN Specs allow a full .040 tolerance in tube base diameters—and the BIRTCHER TYPE 22 is the ONLY tube clamp that fits over this entire allowed size range! Special dual-tension-loop construction, using type 302 stainless steel, guarantees a minimum of 4 POUNDS retention on the minimum diameter tube base—even after the clamp has been used for some time on a maximum size base!

This means easier assembly, quicker maintenance, less tube breakage, and more gripping power. YOU CAN'T SHAKE 'EM LOOSE.

SEND FOR CATALOG ED-2-55

The BIRTCHER CORPORATION
4371 Valley Blvd. Los Angeles 32, California

CIRCLE ED-130 ON READER-SERVICE CARD

Electronic Switch

With 12 Channels



The Model 19 12-channel Electronic Switch provides a convenient, economical method for displaying 12 separate signals on a conventional single-gun cathode

ray tube. Designed to work into any commercially available oscilloscope having provisions for z-axis blanking, this unit greatly extends the general laboratory uses of the cathode-ray-tube oscilloscope.

The switch consists of 12 individual d-c amplifiers gated sequentially by a ring oscillator. Each gate is open about 25microsec at a sampling rate of 2300ey. The gated amplifiers, being d-c, have a handpass from d-c to about 100ke. Thus, the highest frequency that can be displayed is limited only by the sampling rate. Each base line may be individually positioned on the screen, permitting maximum flexibility in the use of the switch. It operates from 100v, 60ey a-c. Century Geophysical Corp., Dept. ED, 1333 N. Utica, Tulsa, Okla.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Frequency Meters

Provide Direct Readings



The "FXR" Type 410A frequency meter is designed to indicate frequency directly and accurately. Through the proper choice of mode and design, the high Q resonant cavity provides the convenience precise, direct readings.

These high-Q cavity meters act as reaction units when coupled to the narrow side of the waveguide and create a nominal 30% absorption dip in the transmitted power. A non-contacting choke tuning plunger provides long service-free life at peak performance. At room temperature, the frequency is indicated to an accuracy of 0.08%. The Q is approximately 10,000 for a frequency meter with a mean frequency of 10kMc.

The unit has no backlash, and smooth operation is assured by the use of a precision spring-loaded drive screw and nut. Three models are available. Electronics & X-Ray Div., Dept. ED, F. R. Machine Works, Inc., 26-12 Borough Pl., Woodside 77, N. Y.

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955



THE INDUSTRY'S FIRST AIR FORCE TRANSISTOR

Now Available!

● G.E.'s NEW Junction Transistor, 2N43A, is the first to be written into Air Force specifications! MIL-T-25096 (USAF) was actually written around this G-E product developed for the Military. It meets the most rigorous requirements on electrical and mechanical characteristics, and reliability. Spread in beta (gain) is held to a 2:1 ratio—far narrower than for ordinary transistors.

Designed for mass production at low cost, this P-N-P transistor offers performance characteristics second to none! It is the completely dependable audio amplifier for *commercial* and *military* applications. Include it in your design plans now while production lots are rolling through the assembly line.

For complete specifications and details on applications write today. *General Electric Company, Section X7425, Germanium Products, Electronics Park, Syracuse, New York.*

DESIGN FEATURES:

- EXCEPTIONALLY HIGH BETA (GAIN)**... and spread is held to 33-66.
- STURDY CONSTRUCTION**... built to comply with rigorous vibration and shock requirements. Welded seam keeps transistor free from solder-flux contamination.
- SEALED JUNCTION**...contamination gases permanently eliminated!
- HIGH POWER OUTPUT**...case design makes possible a collector dissipation of 150 MW.
- HERMETIC SEAL**...unaffected by moisture.
- HIGH TEMPERATURE OPERATION**...rated for a maximum junction temperature of 100°C.
- LONG LIFE**...stable performance throughout the life of your equipment.
- SMALL SIZE**...extremely compact design provides added flexibility for all applications.



THE MILITARY DESIGN
USAF-2N43A per specification
MIL-T-25096

●
COMMERCIAL DESIGN - 2N43A
Absolute Maximum Ratings:

Collector Voltage (Referred to base)	-45 volts
Collector Current	-50 ma
Emitter Dissipation	25 mw
Collector Dissipation	150 mw
Storage Temperature	100°C
Collector Cutoff Current (-45 V)	-10 microamps

Electrical Characteristics, Common Base

($V_c = -5V$, $I_b = 1$ ma, $T = 25^\circ C$)

Input Impedance (h_{11})	30 ohms
Output Admittance (h_{22})	1.0 μ hos
Feedback Potential Ratio (h_{12})	4×10^{-4}
Current Transfer Ratio (h_{21})	0.9775

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6 Instruments in 1

without
plug-ins!



BERKELEY Model 5571 Frequency Meter

Another BERKELEY first! Model 5571 offers for the first time the combined functions of six instruments in one compact, light weight unit—without plug-ins. Additional features include:

1. 0-42 mc frequency meter (extendable to 515 mc)
2. Frequency ratio meter
3. 0-1 mc period meter
4. 1 μ sec to 10,000,000 sec time interval meter.
5. 0-2 mc events-per-unit time meter.
6. 1 mc counter

features

- Frequency range extendable to 515 mc
- Direct-coupled input amplifiers
- Direct connections to digital printer, digital-to-analog converter, or data converters for IBM card punches, electric typewriters or telemetering systems
- Provision for external frequency standard input
- Coupling to WWV receiver
- Relay rack mounting if desired

CONDENSED SPECIFICATIONS

Frequency Meas. Range:	0 cycles to 42 mc
Time Interval Meas. Range:	1 μ sec. to 10 ⁷ seconds
Period Meas. Range:	0 to 1 mc (Period x 10, 0 to 100 kc)
Input Requirements:	0.1 v. peak to peak
Time Bases:	Frequency: 0.000002 to 20 seconds, decade steps. Time Interval and Period Meas: 1 mc to 1 cps, decade steps
Accuracy:	± 1 count of unknown (or time base) \pm crystal stability
Crystal Stability:	Temperature stabilized to 1 part in 10 ⁷ (short term)
Display Time:	0.2 to 5 seconds
Power Requirements:	117 v. \pm 10%, 50-60 cycles, 260 watts
Dimensions:	20 $\frac{3}{4}$ " W x 19" H x 16" D. Weight, 100 lbs.
Price:	\$1,650.00 (f.o.b. factory)

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CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

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Control Switch

With Operating Time of 1 Millisec

This magnetically operated, glass enclosed, dry-reed switch has an operating time of 1 millisec or less. Barely larger than an ordinary kitchen match, the switch operates in any position at temperatures from -85° to $+500^{\circ}\text{F}$ and at rates as high as 400cy.



Contacts, which are closed when an external magnetic field is applied, are rhodium plated. They operate in an inert atmosphere hermetically sealed in a glass tube, permitting safe operation in explosive atmospheres. Contacts are rated at 0.5amp resistive or inductive at 28v d-c, or 10w 1amp load at 115v a-c. Revere Corp. of America, Dept. ED, 1000 N. Colony Rd., Wallingford, Conn.

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor

For Transistors, Hearing Aids



The Type C-5 miniature carbon deposited resistor is for transistor and hearing aid circuits. It has a diameter of 0.032", and is just 9/32" long. It is rated at 1/8w, with a minimum resistance of 5 ohms and a maximum resistance of 500,000 ohms.

The resistor has a power rating of full load at 70°C , derate to zero at 160°C . Its voltage rating is 150v d-c. Peak voltage is 500v. Temperature coefficient is negative: 180ppm to 400ppm/ $^{\circ}\text{C}$, depending upon resistance value.

The unit is coated with one coat of clear varnish and two coats of resin. Its resin coats make it scratch and moisture resistant. The unit meets the requirements of MIL-R-10509A. In addition, the resin coats enable it to withstand cycling from -65° to $+170^{\circ}\text{C}$ without damage to the coating. The coating also will not dissolve in potting compounds. If desired, the resistor can be fungus proofed. Mepeo, Inc., Dept. ED, 37 Abnett Ave., Morristown, N. J.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

Telesyn^(R) SYNCHROS

from FORD INSTRUMENT
for
**extreme accuracy
in transmitting
signals**



STANDARD TELESYN SYNCHROS
are available from Ford
Instrument in

Size 1 Size 3
Size 5 Size 23

for EARLY DELIVERY

A pioneer in the field of synchronous transmission, Ford Instrument produces synchros of proven precision accuracy.

- Available to meet Mil specs
- In sizes to meet a multitude of requirements
- For torque transmission and voltage indication

FREE a fully illustrated technical data bulletin gives characteristics and specifications. Please address Dept. ED.



43



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Resolvers



Integrators



Telesyn
Synchros

CIRCLE ED-137 ON READER-SERVICE CARD

METAL FILM RESISTORS now available with RADIAL or AXIAL LEADS

Both types are illustrated. The NOBLETTE is available in 1/2, 1 and 2 watt, in resistance range of 1 ohm to 10 megohms. The NOBLELOY in 1/2, 1, 2 and 5 watt in resistance range of 1 ohm to 30 megohms. Standard tolerances of 1, 2 and 5%, tolerances of 1/2% are available on special order.

NOBLETTE TYPE NA



NOBLELOY TYPE NR



Write for new 1955 catalog.

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CIRCLE ED-138 ON READER-SERVICE CARD

Ceramic Cartridge Widely Applicable Hi-Fi Unit



The "1P" single-needle, high-fidelity ceramic cartridge features high compliance and an extended frequency response. It is available in two versions—one for fine groove records (33-1/3 and 45rpm) and the other for standard groove records (78rpm).

The unit does not require either equalizers or preamplifiers and is unaffected by moisture or temperature. Because of its small size, it will fit into an unusually large number of tonearms. It is especially recommended for use in 45rpm record changers and 33-1/3rpm players. Output voltage is 1v on microgroove records. The replacement needle (bottom of picture) snaps into place and is available with either diamond or sapphire tip. Sonotone Corp., Dept. ED, Elmsford, N. Y.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Panel Meter For One-Hole Mounting



The Model 150 is a high precision 1-1/2" sealed panel meter designed for easy one-hole mounting without conventional mounting screws and related hardware. A Neoprene O-ring panel gasket provides a positive watertight juncture between the meter and panel. Terminal studs are similarly sealed. A knurled locknut with slots for wrench-tightening secures the instrument to the panel at the rear. Damage to the scale window will not destroy the watertight seal to the panel.

The meter is watertight and meets MIL-M-3823 specifications. Featured also are high flux density Alnico magnets. A miniaturized external D'Arsonval movement with external pivots which prevents pointer racking provides maximum accuracy and stability of adjustment.

Housing is shock-resistant die-cast aluminum with corrosion-resistant black anodized finish. Standard instruments are made with zero-left scales, but zero-center and zero-right models are also available, in white or black and with various markings. DeJUR-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

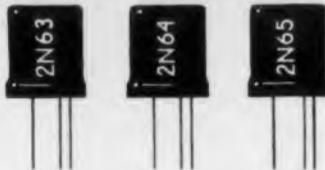
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ELECTRONIC DESIGN • February 1955

**LOOKING FOR
GERMANIUM TRANSISTORS
THAT CAN DO THE JOB UP TO**

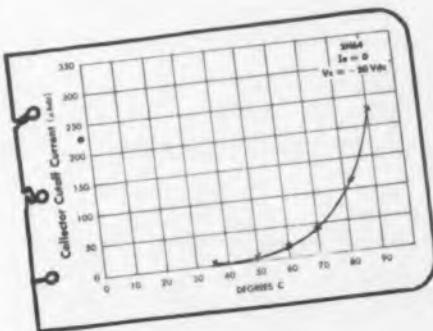
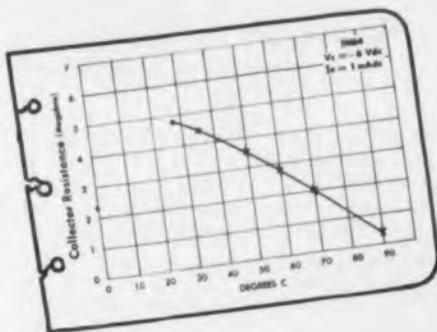
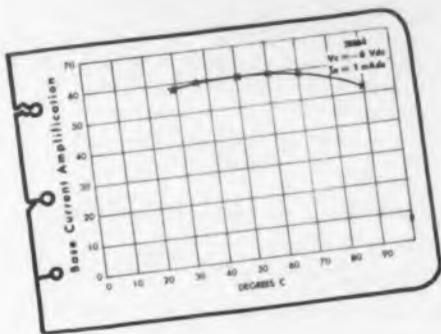
85°C

HERE THEY ARE!



Hermetically sealed

**GERMANIUM PNP
Diffused Junction TRANSISTORS**



Look at these typical curves taken on a Raytheon 2N64. You can see for yourself how reliably they perform at high temperature. These transistors are rated up to 85°C operating temperature — maximum storage temperature up to 100°C.

- There are three of them now available:
2N63—base current amplification factor 22
2N64—base current amplification factor 45
2N65—base current amplification factor 90

All measured at $V_c = -6 \text{ Vdc}$, $I_b = 1 \text{ mAdc}$



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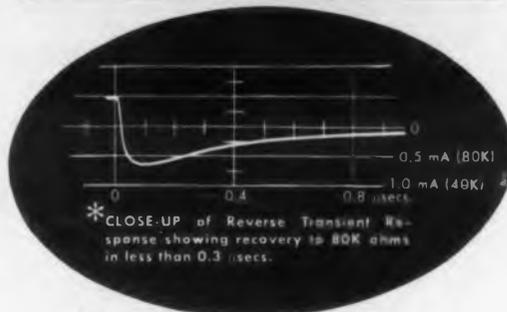
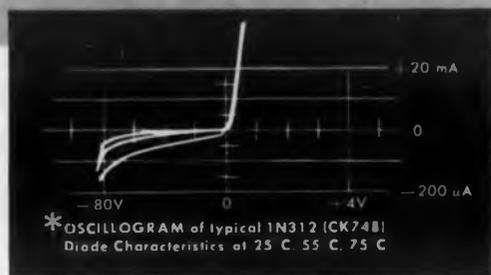
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and the uniformly
dependable performance
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		25°C µa at volts	55°C µa at volts
1N308 (CK741) with 50% higher conduction than its nearest competitive type	300	500 at -8	1500 at -8
1N310 (CK743) for high voltage, high resistance	15	20 at -20 100 at -100	150 at -20 300 at -100
1N309 (CK747) with unbeatable transient characteristics	100	100 at -20	350 at -20
1N312 (CK748) 100% tested for forward and reverse transient response	30	50 at -50	200 at -50
1N313 (CK749) High voltage, extra high resistance ALL with 150 milliwatt dissipation rating ALL with -50°C to +90°C ambient temperature rating	20	10 at -20 50 at -100	50 at -20 200 at -100

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CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

Video Amplifiers Low-Cost 10Mc Units



Versatile low-cost, video amplifying units, manufactured in two models, are offered for use in distribution systems, color TV systems, computer development, nucleonic circuits, pulse control systems, etc. These amplifiers have a bandwidth of less than 1cy to 10Mc (3db).

On Model 119A, output is 150v peak-to-peak into capacitive load of 25mmfd; overshoot is less than 5%, and compression is less than 3% at max output. On Model 119B, output is 10v peak-to-peak into 75 ohms with maximum of 5% compression, overshoot is less than 5%. A continuously variable gain control is provided with each unit.

Both units take up to 1.5v peak-to-peak input and are supplied with input impedance of 500,000 ohms and 10mmfd, 90 ohms, 75 ohms, or 50 ohms at option of user. Power requirements are 350v, 150ma, and 6.3v, 2.5amp. Size is 19" x 3-1/4" x 9" deep. American Electronic Laboratories, Inc., Dept. ED, 641 Arch St., Philadelphia 6, Pa.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Dials

In Thousands of Combinations



"G" Series Standard Dials and Dial Rings are precision designed, machined, and calibrated, to close tolerance. They are interchangeable and will allow thousands of combinations, including vernier readings of 1/4° and 1/10°.

As many as five scale readings can be read from a one-dial assembly.

Dials, dial rings, vernier crows-foot pointers, back rings, and back plates are all stocked by this firm. Ackerman Engravers, Dept. ED, 458 Broadway, New York 13, N. Y.

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

GET THE FACTS

LOW and constant
contact drop
LOW
electrical noise
HIGH
current density
LONG life ...



HIGH PERFORMANCE



BRUSHES CONTACTS SLIP RINGS

& Slip Ring Assemblies

BRUSH HOLDERS, CONTACT ASSEMBLIES,
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PRODUCTS: Unique (oil-free) self-lubricating Bushings and Bearings (applicable -450° to +700°F.; with expansion coefficient half that of steel will not seize shaft at low temperature); Oil-free Platen Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.



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CIRCLE ED-145 ON READER-SERVICE CARD

ELECTRONIC DESIGN • February 1955

TRANSISTOR &

DIGITAL COMPUTER

TECHNIQUES

applied to the design, development
and application of

AUTOMATIC RADAR DATA
PROCESSING, TRANSMISSION
AND CORRELATION IN
LARGE GROUND NETWORKS

ENGINEERS & PHYSICISTS

Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of large ground radar weapons control systems.

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or with exceptional ability, are invited to consider joining us.

fields include

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LOGICAL DESIGN
PROGRAMMING
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INPUT AND OUTPUT DEVICES
SPECIAL DISPLAYS
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Culver City, Los Angeles County, California

Relocation of applicant must not cause
disruption of an urgent military project.

Servo-Polar Recorder

For Patterns of Directional Devices



The Model SPR is an instrument designed especially for recording of antenna patterns and patterns of other directional devices. This recorder includes a self-contained servo system with amplifier, powerpack, etc. Accuracy of the recorder is determined

by the specific component servo-system supplied and is priced accordingly.

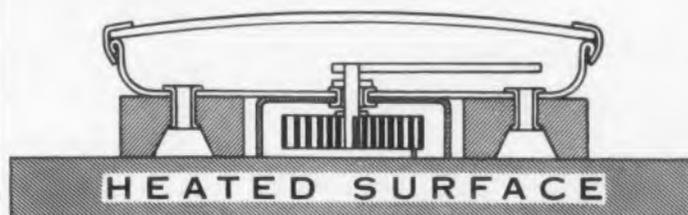
The recorder can also be furnished with a "Selsyn" motor alone (as Model PR) having a standard gear reduction of 36:1 or other gear reductions to customer's specification.

Recording width is 4-1/8". Potentiometer ranges from 0-20db to 0-80db, as well as linear, square root, and squaring scales, are available. Frequency response is from 20cy to 200kc. The electronic circuit can be furnished for either a-c or a-c/d-c signal recording. Sound Apparatus Co., Dept. ED, Stirling, N. J.

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

Thermometer

For Surfaces Heated to 750°F



The Model 314 "Hi-Heat" thermometer is designed for the fast and accurate checking of the surface temperature of hot plates, platens, die casting dies, rubber molds, plastic molds, and all surfaces where the temperature has a range from +50° to +750°F. The heat sensitive element consists of a bimetal spiral that has been aged and accurately calibrated for maximum stability. The metals comprising the spiral have been specially designed for high temperatures.

The spiral is closely coupled to the heated surface to be measured, and the thermometer is affixed to the surface by means of two "Alnico" magnets. The magnets are incorporated within the thermometer base, and the bimetal receptacle itself becomes an integral part of the magnetic circuit, thereby assuring an intimate and powerful contact. The thermometer reaches stability within three minutes. Total weight is less than 2 oz. Pacific Transducer Corp., Dept. ED, 11836 W. Pico Blvd., Los Angeles 64, Calif.

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION

DYNAMIC QUALITY CONTROL

with

MICROSCOPIC INSPECTION

ON ALL



RELIABLE SUBMINIATURE TUBES

Assures Dependable Guided Missile Performance



All these Raytheon Reliable Subminiature Tubes must pass microscopic inspection

TYPE	DESCRIPTION
CK5639	Output Pentode
CK5702WA	RF Amplifier Pentode
CK5703WA	High Frequency Triode
CK5744WA	High Mu Triode
CK5783WB	Voltage Reference
CK5784WA	RF Mixer Pentode
CK5787WA	Voltage Regulator
CK5829WA	Dual Diode
CK5995	Rectifier Diode
CK6021	Medium Mu Dual Triode
CK6110	Dual Diode
CK6111	Medium Mu Dual Triode
CK6112	High Mu Dual Triode
CK6152	Low Mu Triode
CK6247	Low Microphonic Triode
CK6533	Low Microphonic Triode

RAYTHEON, pioneer in microscopic inspection of reliable tubes for missiles, applies this inspection technique as the tubes are made. Employed as an integral part of Raytheon's quality control system, microscopic inspection controls the quality of manufacture of parts and sub-assemblies as well as that of the completed tubes, thus permitting continuous feed back to the production line. This provides positive corrective action during production, in addition to segregation of defective units.

Raytheon microscopic inspection assures continuous quality improvement. The resulting higher quality provides increased insurance against catastrophic tube failures.



The long flat press glass to metal seal is a Raytheon development that eliminates button cracking, reduces glass strain and lead burning, and prevents lead corrosion because leads can be tinned right up to the glass. Its in-line lead arrangement permits easier socketing and easier wiring, and is ideal with printed circuitry.



RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — Home Office: 55 Chapel St., Newton 58, Mass. Bigelow 4-7500

For application information write or call the Home Office or: 4935 West Fullerton Avenue, Chicago 39, Illinois, MAInial 7-2770

589 Fifth Avenue, New York 17, New York, PLaza 9-3900 • 622 South La Brea Ave., Los Angeles 36, California, WEster 8-2851

RAYTHEON MAKES ALL THESE
RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEAR TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW CAPACITORS

Electron

Electron Products, Inc. — recently created by a group with approximately 100 years total experience in Capacitor Engineering, Production and Sales Engineering. It is doing business under an advanced concept of electronic design and processes. The "Epicon" capacitor line announced above is typical of this new approach.

We sincerely invite your inquiries

ELECTRON PRODUCTS, INC.

1225 12th Street Street
Pasadena 1, California — 774-1511

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

Load Isolator For Microwave Tuning Systems



The Model X100 Ferrite Load Isolator, designed for system applications, makes it possible to operate high power magnetrons and klystrons into long lines or high vswr's without the usual adverse "long line" effects or other loading problems. This isolator is particularly valuable in tunable systems where loading problems become acute.

The unit provides a minimum attenuation of the reflected wave of 9db while attenuating the forward wave 1db or less by utilizing the nonreciprocal absorption properties of ferrites at microwave frequencies. It is designed to operate with magnetrons and klystrons covering the band of 8600Mc to 9600Mc, and at power levels of 100kw peak and 100w average.

Other features include a quarter-wave transformer to reduce the RG 51/U magnetron output to RG 52/U waveguide, a permanent magnet field, and conduction cooling. Other frequencies and operating characteristics can be supplied on special order. Components Div., Litton Industries, Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

Other features include a quarter-wave transformer to reduce the RG 51/U magnetron output to RG 52/U waveguide, a permanent magnet field, and conduction cooling. Other frequencies and operating characteristics can be supplied on special order. Components Div., Litton Industries, Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C PM Generator

Produces Sine and Cosine Voltages



This miniature a-c permanent-magnet generator is precision designed and constructed for indicating the position of a rotating shaft by providing two voltages, one the sine of the shaft position, the other the cosine. Use of a permanent magnet for the rotor eliminates the need for sliding contacts. The generator can operate up to 6000rpm with a maximum harmonic content of 3%, is built to military specifications for high and low temperature operation, and contains stainless-steel ball bearings for corrosion resistance.

The generator is available in two sizes, 1.43" diam and 1.67" diam, with identical operating characteristics. The larger size can be provided with a seal at the terminal block end for use in hermetically sealed assemblies. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

The generator is available in two sizes, 1.43" diam and 1.67" diam, with identical operating characteristics. The larger size can be provided with a seal at the terminal block end for use in hermetically sealed assemblies. Arga Div., Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

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Simplify and speed all your electronic supply purchases. Order from the world's largest stocks of electron tubes (all types), test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.). Our expert Industrial supply service saves you time, effort and money. Send today for your **FREE 1955 ALLIED Catalog**—the complete up-to-date guide to the world's largest stocks of quality Electronic supplies for Industrial use.

One complete dependable source for everything in electronics

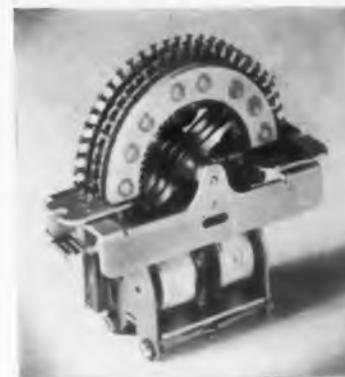
ALLIED RADIO
100 N. Western Ave., Dept. 69-B-5
Chicago 80, Illinois

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

TWO-WAY STEPPING SELECTOR

For Computing, Control, and Indicator Systems

The flexibility of forward and reverse stepping at the operator's choice or by automatic cycling is now obtainable in a compact unit—the G. E. C. two-way stepping selector. Each of these units can replace several conventional one-way stepping relays, thus adding efficiency and versatility to circuit designs.

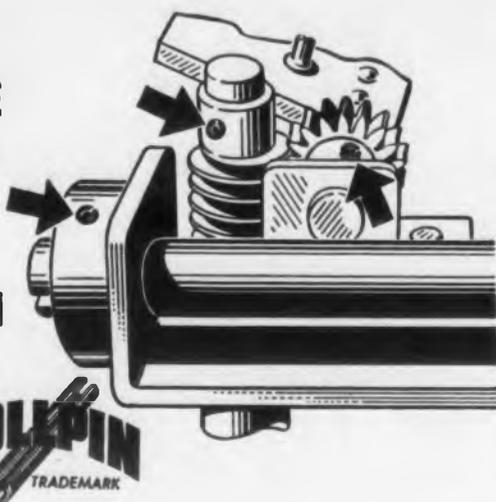


The G. E. C. two-way stepping selector operates in either direction at a speed of approximately 65 steps per second on self-interruption, and at speeds up to 20 steps per second from external impulses. Positive stepping action and freedom from over-stepping are assured by driving the wiper assembly on the forward stroke of the appropriate armature. The unit is designed for use with standard 25-contact banks up to three levels. All selectors can be supplied with bridging or non-bridging wipers, or any desired combination of both. The armature coils can be supplied for operation at 12, 24, 50, 110, or 220 volts d.c. Bank contacts, wipers, and wiper brushes are of nickel silver for maximum life. The interrupter springs, designed for easy adjustment, are fitted with platinum contacts. The finish of the units makes them suitable for either standard or tropical use.

For bulletin and prices, write: General Electric Company, Limited, c/o Imtra Corporation, (U. S. Agents) 58 Charles Street, Cambridge, Massachusetts, U. S. A.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

**FAST,
ACCURATE
PINNING
OF
PRECISION
SHAFTS
WITH ROLLPIN**



Rollpin speeds production alignment of close tolerance shafts. The slotted, hollow steel spring pin, with chamfered ends, is simply pressed or driven into holes drilled to normal production tolerances. It compresses as driven, is self-locking and vibration-proof. Rollpin is light, easily removable, reusable and has a shear strength greater than a solid pin of the same diameter. Diameters from 1/16" to 1/2".

Rollpin, in place of rivets, set screws, dowels and stop pins can cut production costs as much as 90%. For detailed information on any electronic fastening problem, write: Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey. Address Dept. R26-257.



**ELASTIC STOP NUT CORPORATION
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

PENTA



PL-6549

New Beam Pentode

This new transmitting type pentode offers good performance *even at low plate voltage* . . . and requires very little driving power.

