

ELECTRONIC

DESIGN



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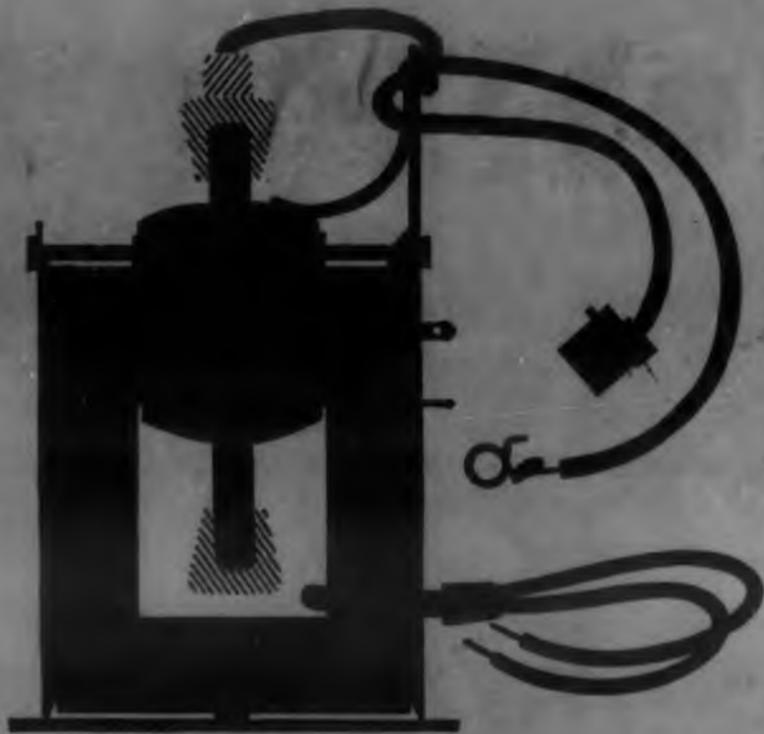
AUG 6 1953

THESE new developments in potentiometers for mass production use such as in TV receivers have several interesting design features. The unit at the top may be furnished with an insulated shaft for hot chassis applications and is held rigidly to the panel by twisting two mounting ears. The usual threaded mounting bushing and nut are eliminated. Shown below is a similar potentiometer which can be used for screwdriver adjustment only or with a detachable shaft that can be purchased separately in varying lengths and plugged into the control after installation in the chassis.



July 1953

*First Commercial
Transistor Chart - page 11*



high voltage ARC INHIBITOR by Guthman

When TV manufacturers discovered that higher voltages of the new 27 and 21-inch television receivers rendered existing wax corona ring sweep transformers inadequate, they brought the problem to Guthman.

In a cooperative program with these TV engineers, a flyback transformer with a cast resin corona ring was developed—the perfect answer to this difficulty.

Your problems in the development of coils and transformers are welcome at **Edwin I. Guthman & Company, Inc.**, 15 South Throop St., Chicago 7, Telephone: CH 3-1600, also Attica, Indiana.

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