For example . . . as a Class C amplifier it will deliver 60 watts at 600 volts . . . 110 watts at 1000 volts . . . with driving power less than 3/4 watt!

PL-6549 is an aligned-grid pentode, conservatively rated at 75 watts plate dissipation. Its quick-heating, 6-volt thoriated tungsten filament . . . its rugged construction . . . make it ideal for mobile applications.

**WRITE TODAY FOR FULL INFORMATION
ASK FOR DATA FILE 202**

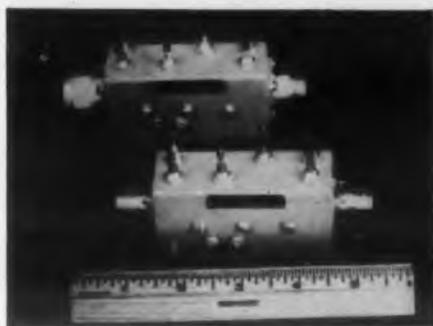


PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET
SANTA BARBARA, CALIF.

102

CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • February 1955

Bandpass Filters
In Line Covering 200-0000Mc



This line of "Bandpass Filters", covering the frequency range of 200-2000Mc incorporate multiple tuned resonant circuits with an insertion loss of less than 1db, and will

display the typical Tschebycheff response.

Size of the filters has been kept to a minimum, consistent with the number of resonant circuits, so that the units may be readily incorporated as external adjuncts to any existing equipment. Although the filters are available at standard frequencies and bandwidths, they may be obtained at any frequency and bandwidth desired within specification limits.

Center frequencies are 200-2000Mc. Bandwidths are 10-150Mc. Impedance is 52 ohm (input and output). Insertion loss and peak-to-valley ratio are both less than 1db. Selectivity is defined by resonant elements; doublets to sextuplets are available. Standard frequencies are 400Mc, 1000Mc, and 1680Mc. Applied Research, Inc., Dept. ED, 163-07 Depot Rd., Flushing, N. Y.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Relay

High Current Carrying Capacity



A variation of the small-size Type J Relay, this power relay is as sensitive and accurate as a telephone-type relay. Increased current-carrying capacity is provided by the use of silver

heavy-duty contacts which are riveted to the spring. The relay is also available with a combination of these heavy-duty contacts and Type J twin contacts.

The relay has handled in-rush currents of 50amp for 50,000 operations with a rating of 10amp, 27-1/2v d-c. It has exceeded 500,000 operations on motor load of 6amp, in-rush current is 15amp, at 70,000' altitude.

Nominal rating is: 115v a-c (resistive); 10amp, 27-1/2v d-c. The relay is 2-1/4" long, 1-1/8" wide, and 1-3/4" high with two form C contacts. C. P. Clare & Co., Dept. ED, 4101 W. Pratt Blvd., Chicago 45, Ill.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

"Q" for quenching flame and arc.

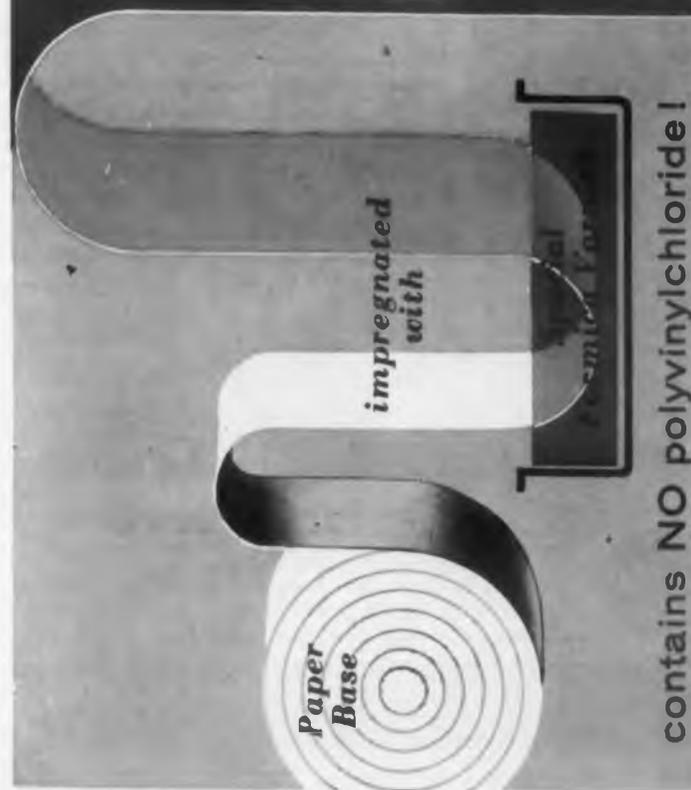
This new paper base grade, impregnated with special Formica resin, is better than any so-called flame- or arc-resistant grade ever made. You can verify this statement by checking the unusual properties of the new Q-125 . . . send today for data sheet.

Flame

Arc

quenching

Q-125



contains NO polyvinylchloride!

CIRCLE ED-159 ON READER-SERVICE CARD FOR MORE INFORMATION

THE FORMICA CO., 4642 Spring Grove Ave., Cincinnati 32, Ohio

More Engineers on A-N and civilian projects are proving—

It pays to specify
AMPERITE
DELAY RELAYS
and
BALLAST REGULATORS

... they're finest

... cost less!

Thermostatic
DELAY RELAYS

Provide delays ranging from 2 to 150 seconds.
MOST COMPACT, HERMETICALLY SEALED

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed. Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from -55° to $+70^{\circ}$ C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

PROBLEM? Send for Bulletin No. TR-81

Also — a new line of Amperite Differential Relays — may be used for automatic overload, over-voltage, under-voltage or under-current protection.

BALLAST REGULATORS

- Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. Operates on A.C., D.C., or Pulsating Current.
- Hermetically sealed, light, compact, and most inexpensive.

Amperite Regulators are the simplest, most effective method for obtaining automatic regulation of current or voltage. Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-55° to $+90^{\circ}$ C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

Write for 4-page Technical Bulletin No. AB-51

AMPERITE CO. Inc., 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp. Ltd., 560 King St. W., Toronto 2B

Coaxial Connectors
In Diversified Heavy-Duty Line



A complete family series of r-f coaxial connectors is designed to maintain performance under the most adverse conditions. These connectors combine excellent electrical performance at microwave

frequencies with the mechanical dependability and quick-disconnect features of high pressure fittings.

Units are available in plugs, jacks, panel-jacks, receptacles, and right-angle plugs for armored or non-armored 50-ohm impedance cables similar in size to RG-10/U. Materials and construction conform with military standards, utilizing brass bodies, beryllium copper springs and contacts, teflon insulation, and synthetic rubber gaskets. All metallic parts are heavily silver-plated. On special orders, rhodium plate can be supplied. Tru-Connector Corp., Dept. ED, 416 Union St., Lynn, Mass.

CIRCLE ED-161 ON READER-SERVICE CARD FOR MORE INFORMATION

Bolometer Mount
For Pulse Work



Model 157 Bolometer Mount is used for measuring relative r-f power, particularly on low duty cycle r-f pulses. It is designed for

operation with pulse-modulated waves where the usefulness of crystal detectors is often limited.

The mount may be used on pulse modulated or unmodulated waves in a direct-reading d-c bridge setup, or with an audio transformer and voltmeter on modulated waves. In either circuit maximum sensitivity is obtained when the mount is operated with approximately 7ma bias, resulting in a maximum power input capability of 20mw. With bias reduced to 1ma, maximum input power capability approaches 50mw, and the sensitivity is reduced.

Model 157 contains a special input terminating resistor, a fuse-type bolometer, and an output bypass condenser. Type N female input connector and BNC female output connector permit rapid connection into most test setups. Sierra Electronic Corp., Dept. ED, 1050 Brittan Ave., San Carlos, Calif.

CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMATION

available from stock for IMMEDIATE delivery

acrylic
rods and
tubes

SIZES AVAILABLE

RODS

1/8"	9/16"
3/16"	5/8"
1/4"	3/4"
5/16"	7/8"
3/8"	1"
7/16"	1-1/8"
1/2"	1-1/4"

TUBES

1 1/2" wall	1/8" wall
1/4" O.D.	1/2" O.D.
5/16" "	5/8" "
3/8" "	3/4" "
1/2" "	7/8" "
5/8" "	1" "
3/4" "	1-1/4" "
7/8" "	1-1/2" "
1" "	1-3/4" "
1-1/4" "	2" "

CLEAR CRYSTAL METHYL METHACRYLATE—Rods and tubes for industrial, novelty, display, models, and all other fields.

Special sizes to order

Write for price lists

and samples today.

ACE PLASTIC COMPANY

Precision Extruders and Fabricators



91-58 Van Wyck Expressway
Jamaica 35, N. Y.

CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMATION

DONNER analog computer

\$995

model 30 with 30-3 problem board as illustrated. f.o.b. Berkeley, Calif.



This versatile and compact Donner Model 30 is the first electronic computer specifically designed as a personal tool of the engineer, mathematician and scientist. It offers the speed and accuracy of electronic computation with slide rule operating simplicity wherever differential equations are used.

Write for Booklet No. 302 on the Model 30 and its applications.

DONNER SCIENTIFIC COMPANY

2829 SEVENTH STREET • BERKELEY 10, CALIFORNIA

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

**Sealer****High-Temperature Rubber**

A new rubber compound is designed for sealing such high vacuum units as electronic components, electron microscopes, and special testing devices. Designated 366YV, the compound is a special formula of Buna N. Polymer which can be injection molded into special shapes as well as standard sizes of Quad-rings and O-rings. Chief advantages of this 366YV rubber is its high resistance to out-gassing at high temperatures and long service life in permanent installations. Free samples are available. Minnesota Rubber & Gasket Co., Dept. ED, 3630 Wooddale Ave., Minneapolis 17, Minn.

CIRCLE ED-165 ON READER-SERVICE CARD

Laminate**Glass-Silicone Combination**

Designated grade G-7, these laminates combine heat-stable silicone resins with layers of woven glass fabric to achieve high heat resistance. Capable of withstanding constant temperatures of 400°F without affecting either the mechanical or electrical values, G-7 is manufactured to conform to MIL-P-997, type GSG. Available in either sheet form, or as parts fabricated to specification. Synthane Corp., Dept. ED, Oaks, Pa.

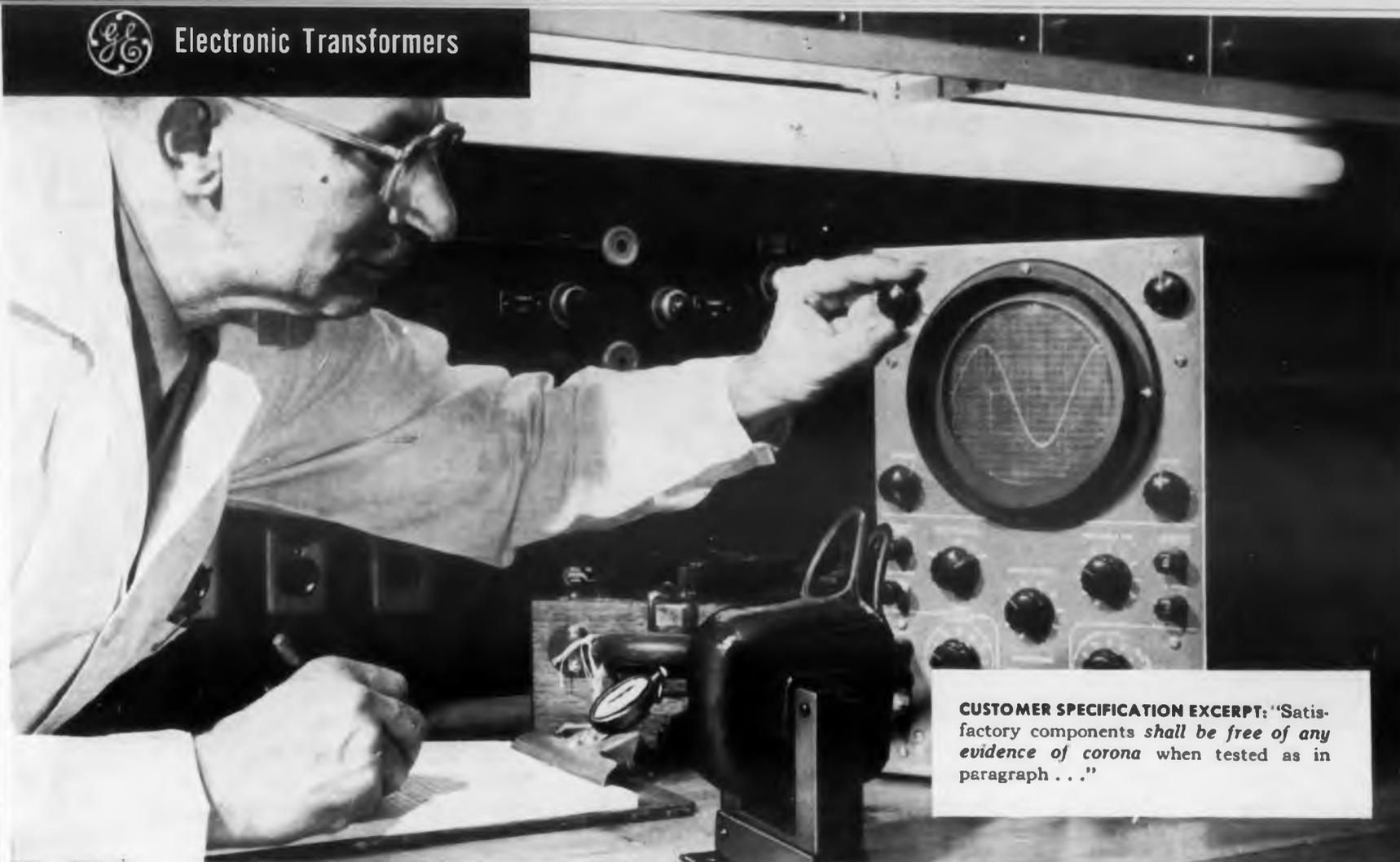
CIRCLE ED-166 ON READER-SERVICE CARD

Cable Insulation**Has High Tensile Strength**

By combining "Fiberglas" yarns and asbestos spinning fibre, a new cable insulation material has been developed. "Novabestos" No. 7503 yarn, used in the firewall of shipboard cables, provides a tensile strength of 95lb/inch of width. Other yarns are No. 7504 and 7505, an asphalt-impregnated tape. Three new "Pyrotex" tapes consist of two layers of asbestos felt with a glass cloth between. Raybestos-Manhattan, Inc., Dept. ED, Manheim, Pa.

CIRCLE ED-167 ON READER-SERVICE CARD

CIRCLE ED-168 ON READER-SERVICE CARD ➤



CUSTOMER SPECIFICATION EXCERPT: "Satisfactory components shall be free of any evidence of corona when tested as in paragraph . . ."

UNDER CUSTOMER-SPECIFIED TESTS, OSCILLOSCOPE POWER WAVE SHOWS TRANSFORMER WINDING TO BE FREE OF ANY EVIDENCE OF CORONA

Here is how G-E engineers developed an electronic transformer—virtually corona-free

General Electric engineers were asked to design and build an electronic transformer—**virtually corona-free**—for use as a component on a commercial television transmitter. The design samples were successfully built and installed. Today, production models are giving reliable performance in a wide variety of high-voltage applications.

CUSTOMER REQUIRES MINIMUM CORONA LEVEL. As indicated in the above specification excerpt, this customer specified a definite corona test on certain transformers in order to be assured of highest quality, maximum performance and dependability in his equipment.

By applying new design techniques to a standard G-E high-voltage electronic transformer, G-E engineers were able to build a unit which met the customer's unusually stringent specifications.

SEVERE TEST OF CORONA LEVEL. Corona, if present, would have been evident as a superimposed high-frequency oscillation on the basic power wave as seen on an oscilloscope. Final recordings showed that all components tested were virtually free of **any** corona.

The oscilloscope was set to a sensitivity of 0.1 peak volts per inch, and had a uniform response up to 200 Kc.

With this customer-specified sensitivity setting, even extremely low ionization would have been detected. By requiring that there shall be "no evidence of corona" under these conditions, the customer was assured that his equipment would give maximum dependability.

SUBMIT YOUR TRANSFORMER DESIGN PROBLEM. This is just one example of the challenge G.E. will accept . . . to design and supply you with the electronic

transformers you need. Whether they be installed on commercial, industrial, or military equipment, G-E transformers will give you added reliability.

For additional information, simply contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, New York. 410-13

RELY ON GENERAL ELECTRIC TO SUPPLY THE ELECTRONIC TRANSFORMER YOU NEED

All of these units are available

Amplistats	Filament Transformers
Anode Transformers	Filter Reactors
Audio Transformers	Plate Transformers
Charging Reactors	Power Supplies
Chokes	Pulse Transformers
DC Filter Reactors	Swinging Chokes

In any of these construction types:

Compound Filled	Hermetically Sealed
Cast Permafil	High Reactance
Core and Coil	Permafil
Encapsulated	Subminiature
	Goose-neck

Progress Is Our Most Important Product

GENERAL  ELECTRIC

No Need to Tie Up Your Money in Large Inventories of Electrical Insulation!



Your capital is released for more important uses when you let IMC stock your electrical insulations. IMC warehouses are as close as your phone—you get "same day" service on your shipments to be sure you receive your material promptly.

You also get additional stock room with none of the paper work and trouble when you use IMC's stocks as your own. Whether your requirements are large or small, you can relieve the load on your own storeroom by using IMC's stocks.

IMC has the experience and "know-how" to help you select the electrical insulation that best meets the requirements for each job. IMC makes and distributes almost every type of electrical insulation.

Phone or write your nearest IMC office today to obtain a product bulletin on any of the following materials.

INMANCO wedges, washers, slot insulation, and fabricated parts • IMCOR woven tapes, cords, sleeveings, reinforced plastics and other insulations • MACALLEN mica products • MANNING insulating papers and pressboards • PERMACEL self-sticking electrical tapes • SUFLEX (formerly DIFLEX) varnished or coated tubings and sleeveings • PEDIGREE insulating varnishes, compounds and coatings • VARTEX varnished cloths and papers; extruded tubings and resinous sheeting • CONOLITE laminates • DOW CORNING class H silicone insulation.

INSULATION MANUFACTURERS CORPORATION

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DAYTON 2 170 W. Second St. Phone 241-1000
MILWAUKEE 3 212 E. Wisconsin Ave. Phone Daily 8-5339
PITTSBURGH 22 535 Lehighfield Street Phone GRant 1-7100

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DETROIT 2 Barry B. Smith 15 Lawrence St. Phone 10-Diamond 8-2527
***MILWAUKEE 3** Manufacturers Specialties Co. 1222 West Clyburn Street Phone Division 4-5488
***MINNEAPOLIS 3** R. A. Hubbs, Inc. 1708 Harmon Place Phone Greater 5255
PEORIA W. C. Johnson 101 Butler Court Phone 2-7778

*LOCAL STOCKS AVAILABLE AT THESE LOCATIONS

CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply Sub-Chassis Mounting Type



This sub-chassis mounting type regulated power supply can be mounted on a chassis along with other components to save space. The unit, known as Model 2, is an electronically regulated d-c power supply. Input is 105-125v a-c 50-60cy. Output is continuously variable from 200v to 325v d-c for load currents of 0 to 100ma. Regulation is better than 1%.

Ripple output is less than 10mv rms. Both positive and negative outputs are isolated from ground. Either side may be grounded, if desired. An isolated voltage of 6.3v a-c at 3amp is available.

Dimensions are 9" wide x 8-3/4" high above chassis; 1-3/4" clearance required below chassis. Size of cut-out required: 8-1/8" wide x 8" high. Net weight is approximately 14-1/2 lb. Associated Specialties Co., Dept. ED, 1751 Main St., Orefield, Pa.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

FASTER, MORE ACCURATE INSPECTION WITH FLASH-O-LENS Illuminated Magnifiers



In industrial inspection departments, on production lines, in foundries and laboratories, wherever close visual inspection is important, FLASH-O-LENS gets the job done better, faster. FLASH-O-LENS spots minute defects by spotlighting the area it magnifies.

Battery models, powered by standard flashlight cells, and AC-DC plug-in models are available with 5, 7, 20 or 40 power precision lenses to meet a wide range of inspection needs. Prices start from \$10.95.

WRITE TODAY
for literature showing
applications, types, prices.

E. W. PIKE & COMPANY, Inc.
492 NORTH AVENUE ELIZABETH 3, N. J.

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

Do you have this handy catalog?



You'll find it mighty useful. It covers the whole standard line of Speer Resistor Division Products:



FIXED COMPOSITION RESISTORS • MOLDED WINDING FORMS
IRON CORES • SLEEVE CORES • COIL FORMS

It tells everything you'll want to know about these products — their specifications, their characteristics, their applications.

If you don't already have a copy, send for yours today.

OTHER SPEER PRODUCTS FOR THE ELECTRONICS INDUSTRY
anodes • contacts • fixed carbon resistors • coil forms • discs • brushes
battery carbon • graphite plates and rods

also R.F. Coils • ceramic capacitors • capristors • high voltage condensers • disc capacitors • chokes made by Jeffers Electronics



SPEER RESISTOR DIVISION
SPEER CARBON COMPANY
St. Marys, Pennsylvania
Other Divisions: Jeffers Electronics
International Graphite & Electrode

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION



Self-Locking Cup Point



Prevents this set screw from working loose

Unique counterclockwise knurls prevent these socket set screws from working loose, even in poorly tapped holes. And UNBRAKO Self-Locking Socket Set Screws can be seated tighter than ordinary set screws—as much as 45% tighter. For complete information, see your local UNBRAKO industrial distributor or write STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

UNBRAKO SOCKET SCREW DIVISION



JENKINTOWN PENNSYLVANIA

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Tester

For Gain of NPN or PNP Types



This low-cost tester provides a rapid, positive means of testing the current gain of any NPN or PNP junction transistor. A front panel selector switch allows rapid

changeover from NPN to PNP testing.

The tester provides direct-reading calibration by a single knob adjustment, with conversion from Beta to Alpha values by means of a simple table or curve, both of which are supplied with the unit.

A power switch, a selector switch (for NPN and PNP transistors), a test lever, and the calibrated Beta control knob are the only controls on the unit. The transistor test frequency of 270cy signal is used. A self-contained oscillator provides high signal stability with considerable harmonic output, enabling the tester to detect transistors with a low Beta cut-off. Devenco, Inc., Dept. ED, 150 Broadway, New York 38, N. Y.

CIRCLE ED-171 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Oscillator

Covers 30cy to 3Mc Range



The Model 3410A Pulse Oscillator is a low-cost variable repetition rate oscillator covering the band from 30cy to 3Mc in five decade

ranges. In addition to a 10-position switch, each range has a fine control covering 10% of that range. Output pulses have a constant 0.1microsec width.

Both positive and negative output pulses have an amplitude of at least 40v under open circuit conditions at 1 Mc or below, and at least 25v, open circuit, at 3Mc. The positive pulse has an internal impedance of 100 ohms. Its rise time is 0.035microsec. The negative output pulse has an internal impedance of 250 ohms. Its fall time is 0.4microsec.

Power required is 110-220v, 50-400cy, 150w. Units are connected for 110v unless otherwise specified. Size is 3-3/4" x 19" x 13". The unit mounts in a standard relay rack. Weight is 22 lb. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City, Calif.

CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955



RMC Plant at Attica, Indiana

RMC DISCAPS

*the standard of performance
throughout the electronic industry*

RMC devotes its entire research, engineering and production facilities to the development and manufacture of ceramic capacitors. Production is controlled from basic powders to completed capacitor assuring absolute quality control. Every DISCAP is tested at twice its rated voltage before shipment. DISCAPS are available in temperature compensating, by-pass, stable capacity, high voltage and AC line types in addition to the exclusive new "Wedg-loc" types for printed wire circuits.



RMC Plant and General Office at Chicago, Illinois



RMC Research Division at Chicago, Illinois

3 RMC Plants to Serve You

RMC operates centrally located production plants at Chicago, Illinois and Attica, Indiana. The Research Division in Chicago houses development and engineering personnel continuously at work improving ceramic dielectrics. For standard or special types of ceramic capacitors specify RMC DISCAPS.

DISCAP
CERAMIC
CAPACITORS



RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

TI subminiature transformer . . .



ACTUAL SIZE

used in the first transistorized consumer product!

The world's smallest commercial radio receiver makes the most of miniaturization possibilities with a Texas Instruments subminiature transformer and four TI transistors. TI subminiature transformers, such as the one used in the Regency pocket radio, are adaptable to mass production dip-soldering assembly techniques.

Your most experienced source of supply for transistorized circuit components, Texas Instruments produces the most complete line of subminiature transformers, consisting of 32 standard models. Ranging from less than $\frac{3}{8}$ inch cubed (one milliwatt output) to one inch cubed (200 milliwatts output in push-pull), TI subminiature transformers are precision units specifically designed for transistorized and other miniaturized circuits. TI engineers will design special models — in virtually unlimited variety — to meet your exact requirements.

Don't delay your own product miniaturization program. Write today for Bulletin DL-C 424, describing TI subminiature transformers in detail.

Rear view of pocket radio with back removed, showing TI transformer and transistors in relation to other circuit components.



CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

Triode Extremely Rugged Design



Type *CK6533* is an improved low noise subminiature triode with 6.3v, 200ma heater, amplification factor of 53, and mutual conductance of 1750 micromhos. At the standard test condition of 40 cy, 15g vibration, noise output across 10,000 ohms in the plate circuit is a maximum of 1mv, with typical tubes usually reading between 100-mv and 200mv.

At vibration frequencies as high as 10,000cy, 15g, the noise output seldom exceeds 1mv, thus making this triode highly applicable for guided missile and other critical electronic equipment applications. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

Decade Scaler For High Speed Counting



The EPIC Model 412 Fast Decade Scale has been designed for precise high-speed counting of the fast pulses encountered in nuclear work, computer and

pulse control problems high frequency measurements (to 10Mc), and small, time interval measurements (to 0.1microsec sec accuracy). The scale factor of 100 and the output pulse characteristics have been chosen so that almost all slower-speed conventional commercial scalers (approx 10^5 counts/sec) and frequency counting equipment, can be operated from the output pulse with ease.

The decade action is accomplished by the direction of pulse flow through a 4-stage binary scaler by diode gates. The gates are controlled by the normal binary progression of counts through the scaler. This makes possible a decade with a bias range as wide as a binary, and with an inherent reliability approaching that of a binary.

The gate switching method minimizes the usual delays in decades. A four neon-lamp 1-2-4-8 indication system is used for each of two decades. The power supply is electronically regulated for maximum stability and performance. Electrical and Physical Instrument Corp., Dept. ED, 25 W. 43rd St., New York 36, N. Y.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

Test for Electrical LEAKAGE • SHORTS • BREAKDOWN

with
"HYPOT"
JUNIORS



HIGH POTENTIAL
TESTING
INSTRUMENTS

WRITE FOR
BULLETIN 4A

- ONLY ONE instrument necessary to make high potential tests for leakage, breakdown or shorts!
- PORTABLE, with rugged steel case...Operates in any position!
- SAFE to use, with protected test leads, shielded high voltage, grounded case!
- SIMPLE—only three easy steps to make a complete test!
- VISUAL INDICATIONS from neon lights give positive test results. Audible test indication for leakage also available.
- RANGES 0-1500 to 0-6000V.A.C. output. Other "Hypots" to 50,000V.A.C. output at 5 K.W.
- WRITE for complete data on "HYPOTS" for your jobs.

ASSOCIATED RESEARCH, Incorporated
"Precision Instruments Since 1936"

3769 West Belmont Avenue, Chicago 18, Illinois

CIRCLE ED-183 ON READER-SERVICE CARD FOR MORE INFORMATION

Stop Corrosion with RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

RHODIUM PLATE offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for Free, detailed booklet on RHODIUM PLATING.

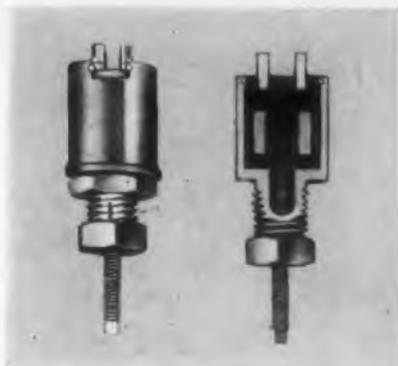
BAKER & COMPANY, INC. PRECIOUS METALS

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

CIRCLE ED-184 ON READER-SERVICE CARD FOR MORE INFORMATION

New Miniature LS-9 Coil Form

Unusually well shielded, rugged



Shown actual size

First of its kind! C.T.C.'s new LS-9 coil form assembly is particularly suited for applications that require miniature size, a rugged, shock-resistant construction and a mechanically enclosed, protected coil.

Electrically and mechanically shielded, the new assembly is excellent in I. F. strips and numerous receiver designs as they can be mounted adjacent to one another and can be used in circuits requiring coils shielded from outside radiation. Forms can be used as simple R. F. coils, tapped R. F. coils or R. F. transformers.

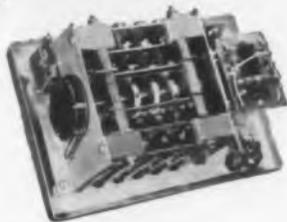
Each LS-9 assembly consists of a brass shell enclosing a powdered iron cup-core, tuning slug, phenolic coil form and silicone fibreglas terminal board. Three terminal boards are available with either a two, three or four terminal layout. Forms can be wound to customers' specifications. For complete information, write Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION



"icing conditions heavy—de-icers working fine—bandits on screen . . ."

7800 Series
A. W. HAYDON
Repeat Cycle
Timer
Lockheed Wing De-icer



Custom Designed By THE A. W. HAYDON COMPANY To Control the Power for 10 De-icing Circuits carrying 35 amperes 3 phase 220 Volt 400 Cps. A.C. to the de-icing heaters in 10 wing sections. Each heater is energized for a 10 second interval in an accurately controlled sequence.

WHEN TIMING POSES A PROBLEM — CONSULT . . .

The A.W. HAYDON COMPANY
227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

Design and Manufacturer of Electro-Mechanical Timing Devices

general
catalogs
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request

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • February 1955

Test Clamps

For Variety of Applications



"Kliplok" Test Clamps are applicable to many types of electronic and electrical circuit connections. Available in a number of types, their applications include testing, grounding, cable splicing, clamping to knife

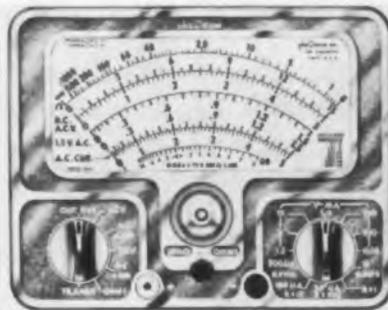
switches or fuse holders, and connecting portable equipment.

A twist of the insulated knob applies jack screw pressure for solid mechanical grip and heavy current conduction. Units are available in a variety of ratings and sizes, with solder or solderless lugs. Trico Fuse Mfg. Co., Dept. ED, Milwaukee 12, Wis.

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION

Multimeter

Has 43 Unduplicated Ranges



The "555" metal-cased, pocket-size Multimeter offers 43 completely unduplicated, self-contained ranges with accuracies of 2% d-c; 3% a-c. It provides for the measurement of d-c

volts from 1.5v to 1500v at 20,000 ohms per volt; a-c volts from 1.5v to 1500v at 2,000 ohms per volt; d-c current from 500microamp to 15amp; a-c current from 1.5ma to 1.5amp; decibels from -10 to +50; and resistance from 0.25 ohms to 10 megohms.

The unit has only 2 jacks; this feature overcomes most mistakes possible with multi-jack multimeters. Further operating and reading simplification is achieved by the large 4-7/8" four color scales which correspond to the color coding of the function switch. For greater reading accuracies, ranges are established in 3 to 1 steps.

This equipment is doubly shielded by a shatter proof, anti-magnetic, chrome and satin case which protects the meter movement from stray magnetic fields. The instrument is packed complete with batteries. The entire unit measures only 4-5/8" x 6-1/8" x 2-1/8". A panel mounting adapter is available as an inexpensive accessory. Phaostron Co., Dept. ED, 151 Pasadena Ave., South Pasadena, Calif.

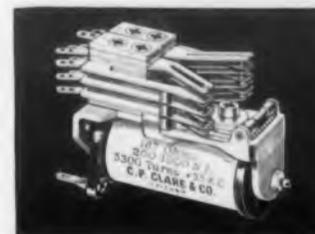
CIRCLE ED-188 ON READER-SERVICE CARD FOR MORE INFORMATION

CLARE

Type J Relays

help count cars
ACCURATELY and FAST

... on Jersey's
**Garden State
Parkway**



● Keeping track of traffic on the Garden State Parkway hour after hour, day after day, is rugged duty for control equipment. Only the most sturdy and precise components can stand the wear and tear.

That's why engineers of Taller & Cooper, Inc., whose toll booths and collection equipment are found on every major American toll facility, chose CLARE TYPE J RELAYS. These relays accurately record the number of vehicles that pass through the Toll Plaza. Their high speed permits accurate readings of automobiles even up to 40 miles per hour.

The Type J Relay may have just what you want in a relay

SMALL AND LIGHT: 2 1/4" long; 2 1/4 oz. (approx.)

LARGE CURRENT CAPACITY: 4 amperes, 150 watts. Twin contact points (palladium) standard.

FAST OPERATE-RELEASE: 1 to 2 milliseconds (Min.) Coils can be provided for time delay on operation, release, or both.

OPERATING VOLTAGE: Up to 220 volts d-c.

NEW FEATURES: Independently operating twin contacts minimize contact failure.

Hinge-type armature recently improved to prolong life and increase stability of relay adjustment.

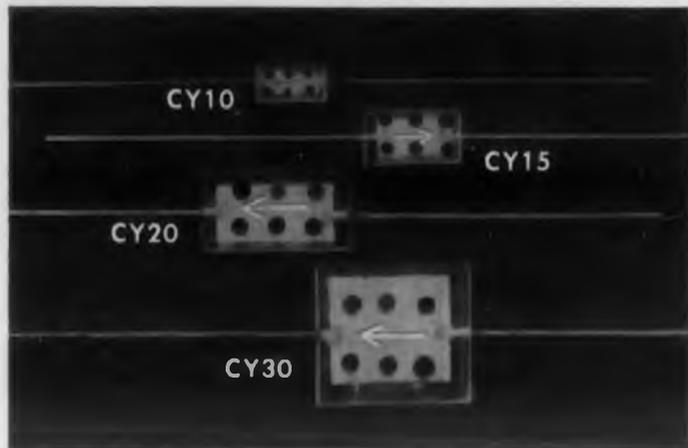
New heavy duty yoke has stainless steel pivot pin with large bearing surface which turns in precisely reamed bearings of non-ferrous material.

● Write for ENGINEERING DATA BOOK. Address C. P. Clare & Co., 3101 West Pratt Blvd., Chicago 45, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.

CLARE RELAYS

FIRST IN THE INDUSTRIAL FIELD

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION



Corning Fixed Capacitors are alternate layers of conductor and dielectric sealed under heat and pressure in a glass case of same composition as the dielectric. Result is a monolithic structure. Shown actual size are four standard pigtail types.

CORNING FIXED GLASS CAPACITORS

stable, rugged, miniaturized

Corning Fixed Capacitors assure excellent moisture resistance, high temperature operation, and extremely high reliability. Now in mass production, these capacitors are available at attractive prices.

Check these features of Corning Capacitors —

The Dielectric—A homogeneous, scientifically produced continuous ribbon of glass; no foreign inclusions, no cracks, no imperfections.

Construction—Only three simple elements: (1) The glass dielectric and case of identical composition; (2) active metal foil plates; (3) the pigtail wire leads—bright, clean and ready to solder. No potting materials, no impregnants, no mechanical slips, no plastic cases. Corning Fixed Capacitors are fused together into a solid, strong, monolithic block. To affect or change their excellent electrical characteristics, you would have to mechanically destroy the capacitor.

Electrical Characteristics—(A) Temperature coefficient is $+140 \pm 25 \text{ ppm}/^\circ\text{C}$. over the range of -55°C . to $+85^\circ\text{C}$. Variation of TC at any given temperature between individual units is less than 15 ppm. The TC remains the same after repeated cycling. The capacitance drift is less than 0.1% and usually less than the error of measurement. This means reliable, predictable circuit control. (B) Dissipation factor is not more than 0.1% at 1 kilocycle.

Operating Temperature—Standard temperature range of -55°C . to $+85^\circ\text{C}$. can be extended to 150°C . with derating. Units available to Military Specification MIL-C-11272A.

Miniaturization—The illustration above shows four standard pigtail types of Corning Fixed Capacitors actual full size. We can pack a lot of capacitance into a small space. The CY10, for example, measuring $3/16" \times 3/16" \times 3/16"$ is available up to 240 uuf at 300VDCW. The CY30 is available up to .01 uf at 300VDCW.

Tolerances—The standard tolerance for capacitance is $\pm 10\%$. Units are also available in 5, 2 and 1% tolerance.

We would like to send you additional information, prices, and samples.

We invite discussion of variations you might need for custom applications, and we manufacture many special types of capacitors. Write, wire, or phone us.

Other Corning Capacitors

Medium Power, Transmitting High Capacitance, Canned
Subminiature Tab Lead Special Combinations



CORNING GLASS WORKS

New Products Division
CORNING, NEW YORK

Corning means research in Glass

CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Triode Tube For Computers, Counters, Scalers



CIRCLE ED-191 ON READER-SERVICE CARD FOR MORE INFORMATION

The E90CC is a low impedance dual triode tube having a life expectancy of over 10,000 hr. It is intended for use in electronic switching circuits such as are used in digital computers, high speed counters, and scalars. Mutual conductance, anode current, balance between halves, and cut-off are closely controlled. In a typical circuit, under fixed bias conditions, the tolerance on anode current at 5.6ma is 0.6ma. A peak emission of 75ma for each triode is specified. Mullard Ltd., Dept. ED, Century House, Shaftesbury Ave., London, W.C.2, England.

Comparator Bridge

Also a Voltage Reference



secondary standard for calibration of laboratory instruments.

A precision 10-turn potentiometer with dial allows the output voltage to be set precisely equal to an external voltage; accuracy to within 0.1% is readily obtainable with direct reading on the potentiometer dial. A special circuit provides sliding meter sensitivity on the null indicator so that a coarse-to-fine null balance may be obtained within $\pm 1/2 \mu\text{amp}$ without range switching.

For analog computer work, the unit may be used to measure the attenuation coefficient of a potentiometer by application of 100v to the "ends" and finding the "arm" potential. The coefficient may then be read directly on the bridge dial. As a precision regulated power supply (0.05% regulation) the instrument will supply up to 10ma at any voltage from -100v to $+100\text{v}$ with a maximum internal impedance of 5000 ohms. Donner Scientific Co., Dept. ED, 2829 7th St., Berkeley 10, Calif.

CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

*Kanthal DR resistance wire
SAVES YOU UP TO 50% because...*

... it is lighter in weight (more feet per pound), and the per pound price is low. Total savings approximately 50%.

... Kanthal DR improves the performance of resistors and precision equipment. Its electrical resistivity is high — 812 ohms per circular mil foot — its temperature coefficient is low ($\pm 0.0002^\circ\text{C}$ between -50° and $+150^\circ\text{C}$), and it has a low thermal EMF to copper.

Available in fine gages and all types of insulation.

WRITE FOR FURTHER INFORMATION AND PRICES TODAY

KANTHAL THE KANTHAL CORPORATION
8 AMELIA PLACE, STAMFORD, CONN.

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMATION

SETKO Announces New

Pivot-Lok Set Screws

For jobs using two screws for security purposes, or where vibration is a factor. Pivot on top screw acts as a bearing. Pivot avoids friction between the two screws and prevents damage to the lower socket. Pivot screw can be furnished with any type of self-locking thread such as Zip-Grip, Off-Set, etc. Provides positive holding action, but both screws easily removed when desired. Send for new illustrated bulletin giving full data.

Set Screw & Mfg. Co.
265 Main St., Bartlett, Ill. (Chicago Suburb)
We Specialize in Solving Puzzling Set Screw Problems

CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMATION

MODERN AS TOMORROW!

This
is the

EXECUTIVE

by **LINEMASTER®**
America's Foot Switch Leader

PRICE ONLY

\$6.50

list less discount

Size 4" x 4 1/2"

x 1 1/4". Weight

14 ounces

- The Executive incorporates two switches in one, with selective circuits and guaranteed mechanical interlock. It's sleek low-to-the-floor design enables easy and comfortable on-center pivot action; only one circuit can be operated at one time—preventing accidental tripping of two circuits.
- It's the Electrician's dream—only one screw to remove and the switch is ready for wiring.
- Engineers will want to incorporate the Executive by Linemaster into their plans when designing their modern machines.

Rating (each interior): Single Pole—Double Th:ow.
20A @ 125V—15A @ 250V

Write Today for Descriptive Bulletin

LINEMASTER SWITCH CORP.

130 PUTNAM ROAD

WOODSTOCK, CONNECTICUT

CIRCLE ED-195 ON READER-SERVICE CARD FOR MORE INFORMATION

What's
Your Use for...



vernistat... The Revolutionary
New Precision Variable-Ratio Transformer

Analogue Computers? Servos? Control Systems? The Vernistat is a completely new type of voltage divider that combines low output impedance with an inherently high resolution and linearity not ordinarily attainable by precision potentiometers.

The Vernistat consists of a tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous interpolating potentiometer that moves between 31 transformer taps.

Because of its unique operating principles, electrical rotation is held to close tolerances eliminating the need for trim resistors. In many applications there is no need for impedance matching amplifiers.

Specifications of the standard model Vernistat are shown below. Other versions are under development to meet specific end uses.

What are your requirements for this unique precision voltage divider?

SPECIFICATIONS

Linearity Tolerance better than $\pm 0.05\%$	Frequency	50-3000 cps
Output Impedance 130 ohms (max.)	Max. Output Current	50 ma
Minimum Voltage Increment	better than .01%	

Other models including a miniaturized 400 cps version will soon be available.

vernistat division Perkin-Elmer Corporation, Norwalk, Conn.

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Dynamic Force Gage

Sensitive to Force Change



The Model 2101 Dynamic Force Gage has an extended frequency range and large output, permitting more thorough dynamic tests of servo systems, vibration-

force generators, wind tunnel balances, structures, etc. The piezoelectric gage principle is used, offering the advantage of sensitivity to force changes only, allowing full scale expansion of dynamic phenomena.

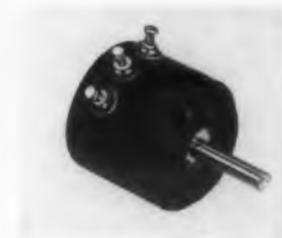
The force gage offers a full scale output of 3v for each range. This sensitivity remains constant over the frequency range of 10 cy to 5kc when loaded with a resistance of 100 megohms or more. Gages will be available for inputs of 15, 50, 100, 500, and 1000 lb.

Ease of coupling and small size permit the use of the gage in servo linkages, force balances, and mechanical systems requiring minimum mass. The 15 lb gage weighs less than 1 oz and is a 5/8" hex by 1" long. Endeveo Corp., Dept. ED, 689 S. Fair Oaks Ave., Pasadena 2, Calif.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer

With 0.10 in-oz Max. Torque



Designed for use in computers, servo-mechanisms, and other applications where minimum torque is of paramount importance, this miniature potentiometer puts a negligible torque load on synchros for remote indication.

Weighing only 1/2 oz, and measuring 7/8" diam x 3/4" depth, the MT-7/8 "Lo-Tork" potentiometer has stainless-steel precision ball bearings, a toroidal winding on a ceramic form, and an anodized aluminum case. Standard linearity is $\pm 0.50\%$ above 1000 ohms. Linearity of $\pm 0.25\%$ can be obtained on special order.

Operating at 80°C, dissipation is 1w. The toroidal winding allows winding angles up to 360° with extreme precision; 354° is standard. The unit is available in resistances from 100 ohms to 100,000 ohms. Servo mount is standard, and up to six potentiometers can be ganged on a single shaft. Waters Mfg., Inc., Dept. ED, 4 Gordon St., Waltham 54, Mass.

CIRCLE ED-196 ON READER-SERVICE CARD FOR MORE INFORMATION

motordyne

will meet your specs
on fractional hp motors
in minimum time!



Designed to meet all applicable Mil. Specs., Motordyne motors withstand high altitudes and ambient temperatures. Sizes as small as 1 1/4" diam. H.P. 1/1000 to 1/2.



Check our standard types

— they come in a wide range of power and speed ratings, torques, weights and sizes. They're designed to drive actuators, valve controls, small blowers, radar antennas... many types of instruments and electronic equipment. If the standard Motordyne types don't quite fill your needs, we can vary the windings, the output shaft configurations or mounting arrangements in minimum time.

Quick service on specials

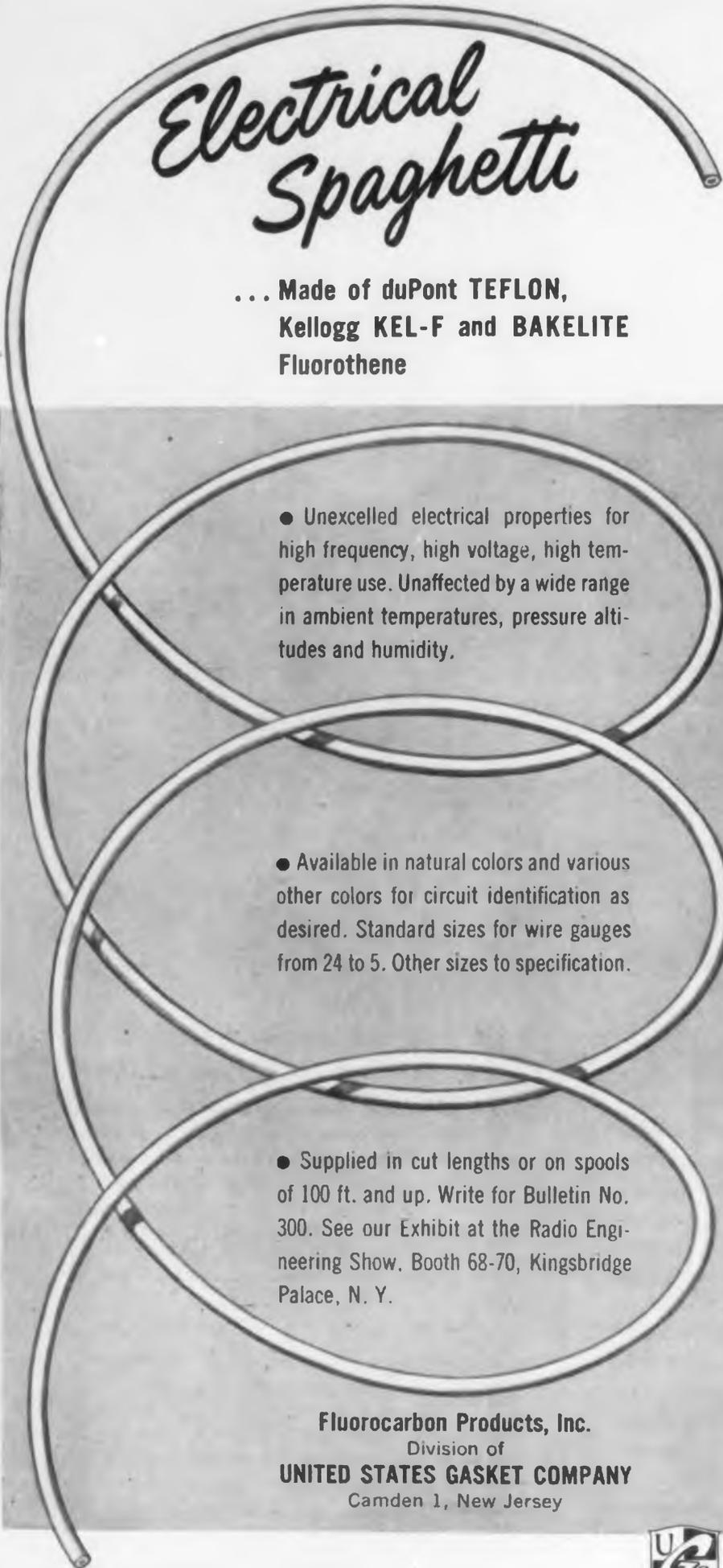
Motordyne's fast, capable engineering staff is set up to submit prototypes usually within weeks. And with a large-capacity plant, fully integrated and operating under rigid quality control, we can meet promised delivery schedules with ease.

Write for literature on the Motordyne line.

MOTORDYNE, INC.

2661 SOUTH MYRTLE AVENUE, MONROVIA, CALIFORNIA
Manufacturers of Fractional H.P. Motors, Dynamotors, Inverters

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION



Electrical Spaghetti

... Made of duPont TEFLON,
Kellogg KEL-F and BAKELITE
Fluoroethene

● Unexcelled electrical properties for high frequency, high voltage, high temperature use. Unaffected by a wide range in ambient temperatures, pressure altitudes and humidity.

● Available in natural colors and various other colors for circuit identification as desired. Standard sizes for wire gauges from 24 to 5. Other sizes to specification.

● Supplied in cut lengths or on spools of 100 ft. and up. Write for Bulletin No. 300. See our Exhibit at the Radio Engineering Show, Booth 68-70, Kingsbridge Palace, N. Y.

Fluorocarbon Products, Inc.
Division of
UNITED STATES GASKET COMPANY
Camden 1, New Jersey

USG



FABRICATORS OF
FLUOROCARBONS & OTHER PLASTICS

Representatives in principal
cities throughout the world

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

Cathode Ray Tube 5" Unit for Radar



Type *GL-5FP-14-A* is a 5" cathode ray tube for radar applications. It has a high - resolution electron gun providing an exceptionally narrow trace on the screen.

Maximum line width limit specification is 0.25mm. This is an improvement over the older *GL-5FP14* type. The decrease in line width, or spot size, aids closely-grouped target identification.

The tube is electrically and mechanically interchangeable with the *GL-5FP14* type. The tube is all-glass, employs magnetic focus and deflection, has a 53° deflection angle, and has a medium-long persistence phosphor.

Typical operating conditions are: anode voltage, 5000v d-c; grid no. 2 voltage, 250v d-c; grid no. 1 voltage (for visual extinction of focused undeflected spot), -25v to -70v d-c; spot position, 9mm; typical line width Δ , 0.009". Tube Dept., General Electric Co., Schenectady 5, N. Y.

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switch For Rates up to 60rps



Typical specifications of this switch are 60 contacts, 30 channels, one pole, and sampling rates up to 60rps. Multiple stacked pole designs, as well as variations in the number and arrangement of con-

tacts, are readily available.

For airborne, shipborne, laboratory, factory, and missile applications, the switch is designed for minimum maintainance, increased life, and extreme reliability. An exclusive wiper design and semi-molded contact assembly are basic factors contributing to its performance.

Dimensions are 2-3/8" diam, 1-7/16" long, excluding terminals, hub, and shaft. Hub is 3/4" diam and 1/2" long. The unit is adaptable to hub, hanger, pedestal, or flange mounting. General Devices Inc., Dept. ED, P. O. Box 253, Princeton, N. J.

CIRCLE ED-202 ON READER-SERVICE CARD FOR MORE INFORMATION

CRITICAL QUALITY CONTROL Means the Finest in Frequency Control in *Midland* CRYSTALS

Midland makes more frequency control crystals than anybody else. Millions are used in two-way communications throught the world.

Only a product of the highest quality rates that kind of demand. That's why you *know* your Midland crystal will do a completely dependable job for you.

The quality of Midland crystals is assured by exacting tests and controls through every step of processing. It's quality you can stake your life on — as our men in the armed forces and law enforcement do every day.



ML-200 Series
for color television

ML-6 Series
for ranges 1.0 mc
to 75.0 mc

ML-6

MIDLAND
MINIATURES
for specified
performances

Other standard
types for
various ranges.

Specials developed
and produced to
individual
requirements.

Whatever your crystal need —
conventional or highly specialized...
when it has to be exactly right,
contact

Midland Manufacturing Co., Inc.

3155 Fiberglas Road • Kansas City, Kansas

**WORLD'S LARGEST
PRODUCER OF QUARTZ CRYSTALS**

CIRCLE ED-203 ON READER-SERVICE CARD

Transformers For Junction Transistors



These push-pull driver and output transformers are designed for use with high power alloy junction transistors. To avoid switching transient voltages in the Class B output stages and to

maintain good circuit balance, "Bi-Filar" windings are used.

Frequency response is 200cy to 4000cy. Power level is 2w. The driver transformer provides a suitable match to the 25-ohm input impedances of the output stage of the transistor circuit in question. The output autotransformer matches a 4-ohm speaker load. Microtran Co., Dept. ED, 84-11 Rockaway Beach Blvd., Rockaway Beach 93, N. Y.

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION

Scalers

Measure Radioactivity



"Decimatic" Scalers are designed to measure all types of radioactivity precisely and easily. One of the main features of the design is the use of "modular" construction where-

by a register-timer assembly can be added or deleted to the input amplifier of the Scaler in different arrangements. This construction leads to several arrangements for various applications—all from the same basic design; the user can modify an arrangement at any time to meet new requirements.

Scaler features include: non-overloading input amplifier with a choice of 0.2v or 1mv input sensitivity; a 10-turn discriminator control (+5v to +50v); preset time and count; electrical reset of register, timer, and scaling circuits with a single switch; a precision high voltage supply with coarse and fine adjustments; a line frequency test facility and a stand-by switch position which prevents overshoot at warm-up. Berkeley Div., Beckman Instruments, Inc., Dept. ED, 2200 Wright Ave., Richmond, Calif.

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

"GIANT BRAINS" FOR BUSINESS & INDUSTRY?

Would modern electronic equipment really improve a company's operations... decrease its costs?

If so—where?

In production control? Payroll accounting? Customer billing? Factory automation?

What make of equipment is best? What changes in company methods and procedures would be required?

To assist managements in answering such questions, The Ramo-Wooldridge Corporation through its Computer Systems Division, offers to business and industry the consulting services of a team of scientists, engineers and business methods and procedure analysts experienced in the application of modern analytical and machine methods. With no equipment of their own to sell to non-military customers, but with understanding of available machines and techniques, this group is in a position to be objective in its recommendations.

Other activities of the Computer Systems Division include a program of development of an advanced type of digital computer for military applications and operation of the company's own computing center, consisting of extensive, general-purpose computing equipment.

These activities comprise a part of the program whereby The Ramo-Wooldridge Corporation seeks to maintain broad coverage of the important field of automation, computation and control.

The Ramo-Wooldridge Corporation

DEPT. ED-7, 8820 BELLANCA AVENUE, LOS ANGELES 45, CALIFORNIA
CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

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STOCKED "HS" SERIES TOROIDS

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LOS ANGELES — Samuel O. Jewett — State 9-6027 — 13537 Addison St., Sherman Oaks, Calif.
SEATTLE — Testca — Mohawk 4895 — Boeing Field, Room 105, Seattle 8, Washington
SYRACUSE — Naylor Electric Co. — 2-3894 — State Tower Bldg., Room 317, Syracuse 2, N. Y.
MERIDEN — Henry Lavin Assoc. — 7-4555 — (Henry Lavin) P. O. Box 196, Meriden, Conn.
NEEDHAM — Henry Lavin Assoc. — 3-3446 — (Robt. V. Curtin) 82 Curve St., Needham, Mass.
CLEVELAND — Ernie Kahler Assoc. — Olympic 1-1242 — 8905 Lake Ave., Cleveland 2, Ohio
INDIANAPOLIS — R. O. Whitwell & Assoc. — Melrose 2-8517 — 2208 E. Washington, Indianapolis 1, Ind.

FOR ADDITIONAL INFORMATION CONTACT
COMMUNICATION ACCESSORIES COMPANY
 HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 5528

CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Oscillator Has Low Distortion



The Model DK-1 low distortion fixed-frequency power oscillator produces essentially pure, highly-stabilized sine wave power at 10v, 2w, and 0.03 ohm

impedance. It is useful in the engineering laboratory and may be used for production testing. Frequency is factory set to customer's order within the range of 300cy to 10,000cy; a trimmer provides adjustment.

Total harmonic content of the sine wave is less than 0.08%. Amplitude shift due to loading or line-voltage variations of 10v is less than 0.18%. Frequency shift between no-load and full load is less than 0.16%; there is no shift due to line fluctuations up to 10v.

The unit is housed in a ventilated metal case 3-3/4" x 4-3/8" x 8-1/2" deep. The circuit is an L-C, bridge type. Incorporating a high-Q toroid, combined with a self-balancing feedback amplifier. Neucor, Inc., Dept. ED, 45 W. Union St., Pasadena 1, Calif.

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

Write today for your free copy of this Technical Paper.

ask for data file **207**

A Precise, Wide-band, Continuously Variable Delay Line

BY NORMAN GAW, JR.
 AND DAVID SILVERMAN
Helipot Corporation
 MELVIN B. KLINE
Instrument Division
 Allen B. DuMont Laboratories, Inc.

Presented at THE 1954 WESCON

436

Helipot first in precision potentiometers
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MINIATURE SPEED CHANGERS

COMPLETE COMPACT ADAPTABLE

- Over 400 different Standard ratios! 10:9 to 531,441:1
- SMALL! 1.050" Diameter. Overall lengths: Class A, 3-1/8" Class B, 3-15/16" Class C, 4-3/4"
- Transmit power either way to 100:1 ratios!
- Concentric ball-bearing input and output shafts.
- Hardened steel spur gears.
- Permanent lubrication.
- Prompt deliveries on production or experimental quantities.

BULLETIN No. 100
 Gives complete details - Write for it today to METRON INSTRUMENT COMPANY, 450 Lincoln Street, Denver 3, Colorado

BUILT BY **Metron** MAKERS OF INSTRUMENTS FOR PRECISION MEASUREMENTS

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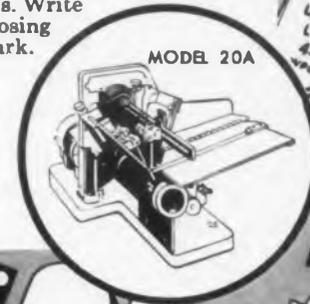
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ELECTRONIC DESIGN • February 1955

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AND
SAMPLES

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CUT ASSEMBLY COSTS!

These ingenious new plastic fastenings drive from one side—simplify blind fastening problems—resist vibration loosening and corrosion. Available in a wide variety of thermo-plastic materials, in a wide choice of colors, sizes and standard or special types.

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CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

WIDE-BAND POWER OSCILLATOR

200 to 2500 mc/sec.



A new instrument of unusual capabilities, the Maxson Model M1141 UHF Wideband Power Oscillator, provides exceptionally broad frequency coverage and substantial power output in a single source. A simple changeover of feedback assemblies provides overlapping coverage of the full range in two bands. For easier portability, the instrument is divided into two units. Provision is made for internal and external amplitude modulation and for CW operation. With its smooth tuning and precise resettability, the Model M1141 is an excellent general-purpose signal source.

Specifications are: ranges—200 to 1050 and 1000 to 2500 mc; power—50 watts to 400 mc—25 watts to 1000 mc—10 watts to 2500 mc; calibration accuracy $\pm 1\%$ or ± 5 mc, whichever is greater; resettability—better than 0.1%; modulation—internal square- and sine-wave at 400 and 1000 cps; output impedance—50 ohms (nominal).

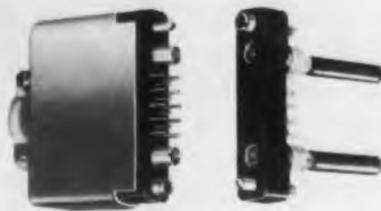
THE W. L. **MAXSON** CORP.

460 WEST 34TH STREET, NEW YORK 1, N. Y.

CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Connector

Combines 14 Regular, 2 R-F Contacts



The MRX14-2 connector is a light-weight, compact unit combining 14 conventional miniature contacts and two general purpose r-f contacts.

The coaxial contacts have a nominal impedance of 53 ohms and minimize electrical discontinuity when used with small cables such as RG-58/U.

All contacts, both miniature and coaxial, are rated at 5amp and are gold plated over silver for high conductivity, corrosion-resistance, and ease of soldering. Molded melamine, mineral filled, is used as the matrix material to provide high arc resistance and high dielectric and mechanical strength. Guide pilots and sockets insure positive polarization.

Voltage breakdown between adjacent miniature contacts is 4000v d-c at sea level; 1050v d-c at 60,000'. Voltage breakdown between the inner coaxial contact and ground is 2900v d-c at sea level; 700v d-c at 60,000'. Weight of plug is 0.7oz; weight of receptacle, 0.6oz. Winchester Electronics, Inc., Dept. F, Willard Rd., Norwalk, Conn.

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

Radomes

Fiberglass Resin Laminates

Sandwich Structures with Foam Cores
Honeycomb Cores

Excellent design and manufacturing facilities for the production of the very best fiberglass laminates are available here at Emerson & Cuming. Matched metal, vacuum bag and contact pressure molding are usual production techniques. Both fiberglass mat and woven fabrics are used with epoxide, polyester and phenolic materials to build laminates to the most exacting specifications. Ask us to quote on your requirements—for delivery when you want it.

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properties of selected Laminates

High Flexural Strength 85,000 psi
Energy Transmission to 99%
Temperature Range -100°F to +500°F
Water Absorption less than 0.1%



Emerson & Cuming, Inc.

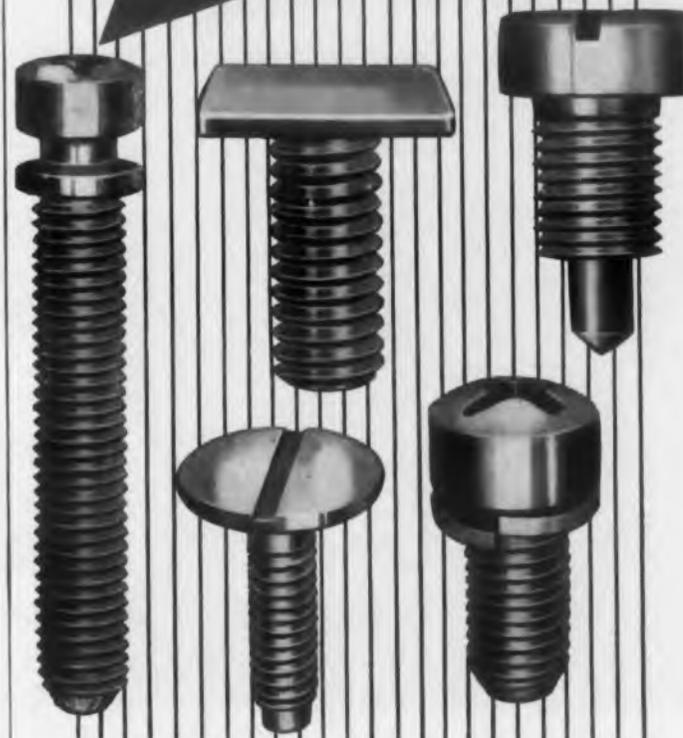
PLASTICS for ELECTRONICS

669 Washington Street, Canton, Mass.

CIRCLE ED-215 ON READER-SERVICE CARD FOR MORE INFORMATION

ELCO

Specials



FOR EXAMPLE

This special screw was formerly made in two parts and spot-welded together. Elco now produces this part, in one piece, by the Cold Heading method at a savings of \$13.26 per thousand.

OVER 30 YEARS EXPERIENCE MAKING SPECIALS AND STANDARDS

ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY • ROCKFORD, ILLINOIS

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION

announcing an

ext

miniature relay

It's the new ADVANCE SQ—a telephone
type that hits a new high
in ruggedness and efficiency!



Only 15 milliwatts per pole will operate the new SQ relay in the DPDT combination. Here is sensitivity teamed with stable performance—the DPDT unit withstands 10 G's vibration from 10 to 500 cycles. When power is increased to 40 milliwatts per pole, vibration resistance rises to 30 G's. A single-coil relay, the ADVANCE SQ is available in 1- to 5-amp contact ratings, and in contact combinations from SPST to 6PDT. It comes through Signal Corps tumbling and shock tests in excess of 200 G's with operating characteristics unimpaired.

Sustained efficiency keynotes SQ operation. The use of a beryllium copper armature retaining spring insures positive contact between armature and pivot points at all times. Cross-bar palladium contacts are always properly aligned. A wide variety of coil resistances is feasible. Instead of organic insulation, the unit employs Silicone glass, Kel-F, or Teflon tubing. Life expectancy for 5-amp, non-inductive loads is 150,000 cycles . . . for 1-amp, non-inductive load: 1,000,000 cycles.

Open type dimensions are 1" x $\frac{3}{4}$ " x $1\frac{1}{16}$ ". DPDT units are supplied in a sealed container measuring 1" x 1" x 2". Write for literature on the SQ series.



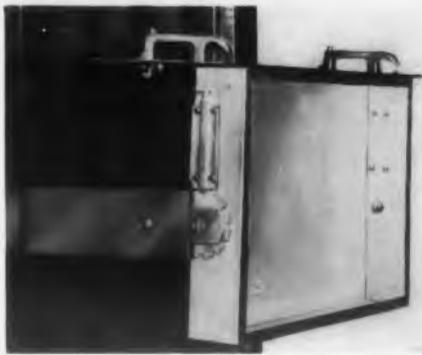
ADVANCE ELECTRIC AND RELAY CO.

2435-K NORTH NAOMI STREET, BURBANK, CALIFORNIA

*Sales Representatives in Principal Cities of
U. S. and Canada*

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

Chassis Slide Chassis Can Be Tilted



A chassis mounted on "Chassis-Traks" can not only slide out from the rack-cabinet to a locked "out" position, but can be rotated while in this position, so that top or underside can be serviced.

Chassis Trak is designed to universal rack standards, permitting the mounting of standard 17" chassis in standard 19" rack. The slides occupy less than 1/4" of width on either side of the chassis. Slides are available for chassis depths of 14, 16, 18, and 20 inches.

The slides are available in two variants: Type CTD is provided with a tilt-lock detent mechanism locking at 30° intervals of rotation from minus 90° to plus 120°; Type CTB tilts back to plus 120° for underside servicing. With either type, the chassis may be easily removed from the slides by finger tip control.

The slides feature sturdiness and permanent lubrication. They are made of welded hard-rolled steel, cadmium plated and covered with moly-base dry lubricating paint. Ventrak Corp., Dept. ED, 11 West 42 St., New York, N. Y.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

Generator In Double-Purpose Design



A two-phase indicating sine-wave, and two 10° pips 180° apart, coordinated to one of the phases, are produced by the GPM-3 Generator. Delivering a 13v, 20cy output at 1200rpm, the standard generator has a normal voltage tolerance in production of $\pm 0.15v$, while over a load range of more

than 4 to 1, output voltage is held to $\pm 0.5v$. Harmonic content, nominal at 3%, averages about 0.8%.

Current rating of the generator is 0.015amp per phase, with a substantial overload factor—particularly under favorable environmental conditions. Peak current rating of the pip-generating switch is 300ma.

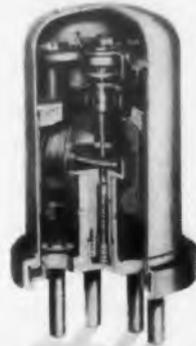
Weighing 19 oz, the generator has a 3-1/4" diam at the mounting flange and a 4" overall length. Electrical terminals (illustrated) are standard, but alternative arrangements can be provided. Dalmotor Co., Dept. ED, 1326 Clay St., Santa Clara, Calif.

CIRCLE ED-219 ON READER-SERVICE CARD FOR MORE INFORMATION

Thomas A. Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

When you need
more
than a relay—
consider the
Edison 219



So sensitive—so sure in action is the new EDISON 219 Sensitive Control Relay that it actually eliminates the need for a vacuum tube amplifier. Because of low operating power level, the Model 219 can operate directly from a thermocouple or photocell output. And this extreme sensitivity is matched with compact design and relative lightness in weight.

Designed and developed in the world-famous EDISON Laboratory, the new Sensitive Control Relay has proven reliability in military and commercial applications.

Important features of the EDISON Model 219 include:

extreme versatility—interchangeable coils can be supplied with resistances from 0.5 to 23,000 ohms. Normal closing power may be increased 10,000 times without adverse effects.

absolute stability—repeatability averages about $\pm 1.5\%$.

platinum-iridium contacts—either SPST or SPDT, with capacity of 1/2 ampere at 28 volts DC, non-inductive.

maximum vibration resistance—withstands shock of 50 g's in all planes without damage.

Simplify your design problems by writing for complete data on the new EDISON Model 219—today!

Thomas A. Edison
INCORPORATED
INSTRUMENT DIVISION
55 LAKESIDE AVENUE
WEST ORANGE, NEW JERSEY

CIRCLE ED-220 ON READER-SERVICE CARD

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low cost

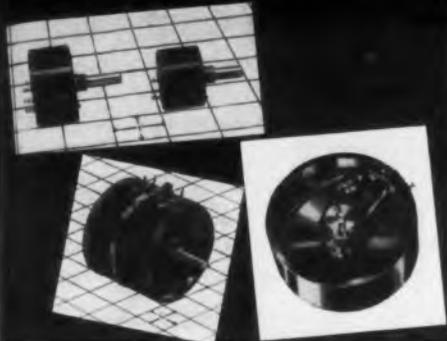
PRECISION POTENTIOMETERS

for AUTOMATION and INDUSTRIAL APPLICATIONS

The P-Series have been designed to meet the growing demand for economical precision potentiometers used in commercial instrumentation. These units retain many of the precision features developed for stringent military requirements.

P-SERIES FEATURES:

- TIC Standards of Accuracy
- Low Noise
- Long Life
- Low Torque
- Linear and nonlinear functions
- Minimized Distributed Capacity
- Excellent Frequency Response
- High Stability
- Single or Ganged Assemblies



SPECIFICATIONS

	P 3	P 15 $\frac{1}{2}$	P 1 $\frac{1}{4}$
ELECTRICAL			
Resistance Range	100-200 K Ω	100-150 K Ω	100-100 K Ω
Independent Linearity	$\pm 0.5\%$ std to $\pm 0.15\%$ spec.	$\pm 0.75\%$ std. to $\pm 0.25\%$ spec.	$\pm 2.0\%$ std to $\pm 0.5\%$ spec.
Winding Angle	$320^\circ \pm 3^\circ$ std. to $\pm 1^\circ$ spec.	$315^\circ \pm 3^\circ$ std. to $\pm 1^\circ$ spec.	$315^\circ \pm 5^\circ$ std. to $\pm 2^\circ$ spec.
Power Rating	8 watts @ 25°C	4 watts @ 25°C	2.5 watts @ 25°C
Taps	Available with 10° minimum separation, located within $\pm 1^\circ$ standard to $\pm 0.5^\circ$ special		
Ambient Temp. Range	-55° to $+80^\circ$ C	-55° to $+80^\circ$ C	-55° to $+80^\circ$ C
MECHANICAL			
Mounting	Tapped Hole	Threaded Bushing	Threaded Bushing
Housing	Bakelite base with aluminum cover	Bakelite base and cover	Bakelite base and cover
Terminals (Gold flashed on silver plate)	Side of base only	Side or cover optional where not ganged	Side or cover optional where not ganged
Bearings	Precision-Bored phosphor-bronze sleeve-type		
Mechanical Rotation	360° std. Mechanical stops available		

A brochure and full details upon request.

TECHNOLOGY INSTRUMENT CORP.

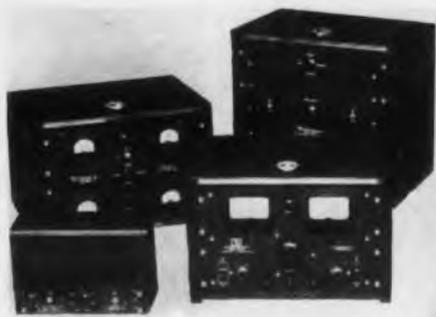
555 Main Street, Acton, Mass.
P.O. Box 3941, North Hollywood, Calif.

See us at Booth 226-228 at the IRE Show

CIRCLE ED-221 ON READER-SERVICE CARD
ELECTRONIC DESIGN • February 1955

Regulated Power Supplies

Laboratory and General-Purpose Grades



This complete line of Regulated power supplies ("B" Supplies) is divided into two grades: "standard" and "laboratory". Thirty-two models of each grade are included.

Dual supplies, with special built-in switching, cover a wide range of requirements, from 100v, 100ma to 1200v, 1200ma. The switching system permits four modes of operation: separate supplies, parallel (with single-knob control), series bucking, and series aiding.

The laboratory grade is designed specifically for long life and stability and includes the following features: blower cooling, selenium power rectifiers, 10,000-hour tubes, no carbon resistances, hermetically-sealed capacitors, components derated at least 30%, and magnetic circuit breakers. The laboratory models should be particularly useful as a power source in computers, permanent laboratory installations, industrial equipment, and remote installations where uninterrupted service life is a prime quality factor. The standard models are suited for bench and production line use. The illustrations shows sizes, from the smallest standard grade to the largest laboratory grade model. N. J. Electronics Corp., Dept. ED, 345 Carnegie Ave., Kenilworth, N. J.

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

Motors

Rated From 1/200 to 1/40hp



This line of high power, uni-directional small motors combines high starting torque with exceptionally high power output.

Known as "YAF" motors, they are available in three stack thicknesses and nine power ratings from 1/200hp to 1/40hp.

Other features include large oil reservoirs, alignable oil-impregnated porous bronze bearings, selection of mounting arrangements, and stainless steel hardened and ground shafts. Typical applications include industrial instruments, small pumps, toys, and many other devices. Small Motors Div., Barber-Colman Co., Dept. ED, 1200 Rock St., Rockford, Ill.

CIRCLE ED-223 ON READER-SERVICE CARD FOR MORE INFORMATION

KEARFOTT

series 900

... all new
synchros



Mechanical Stability

Stator integrally bonded with housing prevents null shifts when rotating or clamping synchro in its mount. All materials have similar thermal coefficient of expansion for optimum performance over a wide temperature range. Case provides positive grounding and shielding.

High Accuracy

10 minutes maximum deviation from electrical zero.

Corrosion Resistant

Housings, shafts and ball bearings are stainless steel. Laminations are corrosion resistant, nickel-bearing steel. Non-metallic materials are fungus inert.

Size 11

1.062" Diam. x 1-45/64 long, weight 4 oz.

Options

Available with leads or terminals, single or double ended shafts.

And Low In Price

Type	Model	Price*
Transmitter	RS911-1A	\$29.50
Control Transformer	RS901-1A	29.00
Repeater	RS921-1A	31.50
Differential	RS941-1A	51.00
Resolver	RS931-1A	44.00

*Based on 1-25 unit price with leads and standard shaft. Quantity prices on request.

Kearfott Series 900 synchros are dimensionally and electrically interchangeable with Kearfott R200 Series Size 11 Synchros. Write today for data sheets.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

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Many opportunities in the above fields are open—please write for details today.



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Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas

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INSTRUMENT and CONTROL KNOBS at Interesting Prices! — no Tooling



See us for "best buys" in standard parts



Parts of hard-finish thermosetting plastic
Readily available—often in stock



Many more models than illustrated—most in
complete size ranges



Send for complete catalog

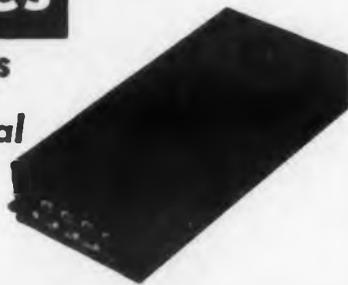
KURZ-KASCH, INC.

Standard Parts Division
1422 S. Broadway, Dayton 1, Ohio

CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

Brew Delay Lines

... for applications
requiring exceptional
characteristics



Shown above is a Lumped Constant Delay Line designed, manufactured, and delivered on schedule to a customer who came to us with the following requirements: delay 1.0 usec, reflections 50 db below peak signal, frequency response: from 0-4.5mc less than ± 0.1 db— from 4.5-10mc less than ± 6 db, attenuation less than 6 db, phasing $\pm .01$ usec 0-4.2 mc, impedance 150 ohms, max. temp. 150° F., operating temperature 120° F., voltage 350 VDC ± 6 VPP video, source impedance 4 uu 1200 ohm, grid circuit termination 10 uu.

The three main types of delay lines . . . Lumped Constant, Ultrasonic, Distributed Constant . . . are available from Richard D. Brew and Co., and our special techniques and methods, plus rigid quality control measures assure you of the finest and most practicable delay lines to meet your needs. Major consideration is given to proper packaging as well as electrical specifications.

Consult Richard D. Brew and Co. and you'll get enthusiastic cooperation and help.

Send for General Catalog 54

BREW

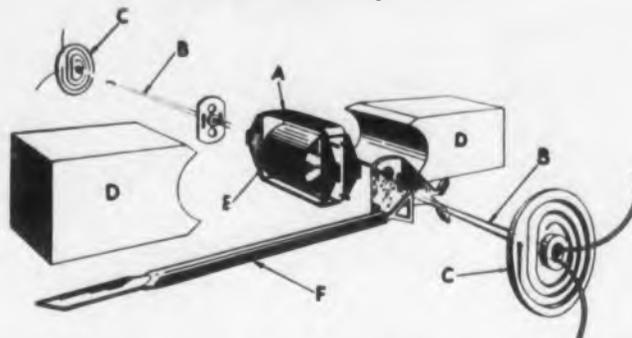
Richard D. Brew and Company, Inc.
Concord, New Hampshire
design development manufacture

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

90

Meter Movements

Use Bifilar Suspension



This firm supplies Greibach bifilar suspension-type meter movements. In this design, the armature is held in place by fine bifilar wires that are kept under precise tension by disc springs contained in the adjustable end pieces of the movement cartridge. Friction inherent in common pivot and jewel construction is eliminated by the bifilar suspension principle, providing a far more rugged meter movement generally associated with instruments of laboratory accuracy. Laboratory standards constructed by this principle have been shock tested to 500g without appreciable loss of accuracy. Initially, the new meter movement will be supplied in custom-built meters and high precision, high shock, laboratory instruments. Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE ED-227 ON READER-SERVICE CARD FOR MORE INFORMATION

DATA SHEET

FAIRCHILD PRECISION POTENTIOMETERS



TYPE 751
7/8"



TYPE 741
1 1/8"

Miniature Single Turn Pots linear and nonlinear

Precision performance in linear or nonlinear functions is assured with these Fairchild miniature pots. The Type 751 (7/8" dia.,—weight 13 grams) has a resistance range up to 75,000 ohms. The Type 741 (1 1/8" dia.,—weight 20 grams) has a resistance range up to 100,000 ohms. 0.5% standard accuracy, 0.25% special accuracy available. Terminals are gold-plated for reduced contact resistance and easier soldering.

SAMPLES AVAILABLE ON ORDER

These units show how Fairchild can help you solve all your precision potentiometer problems. For more information write Fairchild Camera & Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-60N1.

CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION

Type MCM Lever Switch



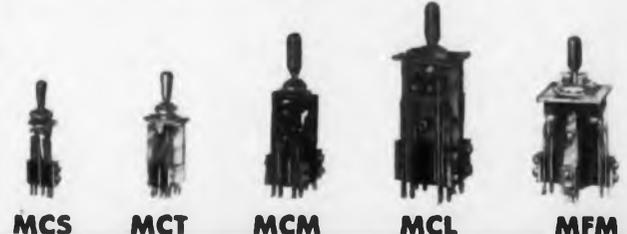
MCM

All lever combinations available. Four contact quadrants. Variety of circuits permitted. Ball-bearing lever action is smooth and positive. 5 amp. contacts are mounted on an easily removed contact block. Single-hole mounting.

Write for Bulletin CL-100

All General Control switches feature riveted coin silver or palladium alloy contacts and are individually adjusted and inspected. Switch types are available from 1 to 10 amperes.

Also available are special switches and contact assemblies to customer specifications.



FOOT LEVER, PUSH BUTTON and LIMIT SWITCHES
ELECTRONIC and SYNCHRONOUS—MOTOR TIMERS
CUSTOM CONTROL PANELS

GENERAL CONTROL COMPANY
1207 Soldiers Field Road • Boston 34, Massachusetts

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW

Measure Noise- Check Performance

**IN MICROWAVE
SYSTEMS**

KAY

MICROWAVE
Mega-Nodes

Employing radiated monochromatic light, the eight waveguide sizes of KAY *Mega-Nodes* provide primary standards covering the microwave spectrum. Useful for measurement of noise figures and receiver gain and sensitivity, and for the calibration of standard signal sources, they also provide a fast and simple check on the performance of radar and other microwave systems. Available in the following waveguide sizes to cover the range of 1200-1400 mc and 2600-40,000 mc:

RO-49/U, RO-48/U, RO-49/U, RO-50/U,
RO-51/U, RO-52/U, RO-51/U, RO-53/U

Available with fluorescent or inert gas (argon or neon) tubes. Noise output fluorescent tubes 15.8 db $\pm .25$ db
• Noise output argon gas tubes 15.2 db $\pm .1$ db. • Noise output neon tubes 18.0 db $\pm .5$ db • Noise output of inert gas tubes, independent of operating temperature.

WRITE FOR DETAILED SPECIFICATIONS
Prices \$295—\$330 Including Power Supplies

KAY ELECTRIC COMPANY
Dept. ED-2, 14 Maple Avenue
Pine Brook, New Jersey

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

NEW Tinnerman Push-On

Speed Nuts®

Available Now
...at a **NEW LOW COST!**



Start by
hand...



Zip down
on studs!

A newly created line of standard Spring Steel Push-On type SPEED NUTS now available at an average price reduction of 25%! This is made possible by large volume, high-speed production. Tinnerman, originators of Push-On type SPEED NUTS, has developed the C12000 Series to fit all popular stud sizes, round, D-shaped, and rectangular. They meet most application requirements... are available in rust-resistant finish. For full cost-saving details on these new low-cost SPEED NUT brand fasteners, see your Tinnerman representative, or write direct to:

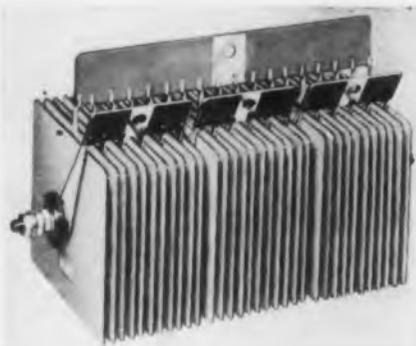
TINNERMAN PRODUCTS, INC.

Dept. 12, Box 6688, Cleveland 1, Ohio

CIRCLE ED-231 ON READER-SERVICE CARD FOR MORE INFORMATION

Rectifier

For High Temperature Uses



This type of selenium rectifier is intended for operation at temperatures substantially above the limits of conventional rectifiers. Extended tests, both laboratory and service, show that it will

operate in ambient temperatures up to 100°C without derating; it will operate continuously at the same normal full rated loads as at lower temperatures. With a moderate amount of derating, the rectifier will operate in temperatures up to 150°C.

As a result of this development, selenium rectifiers can now be used in locations where their use has been impossible heretofore because of temperature limitations. Also, it is now possible to obtain desired de output in high temperature locations with smaller, more compact rectifiers with savings in space, and often in cost. The rectifier is available in all standard cell sizes and circuit arrangements. Fansteel Metallurgical Corp., Dept. ED, North Chicago, Ill.

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

THE RIGHT LATCH TO DO THE JOB BEST

SOUTHCO DOOR LATCHES

Designed for quick, low-cost installation, Southco latches provide a variety of rugged, smart-appearing door and panel fasteners.



LIGHT-WEIGHT DOOR LATCH
For extra low-cost assembly. Adaptable to any light gauge metal closure.



SLIDING LATCH
Mounted entirely on outside, seals door and frame together under pressure.



UNIVERSAL CABINET LATCH
For quick installation on all sheet metal doors without welds, bolts, or rivets.

Write for full data, Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.



ADJUSTABLE PAWL FASTENER
Adapts grip length and tightness to various door and frame thicknesses.



ARROWHEAD DOOR LATCH
Ideal for slide-out drawers, removable or hinged panels. Uses minimum inside space.

SOUTHCO

© 1955

FASTENERS

Whenever two or more parts are fastened together.

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION

NEWLY-
DEVELOPED
Sub Miniature
Type 10
H-SERIES

hermetically sealed resistors

The "H" Series Precision Resistors are encapsulated in a tough plastic compound. The result is a solid, homogeneous unit with unparalleled ruggedness, impervious to the effects of moisture, thermal shock and mechanical shock. The plastic is filled with heat conducting mineral which dissipates the heat and equalizes the "hot spots" in the resistor winding. The sealed-in terminal connections are welded.

SPECIFICATIONS:

MILITARY SPECIFICATIONS:

Performance characteristics satisfy all requirements of MIL-R-93A & JAN-R-93.

TEMPERATURE COEFFICIENT:

±0.0022% per degree C.

OPERATING TEMPERATURE:

-65°C. to +125°C.

RESISTANCE ACCURACY:

Standard resistance tolerances are 1%, 0.5%, 0.25% and 0.1%.

TYPE 10 (illustrated):

1/4" dia. x 1/2" long.

Resistance range: 1.0 ohm

-0.35 meg.

Send for Bulletin H for complete description on other physical sizes and wattage ranges.

HYCOR

Company, Inc.

11423 Vanowen St., North Hollywood 4, Calif..

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C INDUCTION TYPE New Series 15 and 18 SERVO MOTORS

Two new G-M Miniature Servo Motors are now available for use in electronic control circuits. The motors are standard frame sizes 15 and 18 which are 1.437" and 1.750" in diameter respectively, and are designed for use in a wide variety of equipment such as computers, gun sights, navigation equipment, guided missiles, radar and similar applications. These

light weight, high torque, low inertia, two-phase induction motors are available in 2, 4 and 8-pole models for 400 or 60 cycle supply, and can be supplied to meet performance specifications for military servo motors, Mark 7 and Mark 8. The control phase can be wound for connection by the user for either series or parallel operation. The stators of the motors, as in all G-M Servo Motors, are embedded in an insulating compound of high dielectric strength and high temperature stability. This material has a low mechanical coefficient of expansion and great stability at high temperatures. High dielectric strength is maintained between windings and housing when at high altitudes. Write for information on G-M Size 15 and/or Size 18 Servo Motors to



Write for information on G-M Size 15 and/or Size 18 Servo Motors to

G-M LABORATORIES, INC.

4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION

CUT FASTENING COSTS with HASSALL THREADED PINS

- Low cost
- To your specifications
- Roll threaded for greater strength
- Large or small quantities
- Close tolerances
- Any finish • All metals

We are saving many of our customers from 20% to 50% on their special small threaded pins. These threaded pins may be made to your specifications in a wide variety of metals and finishes. Large or small runs are economical.

Let HASSALL quote on your small threaded pins... we can show you real savings.



ESTABLISHED 1850

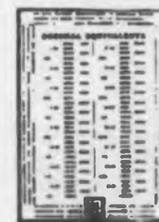
Other HASSALL Specials

- Rivets
- Nails
- Studs
- Hinge Pins
- Screws
- Drive Screws
- Machine Screws
- Fasteners
- Small parts

Our 3 color decimal equivalent wall chart and our complete catalog on request.

JOHN HASSALL, INC.

P.O. Box 2202 Westbury, L.I., N.Y.



CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION

For Absolute dimensional stability... specify

After testing numerous design materials Technology Instrument Corporation specified injection-molded Mycalex 410 for shaft and drive pins in a new series of ganged precision potentiometers

MYCALEX
GLASS-BONDED MICA



By permitting closer dimensional tolerances, Mycalex glass-bonded mica allows TIC to reduce the size and hold these dimensions constant under toughest environmental conditions. And dimensional stability of the Mycalex coupling arm provides precision transference of rotary shaft motion between adjacent potentiometers without backlash.

For more details on this exciting material and its application to your design problem, write to General Offices and Plant: Department 123 Clifton Boulevard Clifton, N. J.

TIC designers are typical of the hundreds of electrical and electronic engineers who have discovered the outstanding qualities of Mycalex. Important Mycalex properties include:

- * **low electrical loss factors**
- * **high dielectric strength**
- * **permanent and absolute dimensional stability**
- * **impervious to water, oil and organic solvents**
- * **very high arc resistance with complete freedom from carbonization**



**MYCALEX
CORPORATION
OF AMERICA**

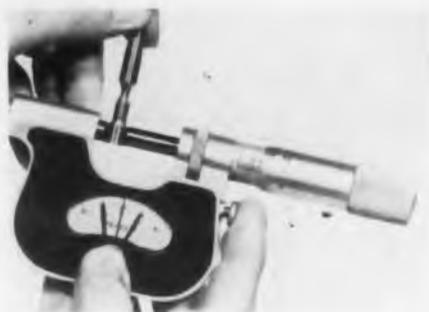
World's largest manufacturer of glass-bonded mica products

Executive offices:
30 Rockefeller Plaza
New York 20, N. Y.

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Micrometer

Built-in Meter Shows Tightness



The "Master Compar" micrometer, providing "visible feel" to the user, has a range from 0 to 1", reading in 0.0001" from an extra-large dial.

The indicating

mechanism controls the measuring pressure so that all uncertainties due to differences in "feel" of individuals are eliminated.

The unit is essentially a master-micrometer and a comparator combined in one instrument. In addition, it provides the user with the equivalent of a complete set of "go" and "no-go" gages of 1" range, reading to 0.0001". An important feature is that it detects out-of-roundness, ovalness, and taper. The release button for the movable anvil is on the right-hand side, enabling the operator to hold it the conventional way.

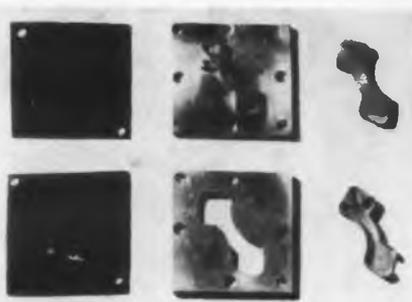
A new feature is resetting to zero, which is accomplished by means of a screw on the bottom of the housing and can be done accurately in less than 5sec. Heavy tungsten carbide anvils and a finished hardwood case are standard equipment. Larger sizes, up to 4", are furnished with a removable indicator. George Scherr Co., Inc., Dept. ED, 200 Lafayette St., New York 12, N. Y.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Parts

Custom Made

Short run plastic molding can be done quickly and economically by the "Economold" process developed by this firm. The method can produce parts from any material that can be transfer molded.



Molds are prepared in plate form, machined from soft metals. This process is particularly adaptable for molding glass-reinforced polyester resin compositions for resultant high strength, high impact, and high temperature resistant parts or components. More flexibility in design is offered with the process, and in most cases delivery can be met on a one-week basis. Douglas Engineering Co., Dept. ED, Montville, N. J.

CIRCLE ED-239 ON READER-SERVICE CARD FOR MORE INFORMATION

Viking miniature connectors

DESIGNED FOR
LONG, RELIABLE
SERVICE LIFE



VIKING circular types. Positive polarization and shielding. Simple locking device mates units against vibration. One to four contacts on small units—5 to 9 on large units.



VIKING printed circuit receptacle. Increases your circuits—unit shown has 20 contacts, and is interchangeable with 18-contact types. Extremely strong contacts, pierced or unpierced.

Hermetic sealing is available on the circular and rectangular series. Write for literature on these or the complete line of VIKING connectors.

VIKING

ELECTRIC

1061 INGRAHAM STREET
LOS ANGELES 27, CALIF.

CIRCLE ED-240 ON READER-SERVICE CARD



Your source for 2K50 REFLEX KLYSTRON TUBES

The new Bendix Red Bank 2K50 is the perfect answer for those who want a thermally-tuned Reflex Klystron tube for K-band operation.

The 2K50 has two primary applications—first, as a local oscillator in small, compact, lightweight, high definition radar and, second, as an oscillator in microwave spectrometers, signal generators and spectrum analyzers.

Because of its thermal feature, the 2K50 may be tuned automatically. Thus, it is ideally suited for difficult locations . . . in aircraft, for example . . . where direct or mechanical tuning is not practical.

Perfection of the complex, ultra-precision 2K50 . . . one of the most difficult electron tubes to manufacture . . . is a tribute to the unique talents of our engineers and production men. It demonstrates why you can depend on Bendix Red Bank for the answer to *any* special-purpose electron tube problem you may have.

MAXIMUM RATINGS

Resonator Voltage	330 volts D.C.
Reflector Voltage	-150 volts D.C.
Tuner Grid Voltage	-50 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	28 ma. D.C.
Tuner Cathode Current	10 ma. D.C.

ELECTRICAL CHARACTERISTICS

Heater Voltage (A.C. or D.C.)	6.3 volts
Heater Current	.755 amps.
Thermal Tuning Range	23216 to 24751 Mc/Sec.
Min. Power Output at 23504 Mc/Sec.	8.5 mW.
Min. Power Output at 23984 Mc/Sec.	10.0 mW.
Min. Power Output at 24464 Mc/Sec.	8.5 mW.
Min. Electronic Tuning at Mid-Band	55 Mc/Sec.

PHYSICAL CHARACTERISTICS

• Dimensions: Maximum seated height 2 1/4" • Base: Small Octal 8-Pin, B8-21, Low Loss Phenolic Wafer • Coupling to Wave Guide: Direct, by means of an insulating fitting • Cooling: Convection • Mounting Position: Any • Cavity: Silver Plated Steel (integral within the bulb) • Bulb: Metal • Output Window: Low loss glass

Manufacturers of Special-Purpose Electron Tubes,
Inverters, Dynameters, Voltage Regulators
and Fractional HP D.C. Motors.

Bendix
Red Bank

DIVISION OF



EATONTOWN, N. J.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif. • Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

CIRCLE ED-241 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial Line Tap Eliminates Line Cutting



This coaxial cable line tap provides isolation and attenuation while eliminating the usual coaxial line cutting and preparation for terminal connections.

The unit is designed for use in master antenna systems,

permitting taps anywhere along coaxial transmission line, either indoors or outdoors. Facilities are provided for rigid mechanical mounting in standard junction boxes. Installation of the line tap is easy. The technician files a half-round notch into the coax line until the center conductor shows. Next, the unit is placed in position on coaxial cable and clamped in place by two machine screws. Finally, a pointed screw is tightened to make the ground connection with coax shield. A standard coaxial fitting with built-in resistance connects to tap line. Technical Appliance Corp., Dept. ED, Sherburne, N. Y.

CIRCLE ED-242 ON READER-SERVICE CARD FOR MORE INFORMATION

Molded Knobs

Wide Range of Types, Sizes



A group of 24 stock molded knobs and handles has been added to the stock items in this firm's line, providing an extremely wide range of shapes and sizes to choose from. Endless variations

from stock molds can be easily obtained to meet specific requirements. In addition, the firm's "deep-relief" branding method permits rapid addition of markings, graduations, designs, etc., on the stock items.

The knobs and handles are designed for use on electrical appliances, radios, television sets, instrument panels, testing equipment, and many other devices. Rogan Brothers, Dept. ED, 8009 N. Monticello Ave., Skokie, Ill.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-244 ON READER-SERVICE CARD >

no matter
how you look
at it...

INTERNATIONAL
Selenium
Rectifiers

do the job!

Write for Bulletin C-349

INTERNATIONAL
RECTIFIER
CORPORATION

El Segundo, Calif. Oregon 8-6281

New York 501 Madison Ave. • Plaza 5-6665

Chicago 292 W. Wacker Dr. • Franklin 2-3889

Broadband RF Power Meters

THE CHOICE OF ALL ARMED SERVICES
FOR MICROWAVE POWER MEASUREMENTS

POWER: PULSE and CW— $5\mu\text{W}$ to 5W average

FREQUENCY: 20MC — 10,000MC

ACCURACY: 5% Absolute at all ranges,
frequencies, temperatures

- **INDICATIONS:** Direct Reading
- **CALIBRATION:** Compensates for All Variables
- **R-F COMPONENTS:** 3, 6, 10 and 20db Attenuators, Bolometer Mount and Elements, R-F Cable
- **BOLOMETER:** Broadband, High Overload Capacity
- **PLUMBING:** $\frac{3}{8}$ " and $\frac{7}{8}$ " 50-ohm Coaxial
- **POWER SOURCE:** 115VAC $\pm 15\%$, 50-1000 cps
- **CONSTRUCTION:** Rugged, meets all JAN, MIL requirements

TYPICAL APPLICATIONS

Microwave Links . . . Television . . . Communications . . .
Radar . . . Telemetry . . . Signal Generators . . .
Laboratory Standards.

Write for descriptive literature to Department ED 2-M

Bruno - New York Industries Corporation

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET NEW YORK 1, N. Y.



Vector Meter

Measures Phase Angle

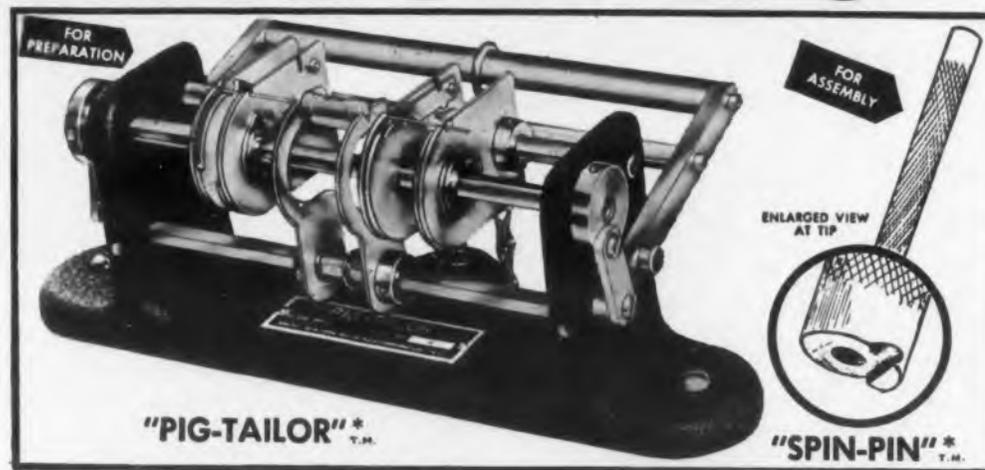


This German instrument is designed to measure the real and reactive components of either alternating current or voltage. Known as Vector Meter II, the unit measures the phase angle between current and voltage. Rms readings can be taken. Covering the frequency range from 45 to 65cy, the instrument has been reported to be especially valuable in magnetic amplifier research. It is particularly useful for tracing electrical curve forms, making harmonic analyses, measuring hysteresis loops, and determining iron losses and permeability. Motor and transformer characteristics can be determined. The compact unit has six current ranges and nine voltage ranges; maximum scale is 15amps, 500v. Accuracy is "class" 0.5% in accord with the German standard. D. C. Seibert, Dept. ED, Box 281, Wilmington 99, Del., is the U. S. representative for Allgemeine Elektrizitats-Gesellschaft.

CIRCLE ED-247 ON READER-SERVICE CARD FOR MORE INFORMATION

"PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

- | | |
|-------------------------------------|-------------------------------------|
| 1. Uniform component position. | 6. Individual cut and bend lengths. |
| 2. Uniform marking exposure. | 7. Better time/rate analysis. |
| 3. Miniaturization spacing control. | 8. Closer cost control. |
| 4. "S" leads for terminals. | 9. Invaluable labor saving. |
| 5. "U" leads for printed circuits. | 10. Immediate cost recovery. |

PIG-TAILORING eliminates:

- | | |
|--------------------------------|-----------------------------------|
| 1. Diagonal cutters. | 6. Broken leads. |
| 2. Long-nose pliers. | 7. Short circuits from clippings. |
| 3. Operator judgment. | 8. 65% chassis handling. |
| 4. 90% operator training time. | 9. Excessive lead tautness. |
| 5. Broken components. | 10. Haphazard assembly methods. |

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. ED 2-P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT
460 WEST 34th STREET NEW YORK 1, N. Y.



CIRCLE ED-246 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Resist Temperature, Humidity



"Seramelite" capacitors are designed as reliable and economical units that have high humidity resistance and will operate continuously over a temperature range of -50° to $+100^{\circ}\text{C}$. They are available with either paper or "Mylar" dielectric and are encased in ceramic tubes. They are sealed with a new thermosetting plastic.

They have an exceptionally high insulation resistance; after 28 days at 60°C and 95% relative humidity with 100% applied voltage, Model 5038 still has an insulation resistance of 1000 megohm-mmfd with a maximum of 10,000 megohms. The units are available in a capacitance range of 0.001mfd to 2.0mfd, with a voltage range of 100 to 1600v, d-c, working voltage, in sizes as small as $0.215'' \times 27/32''$. Good-All Electric Manufacturing Co., 112 W. First St., Ogallala, Neb.

CIRCLE ED-248 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Motor Generator Sets

Miniature A-C Units



These miniature a-c motor generator sets combine synchronous motors with permanent magnet generators. Designated as Type BAI, they have three principal uses. First, they

provide a source of odd frequencies from standard frequency lines such as 15cy, 30cy, 90cy, 180cy, etc. Second, the synchronous motors are supplied with shaft extensions for driving loads. The a-c permanent magnet generator can then be used to indicate the position of the load at any instant. Third, by fitting the unit with a rotating housing, any phase shift from 0° to 360° can be simulated in relation to another generator mounted on the same unit or to an external source.

Many combinations can be furnished, such as motors with one or two generators, stationary or rotating housings, single or dual-speed motors to cover various frequency ranges; one-, two-, or three-phase motors or generators; and generators with two, four, six or 12 poles. Horsepower rating of motors can be furnished up to 1/8hp, in combination with generators having an output voltage up to 200v per 1000rpm. Electric Indicator Co., Inc., Dept. ED, Springfield, Conn.

CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

Antenna

Covers Broad Band



The "Off-Set Feed" antenna, for microwave relay communications, features broad band electrical characteristics. With only two types, it is possible to operate over the entire 1700-2450Mc and 2450-2700Mc bands, with a vswr at 1.02.

Available are 4' and 6' antennas to be operated back-to-back with greatly

reduced crosstalk interference. Weighing less than 16 lb, the unit is adaptable to many supporting structures and transmission line input connectors. Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearney, N. J.

CIRCLE ED-250 ON READER-SERVICE CARD FOR MORE INFORMATION

NEY'S small parts play a BIG part in precision instruments

Genisco Accelerometers are used in the guidance systems of missiles now in large-scale production. They are rugged, potentiometer-type instruments chosen for their reliability and precise performance. For the double-contact wiper of the potentiometer, Genisco selected Ney's Precious Metal Alloy Paliney #7* because it provides the important advantages of holding noise at a minimum, excellent linearity, long life and satisfactory performance in temperatures from -65° F. to +200° F.

Ney Precious Metal Alloys have high resistance to tarnish, are unaffected by most industrial corrosive atmospheres, and have ideal electrical characteristics. These precious metal alloys, developed by Ney especially for precision instruments, have been fabricated into slip rings, wipers, contacts, brushes, commutator segments and similar components. Call the Ney Engineering Department for the selection and design of the right Ney Precious Metal Alloy which will improve the characteristics and prolong the life of *your* precision instruments.

THE J. M. NEY COMPANY • 373 ELM ST., HARTFORD 1, CONNECTICUT

Specialists in Precious Metal Metallurgy Since 1812

*Registered Trade Mark



The Ney Precious Metal Contact (indicated by arrow) is an important part of this Genisco Accelerometer.

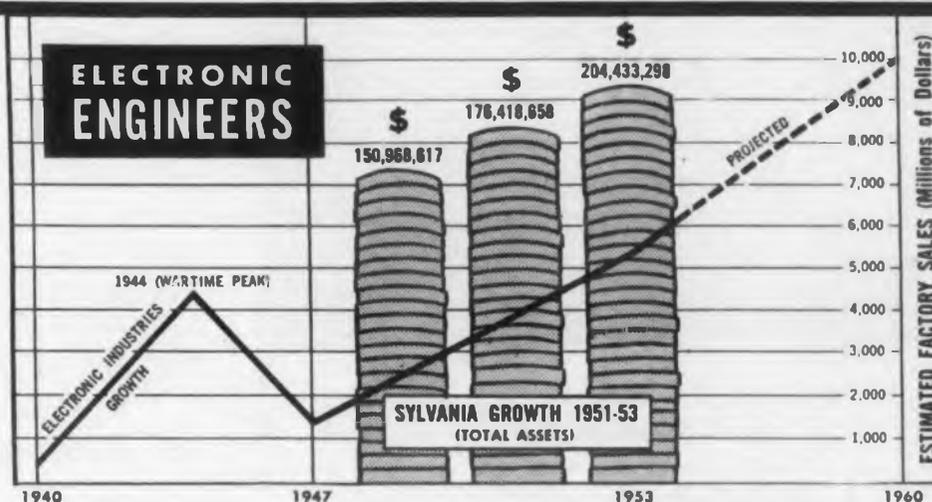
6NY55A

CIRCLE ED-251 ON READER-SERVICE CARD FOR MORE INFORMATION

How Sylvania An Aggressive Leader In Electronics Can Help You Chart Your Growth In The Field

Please forward complete resume to:
Mr. Miles Weaver, Personnel Manager
ELECTRONICS DIVISION

SYLVANIA
ELECTRIC PRODUCTS INC.
Woburn, Massachusetts



If ever there was a field that spelled growth and opportunity for the men in it — that field is electronics, today and tomorrow.

And, fast as electronics is expanding, Sylvania continues its important growth as a leader in the industry. The electronics field has jumped from \$1,350,000,000 in 1947 to \$5,500,000,000 in 1953 and is projecting a \$10 billion year in 1960; Sylvania's assets have jumped from \$150 million in 1951 to over \$200 million in 1953. Today Sylvania is reaching out in more new directions, heavily emphasizing research, and development of new products.

In such a dynamic, forward-moving company, you might say that opportunity is built-in and waiting for engineers to make the most of it. Every day new success stories are being created at Sylvania. One of them can be yours.

Opportunities in Development, Production and Sales Engineering in the fields of:
SEMI-CONDUCTOR DEVICES: Transistors • Microwave Diodes • Germanium Diodes
MICROWAVE TUBES: Magnetrons • Thyratrons • T.R. and A.T.R. Tubes

If you are a college graduate, preferably with a degree in Electrical Engineering, Physics, Chemistry or Metallurgy, and have 1-5 years' experience, you are invited to apply.

OPPORTUNITIES in BOSTON and SENECA FALLS
Live and work in Boston's suburbs: WOBURN, NEWTON, IPSWICH Plants. Excellent living conditions and unrivalled educational facilities.
Or in Upper New York State
SENECA FALLS (near Syracuse)

CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW LOW COST Miniature Capacitors



- Plastic film dielectric
- Very High resistance
- Low dielectric absorption
- Very Low cost
- Temperature range — 70°C to 140°C
- Smaller than the smallest
- Extremely long life
- Voltage 100 to 1000 volts
- Capacitance .001 to 1 mfd.
- Will withstand severest environmental tests.
- Plastic Film Capacitors
- High Voltage Power Packs
- Pulse Forming Networks

We invite your inquiries. Ask for our complete catalogue on your company letterhead.



Plastic Capacitors, Inc.

2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature ...

Metallic Rectifiers

A comprehensive 128-page illustrated handbook on selenium and copper oxide rectifiers has been prepared primarily for the design and development engineer. The "Metallic Rectifier Manual" deals with rectifier types, designs, circuitry, characteristics, and applications. Included are such circuits and applications as modulation, current limitation, and arc suppression. Revisions and additions will be sent free to manual owners. *The price is \$2.00. Bradley Laboratories, Inc., 168 Columbus Ave., New Haven, Conn.*

Voltage Regulator

257

A 4-page, 2-color bulletin No. T-8300 describes an all static voltage regulator for 60-cycle a-c alternators. The brochure gives detailed information on construction, operation, installation, models, and specifications. Also included is a list of suggested applications. Inet Div., Leach Corp., 4441 Santa Fe Ave., Los Angeles 58, Calif.

Office Operations Film

This black-and-white film is a kinescope of a closed-circuit TV demonstration of common language office machines in action processing a sales order. How business firms can mechanize their offices by using a common language for all office machines is described in the 1hr 16mm sound motion picture. The kinescope reports the highlights of the American Management Association meeting that dealt with reorganization of office procedures in preparation for the use of electronic equipment. Accompanied by a kit of reference material, the film is designed for business groups which want to conduct their own conferences on the subject. *Rental for the first day is \$75; for each subsequent day, \$35, with special rates for extended periods. Management Film Library, Dept. 100, American Management Assn., 330 W. 42nd St., New York 36, N. Y.*

Cathode-Ray Tubes

259

This 40-page designer's booklet, No. ETD-985, on cathode-ray tubes provides data on 24 standard tube types and describes engineering and production facilities available. Technical information includes tube essential characteristics, gun design factors, and a description of standard phosphors covering color, persistence, and spectral response. Tube Dept., General Electric Co., Electronics Park, Syracuse, N. Y.

Lens System

260

Catalog No. E.52 describes a water-cooled lens system. Designed for use with industrial TV equipment, the water-cooled system permits direct viewing of furnaces, boilers, and other operations. Radio Corp. of America, Engineering Products Div., Building 15-1, Camden 2, N. J.

Oscillographs; Amplifiers

261

Information detailing recently developed models of oscillographs and amplifiers is provided in this brochure. The literature gives basic details of 4- and 6-channel oscillographs in combination with universal and dual-channel d-c amplifiers. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Relay Selection

262

How to select a magnetically or mechanically held relay is shown in this publication, "Relay Selection Tabulations". Circuit diagrams for 2-wire control, stop-start 3-wire maintained control, and thermostat control for magnetically held relays are supplied. Diagrams for mechanically held relays include momentary contact, push button control, maintained contact control, and ratchet relay equivalent operation. Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

High Dielectric Bobbins

For High "Q" Coils

PRECISION



MADE TO YOUR EXACT SPECIFICATIONS IN ANY SIZE, SHAPE, QUANTITY

Precision coil bobbins are fabricated from high dielectric materials and quality controlled to the most minute tolerances . . . Yet, because they are made on special high production equipment, they're available to you for prompt delivery at low unit cost. Cores are spirally wound dielectric kraft, fish paper, acetate, phenol impregnated or combinations. Flanges are cut to any specification for all types of mountings.

Request illustrated bulletin. Send specifications for samples.

We also manufacture paper tubes in all sizes, shapes, ID's and OD's.

Sales Representatives in:

New England: Framingham, Mass., Framingham 7091	Philadelphia: Philadelphia, Pa., Chestnut Hill 8-0282
New York, New Jersey: Jersey City, New Jersey, Journal Square 4-3574	Northern Ohio, Western Pennsylvania: Cleveland, Ohio, Atlantic 1-1060
Upstate New York: Syracuse, N.Y., Syracuse 76-8056	Indiana, Southern Ohio: Logansport, Indiana, Logansport 2555
Maryland: Baltimore, Maryland, Plaza 2-3211	Missouri, Southern Illinois, Iowa: St. Louis, Missouri, Sterling 2318
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PRECISION PAPER TUBE CO.

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CIRCLE ED-263 ON READER-SERVICE CARD FOR MORE INFORMATION

...KULKA TERMINAL BLOCKS

CUT COSTS . . . SPEED PRODUCTION



● SIMPLIFY WIRING ●
NO SPLICING
NO LEAKS OR SHORTS

Molded Barrier-type Terminal Blocks in approved materials and several styles, ranging in size from miniature to jumbo (90 amps.). With or without plain or printed Marker Strips in fibre or bakelite.

Catalog on Request

KULKA ELECTRIC MFG. CO., Inc.

Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Industrial Movies

265

A 36-page catalog provides complete information on Westinghouse sound motion pictures and slide films. The film subjects are listed and classified into three groups: general interest, product information, and training films and instruction courses. The sound films, both in color and black and white, are loaned at no charge except return transportation costs to organized groups and are available in 16mm and 35mm sizes. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Printed Circuit Relay

267

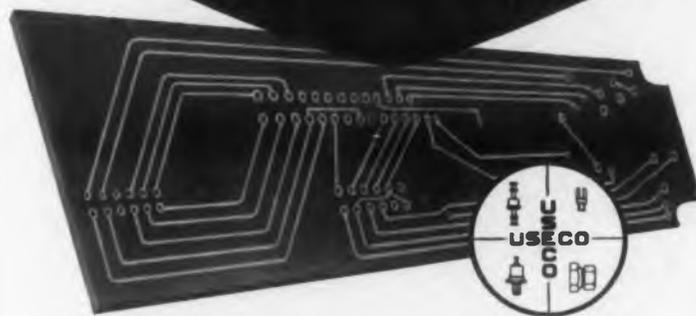
This 2-page, 2-color catalog describes a new sub-miniature type relay available with printed circuit terminals as well as standard soldering lugs. Dimensional drawings illustrate various types and applications are given. Phillips Control Corp., Joliet, Ill.

Technical Books

269

These two catalogs list engineering and scientific books of all publishers available from this company. Catalog No. 1-53 lists about 2000 titles in the field of advanced mathematics and classical works in physics. Catalog No. 1154 contains a bibliography of over 1000 books on radio, TV, electricity, electronics, light, optics, and sound. McKenna Technical Books, 882 Lexington Ave., New York 21, N. Y.

ETCHED AND PRINTED CIRCUITS



Long a recognized leader in standardized electronic hardware and terminal board fabrication, U. S. Engineering Co. now offers expanded facilities for the mass production of quality etched circuits to your prints. Prototype inquiries as well as production runs are invited. Cost estimates and quotations are given immediate attention. Send for new illustrated 8-page Brochure.

U.S. ENGINEERING CO.

(A Division of Litton Industries, Inc.)

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PRINTED CIRCUITS

can simplify your design . . .
speed output . . . cut costs

Eliminate wires! 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
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—Best for printed circuits!



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Please send me a copy of your free booklet on new uses for Straits Tin.

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CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

Introducing FUSITE'S New T.P.* Terminals with V-24 GLASS

*** TORTURE-PROOF**
(Don't take our word
for it. You test them.)



Fusite's exclusive new V-24 Glass, developed in our lab., smelted right in our own plant is now permitting us to offer features in our entire line of hermetic terminals that we've long dreamed of, never 'til now realized.

Check these construction and performance features:

- 100,000 Meg. Ohms at 150° C.
- Extreme Resistance to Thermal and Mechanical Shock.
- Greatly Improved Flash-over.
- Hot Solder Dipped for Better Salt Spray Resistance and Easy Soldering.
- Stronger Low Expansion Alloy Pins in Light-weight Cap.
- Remain Leak-proof through Years of Use and Abuse. (Test 'em on Your Mass Spectrometer Leak Detector!)



Write Dep't. L-1 today for free samples for testing. Specify Fusite V-24 Glass.

THE FUSITE CORPORATION
6000 FERNVIEW AVENUE
CINCINNATI 13, OHIO

CIRCLE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire Flattening

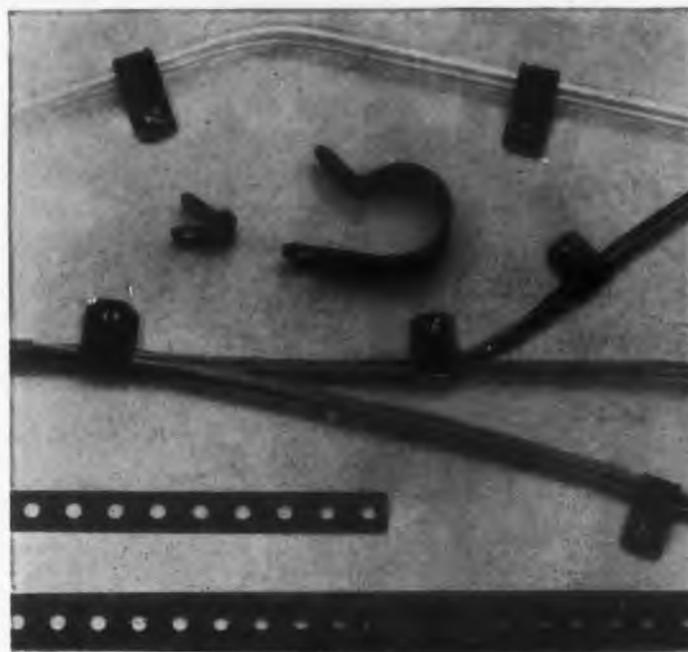
273

This 8-page bulletin on current wire flattening theory and practice is illustrated with schematic drawings, graphs, and photographs. It outlines convenient methods of determining spread, wire size, and wire power requirements. The discussion includes the design and operation of modern, high-speed mill equipment, capable of producing stock with a high degree of surface finish, smooth edges, and dimensional tolerance as close as ± 0.0001 ". Stanat Mfg. Co., 47-28 37th St., Long Island City 1, N. Y.

Precision Cams

277

A 4-page, 2-color bulletin illustrates and describes a wide variety of types and sizes of cams for practically any kind of application. They are especially valuable as highly accurate, compact mechanical "memories" for analog computers and similar systems. Cams fall into two major groupings: "3-dimensional" (two inputs) and single-input cams. Information on construction and applications, and data on sizes, tolerances and materials are provided. Ford Instrument Co., Div. of Sperry Corp., 31-10 Thomson Ave., Long Island City 1, N. Y.



HOLD — wiring — fragile glass tubing — mercury switches — components — etc. with these **NyGrip*** (all Nylon) plastic cable clips and perforated strap-ping — light weight — tough — flexible — strong — chemically resistant — use from -60 to 250°F — send for free samples and literature. TM

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Linde synthetic sapphire
...for excellent optical transmission
PLUS physical strength and chemical inertness

Sapphire is hard, strong, chemically inert and transmits a high percentage of radiation in the important ultra-violet and infra-red regions. At 1750A forty per cent of the radiation is transmitted by a .059 inch section; at 5.7 microns forty per cent is transmitted by a .100 inch section. This unique combination of properties makes it ideal for optical systems that require resistance to abrasion and corrosion and high temperature strength as well as excellent optical transmission.

Now single-crystal sapphire windows are available in diameters up to 2 inches in several finishes. For further information, call or write your nearest LINDE office.

LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street, New York 17, N. Y. • **UNION** Offices in Other Principal Cities

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1440 page MASTER

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Electronics

NEW!
BUYING GUIDE
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Make rapid selections from one industry-wide MASTER CATALOG complete with SPECIFICATIONS, ILLUSTRATIONS, DESCRIPTIONS, DIAGRAMS, PRICES on thousands of Radio-TV-Electronic parts and equipment.

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ELECTRONIC DESIGN • February 1955



Get the right resistor!

• You'll be most likely to find it among Ward Leonard's dependable Vitrohm resistors—the most complete line ever offered by any manufacturer. Write for 64-page free catalog to Ward Leonard Electric Company, 77 South St., Mount Vernon, New York.

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

PHENOLITE • RELAYS • MOTOR CONTROLS • CHROMASTER



CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

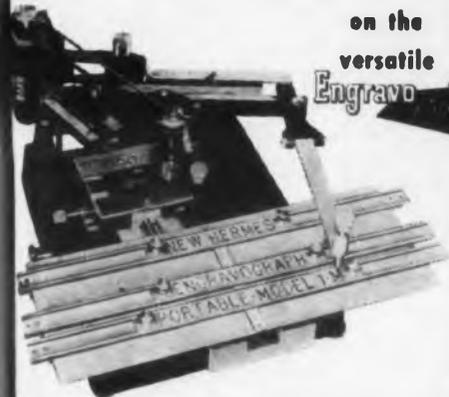
THE NEW WAY TO MARK EQUIPMENT...

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the first chip-proof, flexible engraving stock

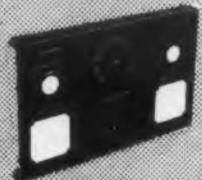
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So simple to engrave GravoFlex. Lettering will stand out permanently on contrasting background. No paint needed.

10,000 Engravographs in use for engraving on metals and plastics. Only the Engravograph has these patented features:

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NEW HERMES ENGRAVING MACHINE CORP
13-19 UNIVERSITY PLACE, NEW YORK 3, N.Y.

CIRCLE ED-281 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

Electronic Gager System 282

A 4-page application sheet describes an electronic gager system widely used in pipeline operation. This literature describes and illustrates principles of operation, equipment, circuitry, and the use of precision potentiometers in this telemetering system. Technical Information Service, Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.

Time Delay Relays 283

A 12-page product bulletin describes this firm's line of time delay relays. Known as bulletin No. PB-310, it covers adjustable time delay relays for panel mounting as well as fixed and adjustable units designed for built-in applications. Cut-away and exploded views illustrate design and application features. Time ranges are included. R. W. Cramer Co., Box 22, Centerbrook, Conn.

Oscillographic Recorders 287

This folder describes type 150 oscillographic recording systems. The systems illustrate a design concept of amplifier interchangeability to provide versatility in recording. Industrial Div., Sanborn Co., 195 Massachusetts Ave., Cambridge 39, Mass.

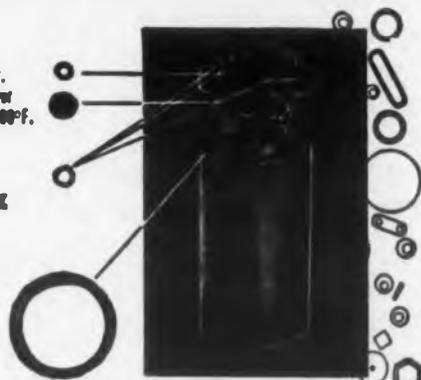
3 Soldering Operations in 1 Easy as ABC

with KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 5% Silver
—95% Lead Alloy. Melting Point 600°F.

B Solder glass terminals to cover.
"Solderform" Rings 63% Tin—37%
Lead Alloy. Melting Point 361°F.

C Hermetically seal cover on can.
"Solderform" Ring 20.5%
Bismuth—20.5% Tin—43%
Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

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Newark 3, New Jersey • Brantford, Canada

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

Koiled Kords* permit EASY SERVICING of In-a-Door or Sliding Units . . .



A six inch section of KOILED KORDS retractile cord will extend to more than two feet when pulled and when released will retract immediately to its original neat, compact, spring-like shape. KOILED KORDS solve the problem of carrying current to movable units without having a long trailing cord to foul in the mechanism. They make it possible to retain electrical contact between units when they are pulled out for servicing, facilitating trouble location and correction.

KOILED KORDS extend as needed without looping, dangling or tangling.

KOILED KORDS are compact, neat, attractive, built to withstand continued flexing.

KOILED KORDS are available on special order to your specifications in multi-conductor types up to 37 conductors. Stocked types include 2, 3, 4 and 5 conductor #23 AWG communications cords and 2, 3 and 4 conductor Underwriters' Laboratories approved SO, SJO and SV-neoprene jacketed power cords. KOILED KORDS can be supplied in 48 inch mandrel lengths or prepared into cord sets for attachment to equipment.

WRITE FOR KOILED KORDS APPLICATION BULLETIN
SHOWING MANY USES.

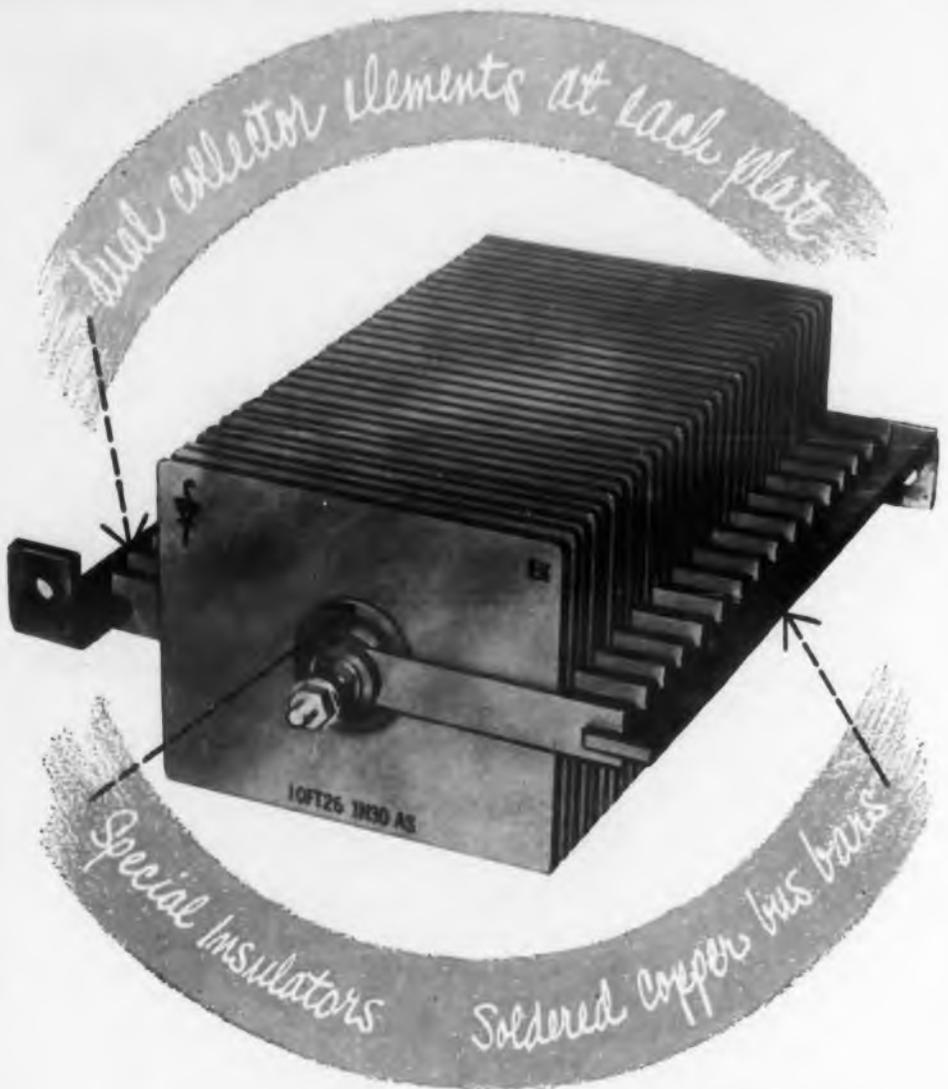
Koiled Kords
Incorporated

Box K, New Haven 14, Conn.

*KOILED KORDS is the trademark of Koiled Kords, Inc.

CIRCLE ED-288 ON READER-SERVICE CARD FOR MORE INFORMATION

These Features Make The Difference



Low resistance electrical connections that stay low even after years of service, eliminate needless heat generation and extend rectifier life. Check these features:

- 1 Soldered copper bus bars.
- 2 Dual collector elements at each plate.
- 3 Special insulators that do not compress with age and cause loose assemblies.

Let us consider your power conversion problems or requirements. Write, wire or phone (Bloomington 2-1435).

Rectifier



Division

Dept. C-1, 415 North College Ave., Bloomington, Indiana

In Canada: 700 Weston Rd., Toronto 9, Tel. Murray 7535

Export: Ad Auriema, Inc., New York City

CIRCLE ED-289 ON READER-SERVICE CARD FOR MORE INFORMATION

Radiation Applications 290

Some potential uses of radiation in foods, drugs and pharmaceuticals, plastics and chemicals, measurement techniques, and self-luminous paints are described in a 12-page brochure. Also included are data on this organization's services and personnel. Radiation Applications, Inc., 342 Madison Ave., New York 17, N. Y.

D-C Motors 291

Catalog No. F4344-1, describing permanent magnet d-c motors with outputs up to 1/10hp, contains data sheets on typical motors from 6v to 115v d-c. Units having radio-noise filters, gear heads, and centrifugal blowers are described. Aircraft Controls Div., Barber-Colman Co., 115 Loomis St., Rockford, Ill.

Alloys 292

This 4-page, 2-color bulletin describes this company's services in providing custom and standard alloys. Facilities for production are shown. Cannon-Muskegon Corp., 2875 Lincoln St., Muskegon, Mich.

Vacuum Metallizing 295

Vacuum metallizing, the depositing of a thin coating of metal by evaporation and condensation under high vacuum conditions, is fully described and many of its applications are illustrated in a special 24-page brochure entitled "Vacuum Metallizing". The brochure itself is a specimen of the silver-bright finish obtained by this process; its cover is a sheet of acetate which has been vacuum metallized with a coating of aluminum 3 millionths of an inch thick before being bonded to the paper stock. In the brochure are specifications for the company's complete range of vacuum metallizing equipment. F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.

Resistors 296

Series 850 resistors, described in this 4-page, 2-color bulletin, are the hermetically sealed precision metal film type. Temperature coefficients, load life stability, moisture resistance, and voltage coefficients of the resistors are discussed. Daven Co., 191 Central Ave., Newark 4, N. J.

DEKAVIDERS



PRECISION POTENTIOMETERS

LINEARITY BETTER THAN 50 PARTS PER 1,000,000

Resolution 3 parts per 1,000,000 • 100,000 scale divisions • Maximum frequency error at 10 kc approximately 50 parts per 1,000,000
• Fully shielded with separate shield connections • Unique adjustable base • Exclusive Dekadial for maximum ease of reading.



ELECTRO-MEASUREMENTS, INC.

4312 S. E. STARK STREET PORTLAND 15, OREGON

Nationwide Representation

CIRCLE ED-293 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955

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Telemetering Components 299

Nine technical data bulletins describing this firm's various telemetering components have been published. Each bulletin contains dimensional drawings, tables of operating and installation data, charts, and schematics. Function, design features, and operating characteristics are discussed. The first bulletin describes a commutator-gating unit; the second a dynamotor unit; the third a dynamotor-commutator-gating unit. Other units discussed are a variable reactance oscillator type 874, strain gage oscillator, type 949; voltage controlled oscillator, type 957; universal mounting assembly, crystal controlled phase-modulated transmitter, and FM transmitter. Raymond Rosen Engineering Products, Inc., 32nd & Walnut Sts., Philadelphia 4, Pa.

Etched Circuits 300

Terminals, terminal boards, and etched and printed circuits are described in an 8-page bulletin. Ordering information and other data are included. U. S. Engineering Co., 521 Commercial St., Glendale 3, Calif.

Injection Molding 301

The Model 700, a 4-oz injection molding machine giving positive ejection and producing finished, de-gated pieces, is described in 6-page Bulletin No. 560. How successful automation is accomplished in the injection machine is shown by a sequence of seven photographs that illustrate the positive ejection of pieces and runners, de-gating, and separation of finished parts from sprues and runners. Specifications, details of construction and operation, and various production economies are presented. F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.

Selenium Rectifiers 302

This 24-page 2-color bulletin No. 177 covers "Selectron" selenium rectifiers. It includes sections on the basic nature of the selenium rectifier, conventional rectifier supports and methods of connecting stacks, selenium cell ratings, a list of rectifier applications, and a table of rectifier stacks available from this firm. Radio Receptor Co., 251 West 19th St., New York 11, N.Y.

For Generation of Pulse Voltages -

**3 electrode
zero bias
thyatron
with peak
power
handling
capacity
to 2.6
megawatts**



CHATHAM MODEL 5C22 HYDROGEN THYATRION

MAXIMUM RATINGS - Absolute Values

Maximum Peak Anode Voltage	
Inverse	16 Kilovolts
Forward	16 Kilovolts
Minimum Peak Anode Voltage	
Inverse	800 Volts
Forward	4500 Volts
Maximum Cathode Current	
Peak	325 Amperes
Average	200 Milliamperes
Averaging Time	1 Cycle
Minimum D.C. Anode Voltage	4500 Volts
Maximum Operating Frequency (Note 1)	1000 cps
Minimum Peak Trigger Voltage	200 Volts
Maximum Peak Trigger Voltage	600 Volts
Maximum Heating Factor (Note 2)	3.7×10^{-4}
Maximum Current Rate of Rise	1500 Amps μ s
Maximum Anode Delay Time	1 μ s
Maximum Time Jitter	0.02 μ s
Ambient Temperature	+90 to 50°C

NOTE 1: This is not necessarily the rated operating frequency and will represent the highest operational rate for pulsed tube operation.

NOTE 2: Heating factor is the product of peak current and time.

HEATER VOLTAGE: 6.3v
HEATER CURRENT: 10.6a
ANODE VOLT. DROP: 150v(pk)

For complete information on this and other Chatham Hydrogen Thyatrons, call, write or wire today. Years of specialized experience insures uniformly high performance.

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ELECTRONICS**

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LIVINGSTON, NEW JERSEY

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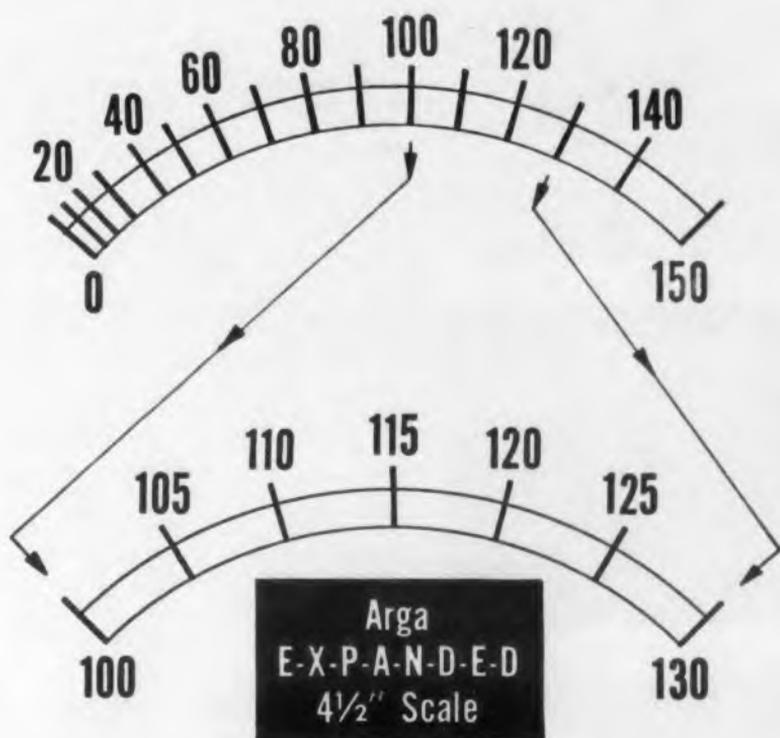
E-X-P-A-N-D-E-D

SCALE

A. C. VOLTMETER



Conventional
4½" Scale



SPECIFICATIONS

ACCURACY — ½% input voltage
FREQUENCY RANGE — 50-2000 cps
BASE VOLTAGE — 115, 120, 208, 230 volts
SPAN — ±5, ±10, ±15 volts
SIZE — 3½" or 4½" — Panel Mounting
SHAPE — Round or Square

Write for Data File 2-116

Arga *division*

BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA 1, CALIFORNIA

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**RHEEM
INSTRUMENTATION
FOR OUTSTANDING
QUALITY**



RHEEM instrumentation units are:

... Designed to operate under the most rigorous environmental conditions and to meet the most exacting specifications required by modern weapons systems.

... Designed to fulfill the demands of missile and aircraft industries for increased performance from existing instrumentation units.

... Designed for compactness, simplicity, and versatility, and for integration into existing systems.

... Designed and built with components of the highest quality for lasting accuracy and dependability.

**RHEEM SUBMINIATURE
INSTRUMENTATION AMPLIFIER**

Model REL-12

SPECIFICATIONS

Size..... 7/8" x 2-5/16" x 4-3/8"
Weight..... 7 ounces
Frequency Response..... 5 to 20,000 cps with
less than $\pm 1\%$ deviation
Voltage Gain..... Adjustable 5 to 500
Linearity..... Within $\pm 1\%$
Output..... 5 v rms maximum
Input Impedance..... Over 100 megohms
Output Impedance..... Less than 100 ohms
Load..... 33,000 ohms minimum
Will maintain a constant output with B+ and
filament variations of $\pm 15\%$.

Different models available with variations of frequency response and recovery time. Recovery time as low as 30 milliseconds.



RHEEM R. F. POWER MINIATURE AMPLIFIER

Model REL-09

SPECIFICATIONS

Size..... 4.90 x 3.37 x 2"
Weight..... 16 ounces
Controls..... Plate tuning
Grid tuning
Filter..... 85-db attenuation filter
on all power leads
Tuning Range..... 215 to 235 megacycles
Power Output..... 12 watts nominal
Required Drive..... 1.4 watts minimum
Plate..... 250 V dc @ 90 ma
Filaments..... 12.6 V @ 0.41 amp
or 6.3 V @ 0.82 amp
Bias..... None Required



**RHEEM SUBMINIATURE
VOLTAGE REGULATOR**

Model REL-11

SPECIFICATIONS

Size..... 1-3/4" x 2-5/16" x 4-3/8"
Weight..... 14 ounces
Output Voltage..... Any nominal voltage from
130 to 235 volts, adjustable
range $\pm 10\%$ of the nominal voltage
Current..... Up to 200 milliamperes
Ripple Reduction Factor..... 5×10^{-4}
Output Impedance..... Will not exceed 2 ohms
from 1 cps to 200,000 cps
Regulation..... Within .05% for load variations
of $\pm 25\%$ and input
variations of $\pm 20\%$
Minimum DC Input Voltage..... Equal to 100 volts
greater than the regulated
output voltage

for complete information on these
and other units or on specialized
electronic design problems, contact

**RHEEM Manufacturing
Company**
Government Products Division

9236 East Hall Road, Downey, California

**YOU CAN
RELY ON...**



Threaded Fasteners 306

"Unbrako Standards" is a 32-page, 2-color catalog covering an extensive line of standard precision threaded fasteners. It includes socket head cap screws, self-locking set screws, shoulder screws, flat head socket cap screws, and button head socket screws, as well as square head set screws, thread pressure plugs, precision ground dowel pins, and socket screw keys. Several applications of each product are indicated in line drawings to suggest hundreds of others. Full photos and cutaway drawings emphasize the special features of each product. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

Hydrogenation 307

"Selective Hydrogenation by the Platinum Metals Catalysts" is the title of this 4-page brochure. Group selectivity and step selectivity in catalytic hydrogenation are discussed and a survey of patents dealing with selective hydrogenation with such catalysts is presented. Baker and Co., Inc., 113 Astor St., Newark 5, N. J.

Electrical Counters 308

This 12-page brochure describes the "Decitron" line of electrical counters available in straight counting, preset, and preset warning types. Counting rates are available from 20/sec to 5000/sec, with maximum total counts up to one billion. Information on the advantages and applications of these various types of units are provided. Electronic Products Div., Post Machinery Co., 150 Elliot St., Beverly, Mass.

Pyrometry 309

A 4-page brochure contains a reprinted article, "Notes on Pyrometry", by the director of research and development of this firm. Some of the topics covered are: factors affecting the accuracy of thermocouples; contact pyrometers; effects of heat input and heat loss on temperature equilibrium in a furnace; partial and total radiation pyrometers; and surface-temperature signals of a chemical nature. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Stability and Opportunity for ELECTRONIC ENGINEERS who want more room to grow

Top opportunities for achievement and recognition are open at FTL... key unit of the world-wide, American-owned IT&T System. FTL's long-range development program offers stability and security. Finest facilities—plus broad and generous employee benefits.

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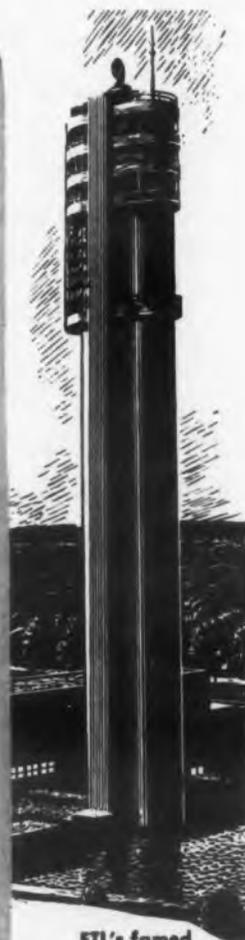
Radio Communication Systems • Electron Tubes
Microwave Components • Electronic Countermeasures
Air Navigation Systems • Missile Guidance
Transistors and other Semiconductor Devices
Rectifiers • Computers • Antennas
Telephone and Wire Transmission Systems



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Federal Telecommunication Laboratories

A Division of INTERNATIONAL
TELEPHONE AND TELEGRAPH CORPORATION
500 Washington Avenue, Nutley, N. J.



FTL's famed
Microwave Tower
—28 minutes
From N. Y. C.

CIRCLE ED-310 ON READER-SERVICE CARD FOR MORE INFORMATION

308 Brush Holders

describes the various types of brush holders available and presents a complete list of prices. There are over 100 different sizes, with a total production of over a billion. Applications are listed for each type. Post Office Box 11, Beverly, Mass.

Vibration Isolators 312

Product Bulletin No. 541, an 8-page brochure, describes the features and uses of the Type 5200 shock and high vibration isolators. It gives information on the load ranges of the mounts, which are designed primarily as shock isolators for application in the marine, transportation, and industrial fields. Graphs give data for isolator loads, shock transmissibility, vibration transmissibility, and coupled natural frequencies. Complete specification data and attachment and installation instructions are also provided. Barry Corp., 1000 Pleasant St., Watertown, Mass.

309

reprinted by the distributor of this article: factors, thermal effects of temperature and total temperature. Tempil York 11.

311 Motor Speed Controls 313

Operating principles and applications of Variac motor speed controls are discussed in this 8-page brochure. A chart of specifications and prices is included as well as circuit diagrams and photographs of the controls in use. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Paint Bonding Chemicals 314

Advantages of protective inorganic chemical finishes that can be used for metal protection and paint bonding are described in this 4-page bulletin. Surface-treating chemicals for use with steel, zinc, and aluminum are listed. American Chemical Paint Co., Box 301, Ambler, Pa.

Arbor Listing 315

This new Arbor List contains specifications on over 2000 coil forms of all shapes, sizes, ID's and OD's. It also provides technical data and construction information. Precision Paper Tube Co., Dept. EDN, 2035 W. Charleston St., Chicago 47, Ill.

THE NEWLY PATENTED CAPLESS STEMAG Chemo-Carbon "Film" Resistor

offers..

PRICE AND SIZE
ADVANTAGES OF FIXED
COMPOSITION RESISTORS

plus..

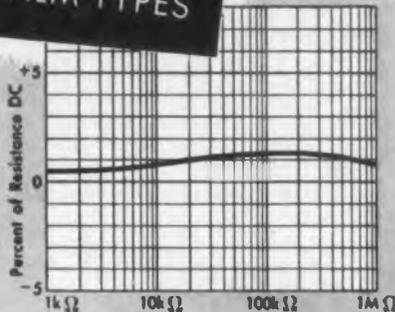
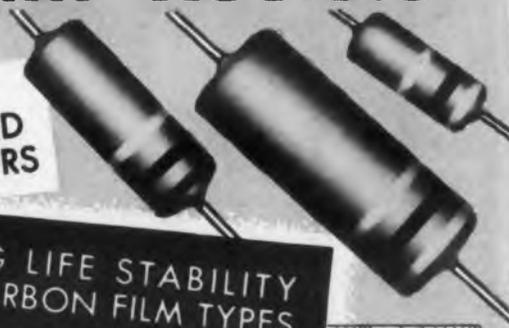
LONG LIFE STABILITY
OF CARBON FILM TYPES

U. S. Patent
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Stemag Chemo-Carbon Capless Film Resistors are manufactured by an exclusive patented process that effectively lowers costs, permits smaller physical size yet insures uniformly high dependability under severe operating conditions. The result is long life resistive components that permanently maintain close tolerance. In 5% tolerance cost is not higher than for ordinary fixed composition types. For complete details request BULLETIN 1-B.



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Engineer assembles pulse system in 30 minutes, using Burroughs "do-it-yourself" units

Standard, matched units, performing basic functions, connect together to form even the most complex pulse systems



1. START

Engineer studies time chart of the desired pulse sequence. This is the output he wants the pulse system to produce.



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He determines which Burroughs units he needs and how they should be connected together. This can be done by means of a simplified block diagram. Time: 10 minutes.



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GET THE FACTS

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ELECTRONIC INSTRUMENTS DIVISION
Burroughs

FIRST IN PULSE HANDLING EQUIPMENT

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Systems

320

These technical data sheets describe this company's line of servo systems and components. Each model is illustrated and dimensional drawings and specifications are given. Feedback Controls, Inc., 1332 N. Henry St., Alexandria, Va.

Miniature Bearings

321

A specification guide contains all necessary information in selecting miniature ball bearings for almost any dynamic application. Space is provided on the guide for sketches and drawings. Miniature Precision Bearings, Inc., Keene, N. H.

Digital Instruments

322

A 4-page 2-color brochure describes and illustrates digital instruments for automatic counting, recording, and control. The instruments are applicable to digital systems for manufacturing, design and development, research and business uses. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Ceramic Products

323

The mechanical and electrical properties of this firm's ceramic products are described in full in this 4-page, 2-color brochure. Eight specific types of ceramic materials are covered, with such properties as specific gravity, weight, water absorption, expansion, shock resistance, strengths, dielectric properties, power factor, etc., listed. Also included is a section of "General Suggestions for Ceramic Design". Star Porcelain Co., Trenton 9, N. J.

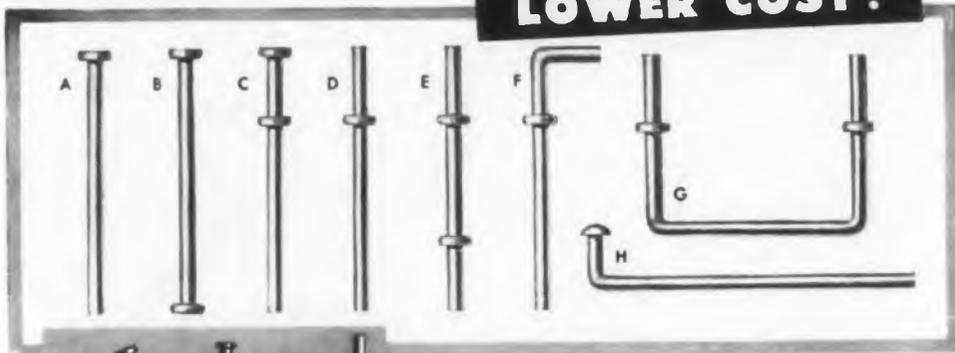
Capacitors

324

This 4-page catalog (Bulletin No. GC-1) describes hermetically sealed, high-voltage, glass-cased "GC" type paper dielectric dc capacitors. Operating temperature of the units ranges from -55° to $+105^{\circ}\text{C}$. Data include an explanation of catalog numbers, high altitude application, lead specifications, ripple voltage, plus complete engineering specifications, and typical performance curves. Gudeman Co., 340 W. Huron St., Chicago 10, Ill.

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Here's high precision production on automatic equipment that delivers continuous uniformity from the first to the millionth unit! Economical production, minimum scrap add up to low piece prices that will surprise you. Upset Pins of the types shown made from any workable metal or alloy . in wire diameters from .010" to .090" Flanges accurately positioned to your specifications. Flanges and heads with rounded edges. Send blueprints or samples for estimate.

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ELECTRONIC DESIGN • February 1955

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Variable-Resistance Devices 326

A 4-page bulletin and four 2-page bulletins are available from this firm, describing a variety of equipments including: impedance bridges and bridge null amplifiers for measurement of resistance, capacitance, and inductance; the "Dekabox", a precision decade box; "Dekaviders", which are precision a-c and d-c voltage dividers; and numerous variable resistance items. Specifications, illustrations, features, and application data are provided on all of these units. Electro Measurements Inc., 4312 S.E. Stark St., Portland 15, Oregon.

Test Instruments 327

Precision laboratory test instruments are described in catalog No. 546. Among the instruments discussed and illustrated are comparison and limit bridges, a null detector-amplifier, power supplies, a-c vacuum tube voltmeters, wide band amplifiers, megohmmeters, filters, and voltage regulators. Freed Transformer Co., Inc., 1718-1736 Weirfield St., Brooklyn 27, N. Y.

Measuring Instruments 328

This firm's "Short Form" catalog provides, in 8 pages, illustrations, brief descriptions, and performance data for a wide variety of measuring instruments. The line includes amplifiers, bolometer mounts, detectors, counters, conveyors, frequency standards, nuclear scalars, microwave test equipment, power meters, voltmeters, and waveform and waveguide equipment. Hewlett-Packard Co., 3000 Page Mill Rd., Palo Alto, Calif.

Porous Bronze Bearings 329

More than 600 of the most widely used sizes (including standard sizes) of oil-retaining porous bronze bearings are listed by size in the 20-page "Compo" Bearing Stock List No. 4. In addition to listing the most popular sizes of flange, sleeve, and thrust bearings, together with cored and solid bar stock, the brochure provides condensed information on application, installation and lubrication. Bound Brook Oilless Bearing Co., Bound Brook, N. J.

for all applications requiring exceptionally high insulation resistance and unusual stability at high temperature

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more versatile!

THE NEW POTTER DIGITAL MAGNETIC-TAPE HANDLER

0 to 60 inches/sec. in 5 msec! 2, 6 or 8 channels

High-speed magnetic tape recorders with low start-stop times bring a new dimension to data handling by absorbing and dispensing digital information when and where it's needed! Any phenomenon can be recorded as it occurs, continuously or intermittently, fast or slow. It can later be fed into computers, punch cards, printers, etc.

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In addition, Potter Magnetic Tape Handlers offer wider tape widths for more channels with lower tape tension controlled by photoelectric servos. Yet, the price is a fraction of much less versatile recorders. Other data handling components and complete systems are available for special problems.

DETAILED SPECIFICATIONS

Model	902AJ	902BJ	902BK	902CJ	902CK
Number of Channels	2	6	6	8	8
Tape Width (Inches)	¼	½	½	¾	¾
Tape Speed (In./sec.)	15/30	15/30	15/60	15/30	15/60
Reel Size (dia. in Inches)	10½	10½	8	10½	8
Reel Capacity (feet)	2,400	2,400	1,200	2,400	1,200
Start Time	5 Milliseconds				
Stop Time	5 Milliseconds				

For complete information, write to Department 10-F.

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CIRCLE ED-332 ON READER-SERVICE CARD FOR MORE INFORMATION

Laminating Adhesives 333

A 12-page manual on "Adhesives for Film, Foil, Fabric, and other Web Laminations" contains over 45 actual photographs of typical laminations, and provides many technical data. It features two new charts. The first of these, a "Master Chart of Laminating Adhesives", lists adhesives for 26 laminating materials, alphabetically, from aluminum foil and asbestos paper to vinyl film and cork, with outstanding properties. The second chart offers a "Check List of End Use Properties of the Completed Lamination". Rubber & Asbestos Corp., 225 Belleville Ave., Bloomfield, N. J.

Transformers 334

Catalog No. 545 describes this company's line of transformers. Technical information is provided on toroidal inductors and magnetic amplifiers as well as many types of transformers. Each instrument is illustrated and dimension drawings given. Freed Transformer Co., Inc., 1718-1736 Weirfield St., Brooklyn 27, N. Y.

Microwave Equipment 335

This 12-page bulletin "Ferrite Microwave Equipment", gives specifications, characteristics, and dimensions of a series of components based upon precision control of Faraday rotation at microwave frequencies. The "Uniline" operational theory involved in this equipment is discussed in detail. Transmission lines, amplitude modulators, and similar equipments are covered. Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif.

Relays 336

The "KP" Relay, designed originally to be used in high-speed code control systems involving as many as 10,000 codes a day, with the relay operating as often as 500,000 times daily, is described in a 4-page bulletin. It can operate on power from 5-150mw, with operating time of 5-15milli-sec, and is a polar, rotary-type. The bulletin is divided into sections on operation, construction, and applications. Union Switch & Signal, Div. of Westinghouse Air Brake Co., Pittsburgh 18, Pa.

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Subminiature Tubes

The third edition of this firm's catalog of cathode-type subminiature tubes is a 2-color, 70-page publication. An extremely wide variety of tube types is covered, with detailed electrical and mechanical data, dimension drawings, and graphs of characteristics. Sections are devoted to uses and tube reliability. Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

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Polyester Resins

This folder contains a number of technical reports and production data sheets on polyester resins for matched die molding, wet lay-up, and laminating. When combined with glass fiber, these resins can be molded into a variety of structures with a very high strength-weight ratio. Other advantages include chemical resistance, water and corrosion resistance, excellent electrical properties, low thermal conductivity, and ease and economy of fabrication. Chemical Div., General Electric Co., Pittsfield, Mass.

Synchronous Motors

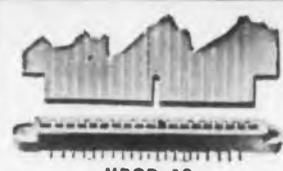
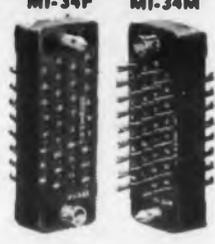
Nineteen models of hysteresis synchronous motors for high fidelity recording and reproducing equipment are described in this 4-page catalog (No. 403-2). Motors feature a flywheel-rotor with a capstan shaft, and provide direct-drive magnetic tape speeds of 1-7/8-, 3-3/4-, 7-1/2-, 15-, or 30ips. Motors are also available in single- or dual-speed combinations from 300rpm to 1800rpm. Complete specifications, wiring diagrams and, mounting details are included. Technical Development Corp., 4050 Ince Blvd., Culver City, Calif.

Recorders, Controllers

Bulletin No. 72-1 fully describes the quick-connect "Tel-O-Set" miniature recorder and controller. A description of the instruments and their operation is included, and specifications are given in this 12-page, 2-color publication. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

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<p>HEAVY DUTY CONNECTORS</p> <p>980-34HR5L 980-34F2 980-34M2SL</p>  <p>For use on rack and panel type equipment in communication and power circuits. U. S. C. heavy duty multi-contact connectors offer</p> <ul style="list-style-type: none"> • Maximum number of heavy current contacts • Mechanical and electrical dependability of operation in a minimum of space. • available 7 to 34 contacts 	<p>PRINTED CARD RECEPTACLES</p>  <p>UPCR-18</p> <p>U. S. C. Printed Card Receptacles offer</p> <ul style="list-style-type: none"> • Channel Strength and Snap-in Contacts • Dependability of operation over range of printed card thickness • Available - Single and double Row, Wire Solder and Wire Wrap - From 6 to 44 contacts 	<p>MINIATURE CONNECTORS</p> <p>MI-34F MI-34M</p>  <p>For Multi-Contact Plug-in</p> <ul style="list-style-type: none"> • Maximum Strength • Dependable Electrical Performance • Minimum of Space • Available 5 to 75 contacts <p>Over 1000 types available</p> <p>Write us for information on your connector problems</p>
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A viewing hood for an oscilloscope seems like a simple problem for the rubber technologist, yet it is significant that Tektronix, Inc., of Portland, had Roth Rubber, in Chicago, provide the solution. The viewing hood must not crack or buckle, has to adjust to any face and must exactly fit the Tektronix scope. Roth engineers solved this problem—they can solve yours.

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The **TORSYNATOR** represents an entirely new design concept in repeater units

A potentiometer as the sender—a motor as the receiver—that's all there is to the TORSYNATOR that replaces servomechanism systems in many applications. NO AMPLIFIER, NO VACUUM TUBES.

Here are a few **TORSYNATOR** features:

- Very small input torque—high output torque.
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And for the system illustrated above:

- Specially designed d-c receiver motor for low inertia and high starting torque.
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Other systems already designed include 60 and 400 cycle inputs and a power unit built for 60 watts continuous output, with receiver follow-up speed of 720° per second.

Applications include remote positioning in airborne and ground equipment, machine tools and the replacement or simplification of hydraulic systems.

Write for technical bulletin giving complete details on existing systems — or outline your remote positioning requirements.

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Amityville, L. I., N. Y.
AMityville 4-6122

West Coast Factory
2055 Pontius Avenue
Los Angeles 25, Calif.

CIRCLE ED-344 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . . By John Montstream

Color Television Image Reproducer . . .

Patent No. 2,677,722, Alda V. Bedford (Assigned to Radio Corp. of America, Princeton, N. J.).

In the development of color television, two systems have had the attention of those working in this field. One system uses a single tube having different color areas on the viewing screen, and the other system uses three tubes each producing an image or picture of one color and the images of the three tubes are superimposed upon each other in some manner to give a composite color picture. In the latter system, there have been two types of construction advanced, one being to use small sized tubes for each of the three component colors and then project the three pictures by optical enlarging means onto a viewing screen. This form presents a problem in the design of a lens which is sufficiently fast yet does not produce chromatic or spherical aberration.

In another form full-sized tubes are used with a pair of mirrors so placed that one image is viewed through both mirrors and each of the other two images are reflected by a mirror to superimpose the three images upon each other. With this arrangement the picture appears in a plane well back from the front of the cabinet which gives a so-called "tunneling effect" and reduces the viewing angle.

The construction of the device described in this patent uses two full-sized picture tubes one of which is positioned horizontally before the cabinet opening and has a mirror arranged at a 45° angle in front of the viewing screen of the tube so that the image or picture is viewed through the reflective coating of the mirror. A second full-sized tube is placed vertically and below the cabinet opening with its viewing screen directed at the mirror so that the

image on the viewing screen of this second tube is reflected from the mirror. The images on the viewing screen of both tubes are thereby superimposed on each other.

A third tube of smaller size is placed above the first tube and in horizontal position. It has a lens to enlarge the picture. The image from this tube is reflected from a mirror above the first mirror and placed at a 45° angle so that the picture is reflected downwardly onto the first mirror and the latter reflects the picture inwardly onto the phosphor viewing screen of the horizontal tube. This third tube is preferably the blue picture tube since the eye's acuity to this color is considerably less than that of the other colors and hence allows for greater tolerance.

The mirror before the cabinet opening, that is the first mirror, may be a dichromatic mirror with a reflecting surface capable of transmitting or reflecting the respective colors in different degrees. For example, the reflective surface will have a low reflective characteristic for the color green so that a large part of the light from the green image from the first tube will pass through the reflective surface. The reflective surface will have high reflective value in the red range and therefore it will reflect most of the light from the red image produced by the vertical tube.

In the blue range the mirrored surface has a reflective characteristic of about one half with the result that about one quarter of its light will pass to the viewer. This reduction in the light transmitted can be overcome by increasing the brilliancy of the blue tube by increasing the cross section of the electron beam. This decreases the definition of the image of this tube; however, the eye is tolerant to lesser definition for this color. With the arrangement described the cabinet size may be reduced, which is of obvious practical value.

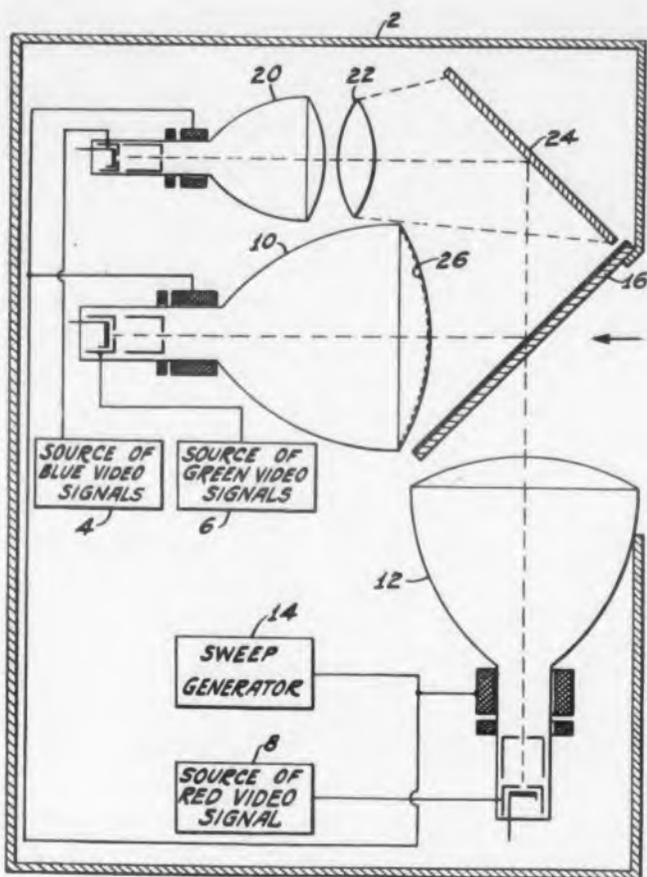


Fig. 1. Color pictures are produced by superimposing the red, green, and blue images in this system.

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All Technitrol Delay Lines are continuously wound for minimum pulse distortion . . .
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ENGINEERING COMPANY

2751 N. 4th St., Philadelphia 33, Pa.

CIRCLE ED-345 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • February 1955



"J. B. seems less inhibited since he specified TEFLON* by Ethylene"

* DuPont trade name for tetrafluorethylene resin**

This amazing material is chemically inert, has excellent dielectric properties, resists heat and cold, is nonadhesive, and possesses great flexural strength. We make it in a great variety of sizes, of the finest quality, and for quick shipment. May our experts help you?

Write for Catalog E2

** Converted by Ethylene into the best basic forms in the world, undoubtedly.***

**EXTRUDED OR MOLDED RODS, TUBES, AND
SPECIAL SHAPES. NON-POROUS SHEETS**

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CIRCLE ED-346 ON READER-SERVICE CARD FOR MORE INFORMATION

TUNG-SOL Series String TUBES

**For the TV Set
Manufacturer . . .**

building series string sets, Tung-Sol can provide the "series string" tube types, the quality and the service needed for a successful competitive program.

2AF4 (Prototype—6AF4) Heater Current 0.6 A Heater Volts 2.35	3CB6 (Prototype—6CB6) Heater Current 0.6 A Heater Volts 3.15	5V6GT (Prototype—6V6GT) Heater Current 0.6 A Heater Volts 4.7	12BQ6GA (Prototype—6BQ6GA) Heater Current 0.6 A Heater Volts 12.6
3AL5 (Prototype—6AL5) Heater Current 0.6 A Heater Volts 3.15	4BQ7A (Prototype—6BQ7A) Heater Current 0.6 A Heater Volts 4.2	6AU7 (Prototype—12AU7) Heater Current 0.6 A Heater Volts 3.15*	12BQ6GT (Prototype—6BQ6GT) Heater Current 0.6 A Heater Volts 12.6
3AU6 (Prototype—6AU6) Heater Current 0.6 A Heater Volts 3.15	4BZ7 (Prototype—6BZ7) Heater Current 0.6 A Heater Volts 4.2	6AX7 (Prototype—12AX7) Heater Current 0.6 A Heater Volts 3.15*	12BY7A (Prototype—12BY7) Heater Current 0.6 A Heater Volts 6.3*
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3BY6 (Prototype—6BY6) Heater Current 0.6 A Heater Volts 3.15	5U8 (Prototype—6U8) Heater Current 0.6 A Heater Volts 4.7	12BH7A (Prototype—12BH7) Heater Current 0.6 A Heater Volts 6.3*	*Using heaters connected in parallel. Other Series String Tube Types in Development.

All Tung-Sol Series String Tubes have uniform heater warm-up time to safeguard against failures from initial voltage surge.

Heater ratings are based on 600 milliamperes of current with the heater voltage adjusted for the same power as in the prototype. All other characteristics and ratings are identical to those of the prototype.

Use of these tubes provides completely satisfactory receiver characteristics during warm-up.

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Wave Transmission Network Utilizing Impedance Inversion . . . Patent No. 2,679,633. John T. Bangert. (Assigned to Bell Telephone Laboratories, Inc., New York, N. Y.)

The network shown in Fig. 2 has considerable versatility, since it can be used to make a complete inversion of the impedance presented or make an impedance inversion over a selected portion of its frequency range. The network may also be used to convert a capacitive or inductive reactance from values which are not of economical size or cost to values which can be supplied by readily available and relatively inexpensive commercial units.

The network includes two connecting terminals (14 and 15) between which is connected a transistor (16) which may be either a point contact or a junction type, although the latter supplies a more constant value of negative resistance. The base electrode terminal (19) is connected with the network terminal (14) through resistor R_B of about 100,000 ohms and usually a series blocking condenser (C_B) of about 1/2 mfd. The collector terminal

(20) is connected with the other network terminal (15) through variable resistor R_A providing a value of 0 to 5000 ohms, a voltage source (17) of about 22v, and a parallel circuit including an inductance L , a resistor R , and an impedance Z , the configuration of which may be varied widely. Emitter terminal 21 is connected with inductance 27, preferably at the midpoint to provide a feedback path.

By varying the value of resistance R_A and with specified values of the circuit elements, the resistance of the network may be varied from the values represented by curve 25 shown in Fig. 3 to those of curve 26 without materially altering the shape of the curve. Should it be desired to compensate for energy dissipation, resistor R_A can be adjusted so that the resistance curve is negative over a part of its range and the network becomes a source of energy derived from the battery (17). The patent describes a procedure and formulas for designing the network to secure the results sought. In an illustrative example it shows how the network having an inductance of 0.089h and a capacitance of

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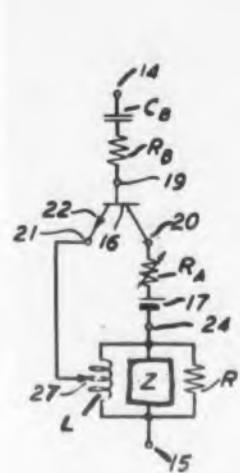


Fig. 2. An impedance-inversion circuit utilizing either a junction or point contact transistor.

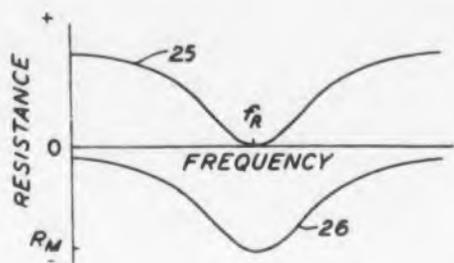


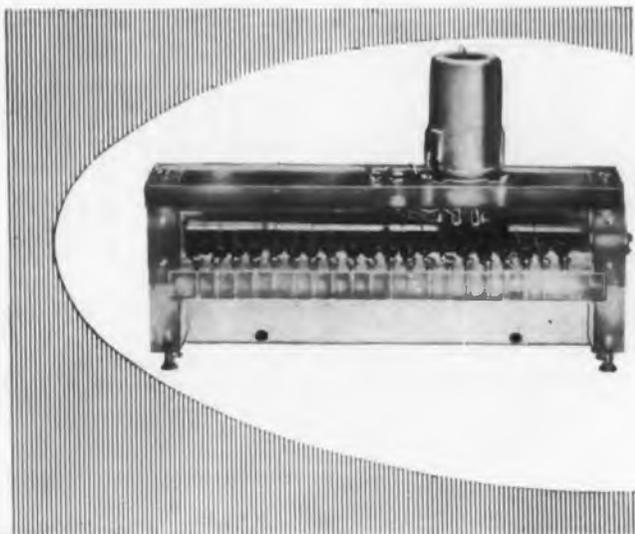
Fig. 3. This waveform representation helps explain how the circuit of Fig. 2 produces an impedance inversion.

.0098mfd at branch Z provides an equivalent circuit having a large value of inductance of 91h and a small and sensitive capacitance of 9.6mmfd.

The wide variations which may be made in the network are illustrated by the branch Z which may be eliminated, may

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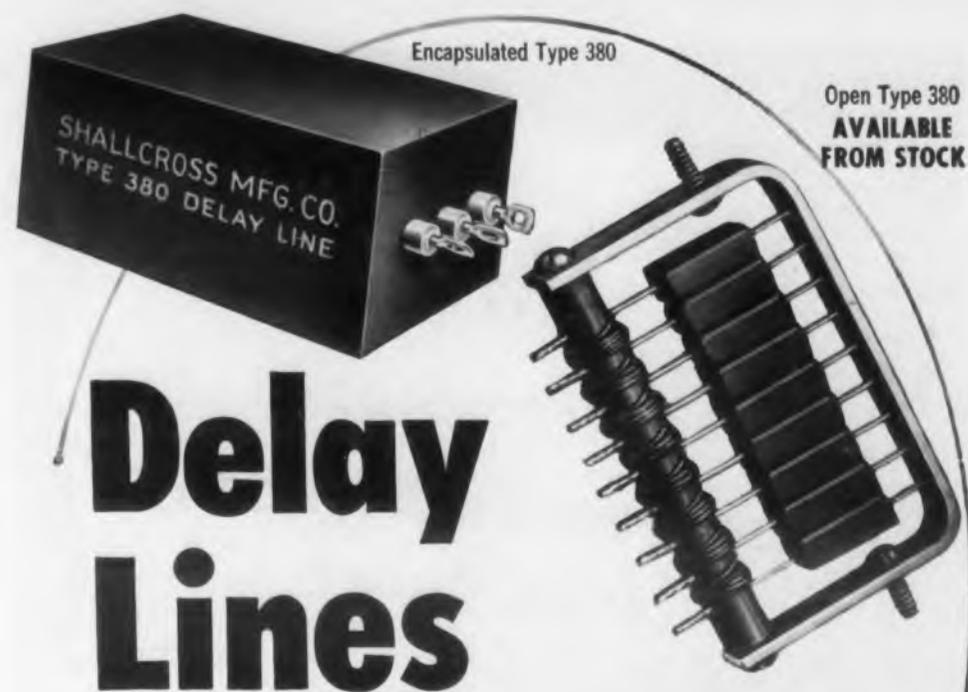
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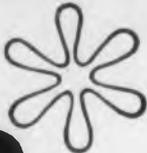
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Radar Scanning System . . . Patent No. 2,678,393. Henry J. Riblet. (Assigned to Raytheon Manufacturing Co., Waltham, Mass.)

In the use of tubular wave guides with radar scanning mechanisms, difficulties have been encountered in securing adequate freedom of movement of the radiating horn for scanning. Joints of various kinds have been resorted to between the wave guide and the radiating member to secure freedom of movement without adversely affecting the ability of the wave guide to guide the signal energy. This system does obtain adequate freedom of movement without any material loss of wave guide characteristics.

Fig. 4 shows the system, which includes a wave guide (10) from the signal generator having a slot (22) extending longitudinally in one side of the guide. A wave guide segment (32) of short length and carrying a radiating horn (46), has guides (48) and bearings (50) along its sides, which mount the segment for longitudinal or vertical movement with respect to wave guide 10. A coupling probe (26) is carried by the segment and extends through slot 22 into the wave guide to re-

ceive energy. A reflecting loop (24) in the wave guide assures a maximum transfer of energy from the latter to the probe. The wave guide segment is moved by a rack (48), gear (60), and motor (64). It will be observed, therefore, that the wave guide segment and its horn may be moved freely upwardly and downwardly without materially affecting energy transference.

The horn directs its energy at a reflector (68), which is mounted for oscillation on a pivot (70). Oscillatory movement of the reflector is supplied by a gear segment (81), gear (86) and motor (90). The energy from the horn is reflected from the reflector through a beam shaping lens (94). Now when the reflector (68) is at an angle of 45° as shown, the effect of an image source at 96 is secured that directs its energy along line 98. With the reflector at an angle as represented by the dotted lines, the image source is in effect at 104 and the energy is directed along line 102. Scanning is secured thereby in a horizontal plane (the plane of the page). Finally by combining the oscillatory movement of reflector 68 and the vertical reciprocating movement of the segment and its horn 3-D scanning is secured.

Fig. 4
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10
24
22



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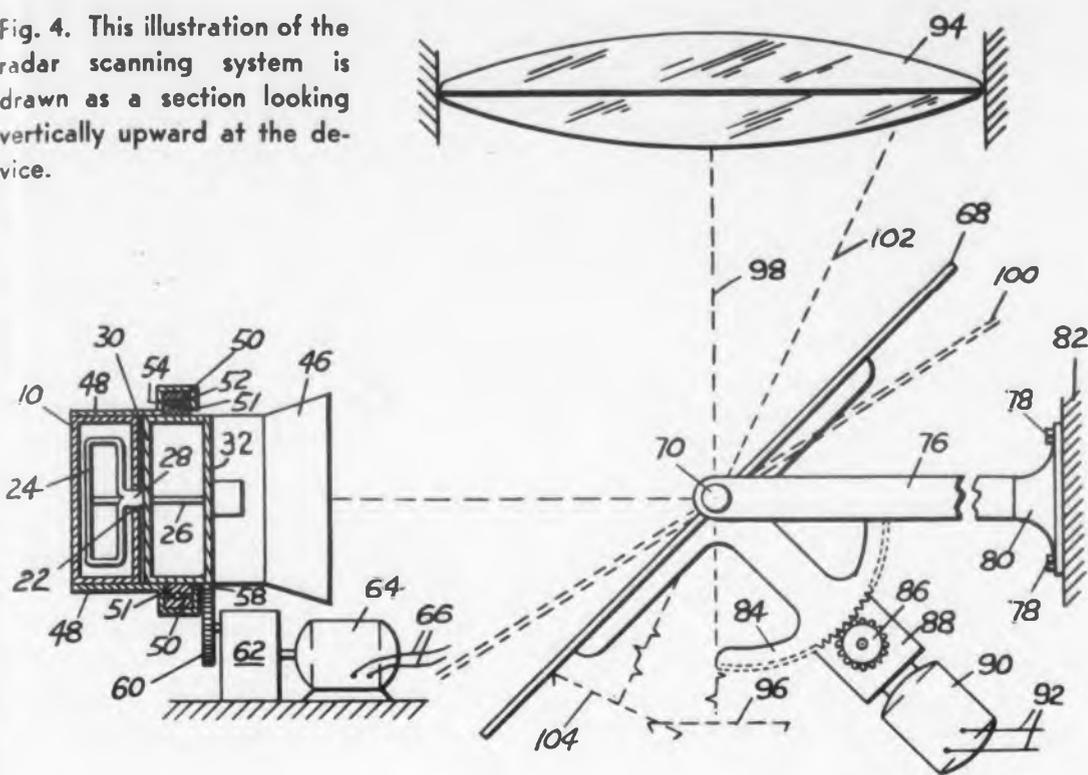
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Fig. 4. This illustration of the radar scanning system is drawn as a section looking vertically upward at the device.



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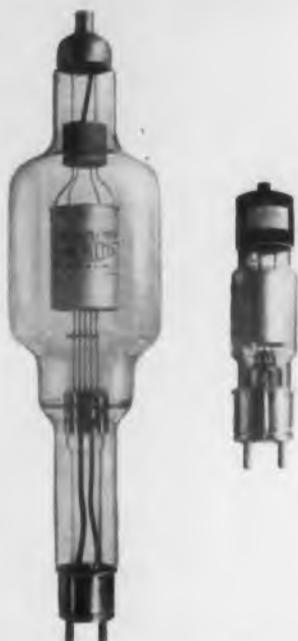
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CIRCLE ED-356 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Controlled Oscillator . . . Patent No. 2,680,197. George T. Royden. (Assigned to Mackay Radio and Telegraph Co., New York, N. Y.)

Vacuum tube oscillators as a general rule are unstable and their output usually includes harmonics of the fundamental or desired operating frequency. Some degree of stabilization of the oscillators has been secured by the use of piezoelectric crystals and current variable resistors. These stabilization circuits, however, use reactive elements and in addition transformers have been used as isolating elements or for impedance matching purposes. Such elements tend to affect stability and may result in undesired frequencies as well as being relatively expensive as compared to resistors and condensers.

The vacuum tube oscillator shown in Fig. 5 includes a pair of vacuum-tube amplifiers (19 and 42) each of which are connected into a separate bridge circuit (17 and 18, respectively). Bridge 17 constitutes the frequency determining network and hence has a piezoelectric crystal (23) in one of its arms to stabilize the

frequency. Resistors provide the impedances in the other arms, with a small condenser (24) in shunt with resistor 22 to balance the equivalent shunt capacitance of the crystal.

The other amplifier is connected in bridge circuit 18 and constitutes the amplitude balancing network. It includes a non-linear impedance such as an impedance that increases with current. A temperature-responsive impedance (shown as a lamp 34) is a satisfactory form of non-linear impedance to provide amplitude stabilization. A blocking condenser (35) may be used in series with the lamp to block direct current from the source of supply (10) for tube 42. The other arms of the bridge network may be resistors.

The output of amplifier tube 19 is connected with the control grid (37) or input of amplifier tube 42 through crystal 23 and coupling condenser 43. The output of amplifier tube 42 is connected with the control grid (27) or input of amplifier tube 19 through blocking condenser 35, lamp 34, and coupling condenser 45. The two bridge networks are slightly unbal-

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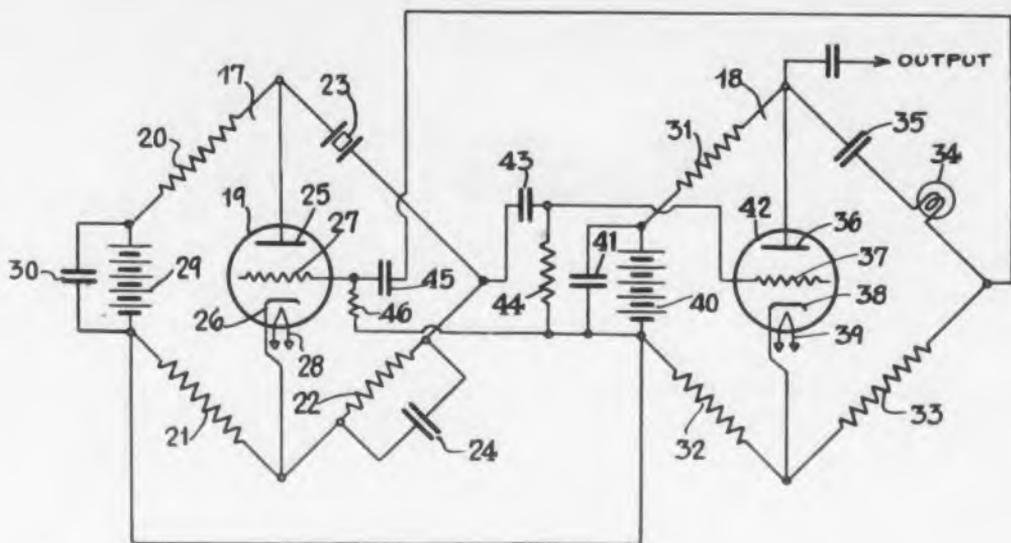


Fig. 5. A two-tube crystal-controlled oscillator circuit utilizing inexpensive parts.

anced at the frequency of operation. It will be noted that the value of non-linear impedance 34 and the value of impedance of crystal 23 are independent of each other so that they may be selected for best results. The impedances in the arms of the

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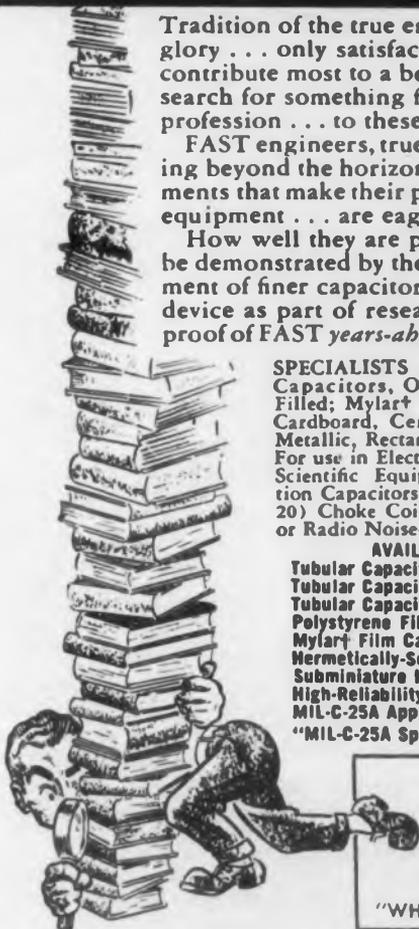
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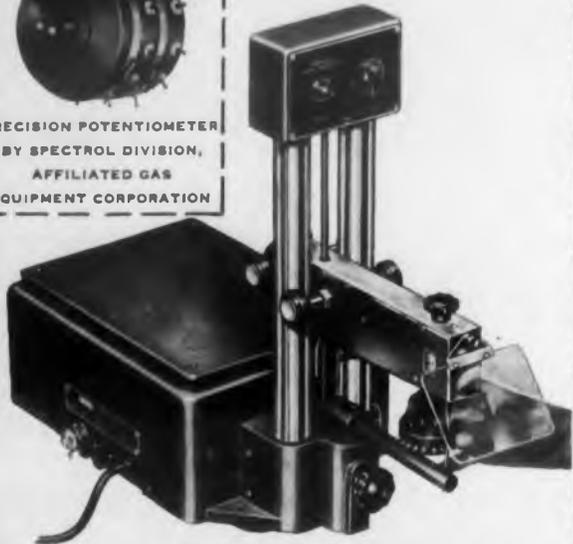
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Books . . .

Transistors: Theory and Applications . . .
 By Abraham Coblenz and Harry L. Owens.
 313 pages. McGraw-Hill Book Co., Inc. 330
 West 42nd St., New York 36, N. Y. \$6.00

The entire field of transistors including manufacture and the various applications are considered in this comprehensive work. The theory of transistors and semiconductors is thoroughly discussed in the first seven chapters, followed by chapters on the "Electronics of Transistors", "Small-Signal Parameters", and "Grounded Emitter and Grounded Collector Connections".

Important circuit uses for transistors are discussed in the next two chapters, "Theory of Transistor Switching Circuits",

and "Cascading of Transistors". Chapter 13 deals with "Manufacturing Processes." The preparation and use of silicon for transistors is considered in the next chapter.

Chapter 14, "Special Topics" deals with special transistor types and metals. Among these special types are the "analog", "uni-polar field-effect", and "coaxial" transistors. Among the special metals considered are germanium silicon alloys, the intermetallic compounds, such as indium antimonide, and gallium antimonide, semiconductors produced by bombarding other metals with radioactive particles.

The text is presented with a minimum of mathematics. Certain essential mathematical operations are included in two

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appendices. Appendix Three consists of 25 pages of excerpts from MIL-T-12G79A (Sig C), which consists of definition of symbols and transistor tests.

The work is based on a series of lectures given at the Signal Corps Evans Laboratory in 1952, by the authors, who were employed there at the time. Mr. Coblenz is now with Transistor Products Inc., Waltham, Mass.

Transistor Audio Amplifiers . . . By Richard F. Shea. 219 pages. John Wiley & Sons, Inc. 440 Fourth Ave., New York 16, N. Y. \$6.00.

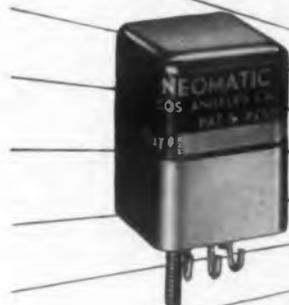
More transistors are now in service in audio amplifiers—especially hearing aids—than in all other transistor applications combined. The hearing-aid market was the first consumer group that could afford the cost of transistors, and did not require transistors with a high frequency limit. As the cost of transistors drops, and as their frequency limit rises, their applications will grow (two transistor portable radios have been announced), but audio amplifiers will continue as the major use

for some time. This volume, written by one of the most well-known engineers in the transistor field, tells how to design audio amplifiers incorporating widely available transistor types.

Beginning with the inevitable chapter on fundamentals, the subjects of transistor networks, basic amplifier design, and methods of coupling transistors are then considered. Considerable practical material on the variation of transistor parameters with operating point, with temperature (See page 19) and beaten units, is presented. Preamplifiers Class A and B power amplifiers, are the topics of the next three chapters, respectively. The eighth and final chapter, which was previewed in the December 1954, issue of *ELECTRONIC DESIGN* (pp. 24-27), gives six examples of audio amplifier design covering hearing aids, a phonograph preamplifier, an electronic megaphone and a power amplifier. The last can be driven by the pre-amplifier.

A bibliography of transistor literature arranged by year of publication is also given. A member of the Laboratories Dept., General Electric Co., Syracuse, N. Y., Mr. Shea is also the author of *Principles of Transistor Circuits*.

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Non-linear	to ±0.5%	±0.5%	±0.4%	±0.3%	±0.5%	±0.3%
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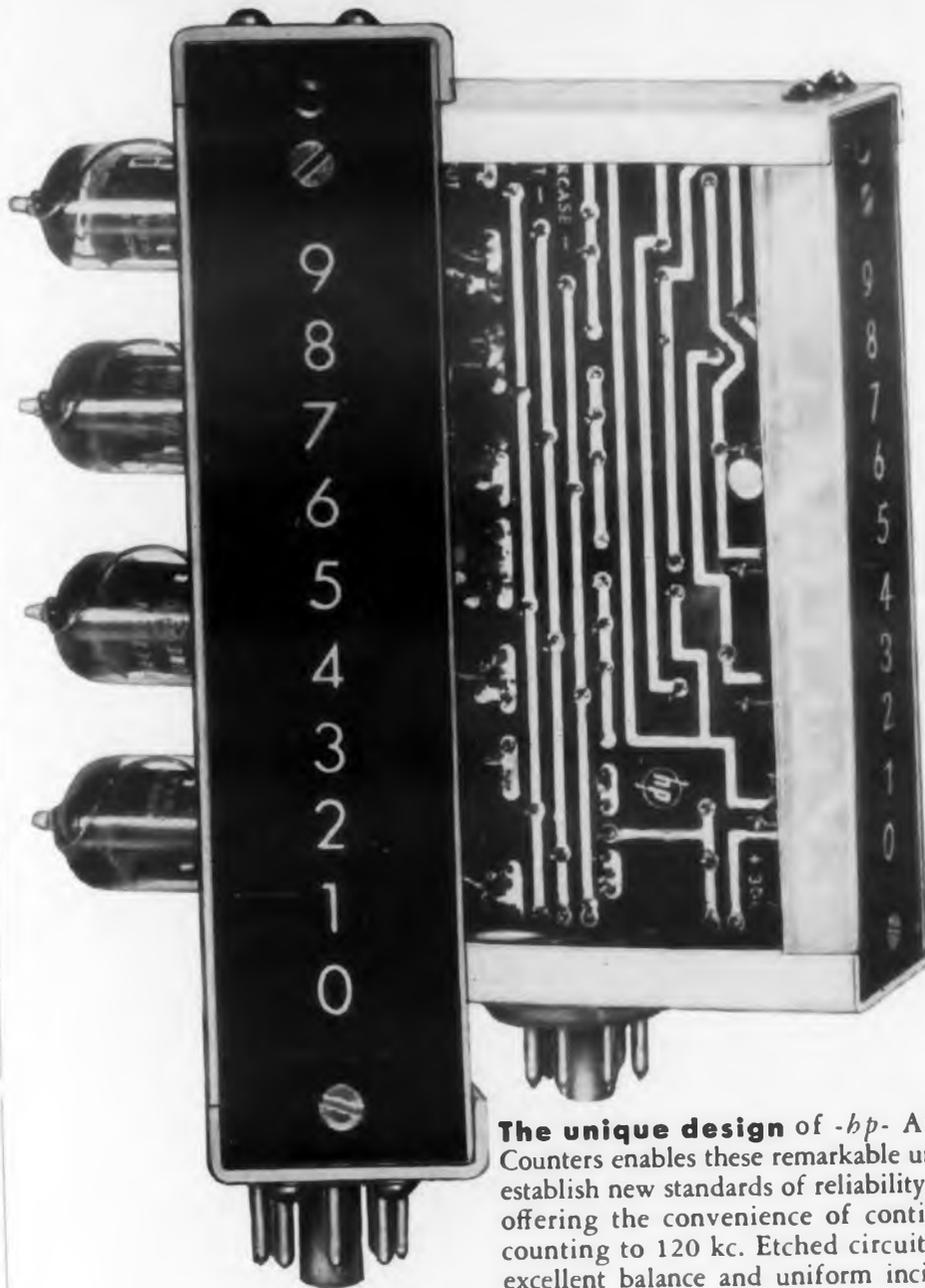
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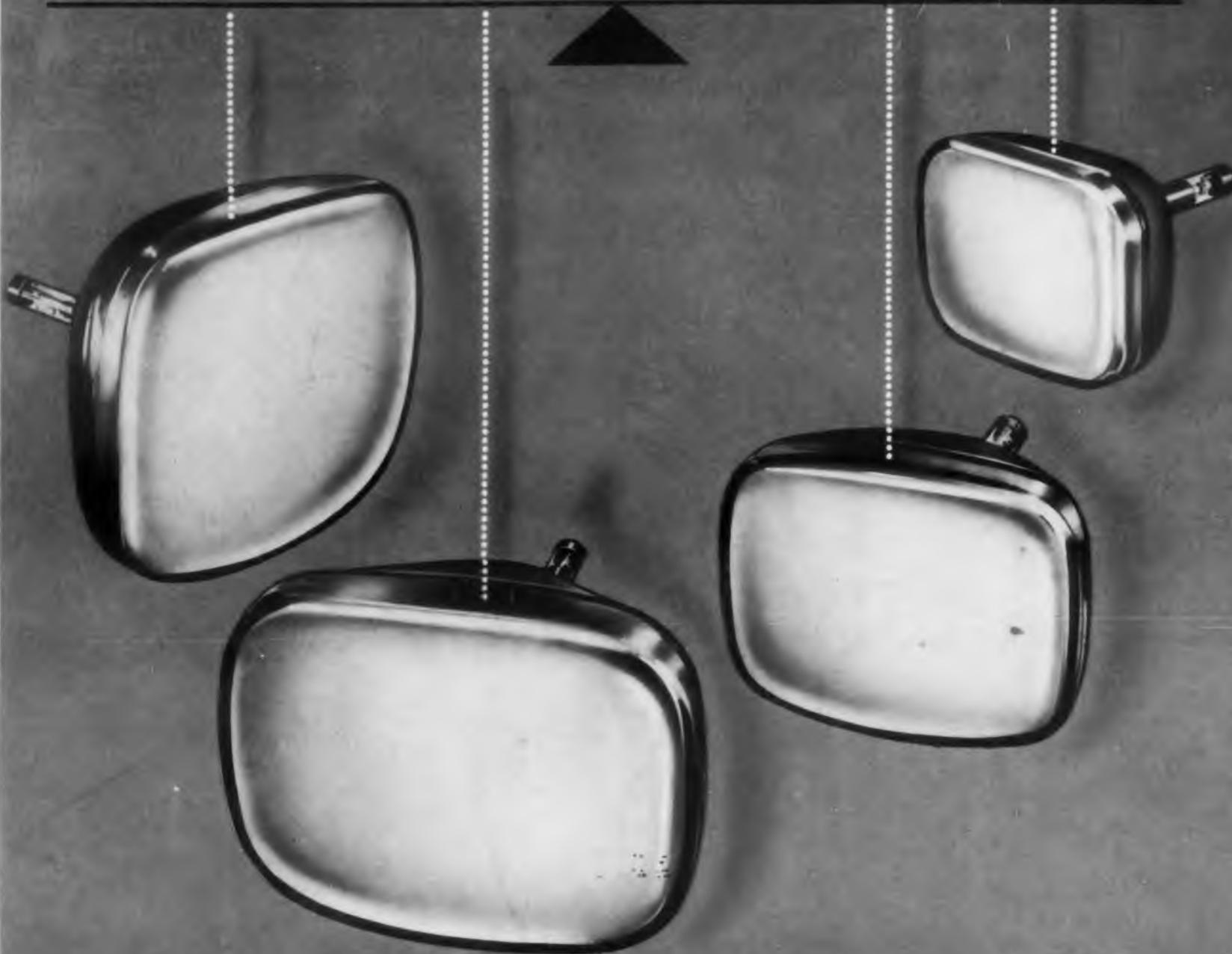
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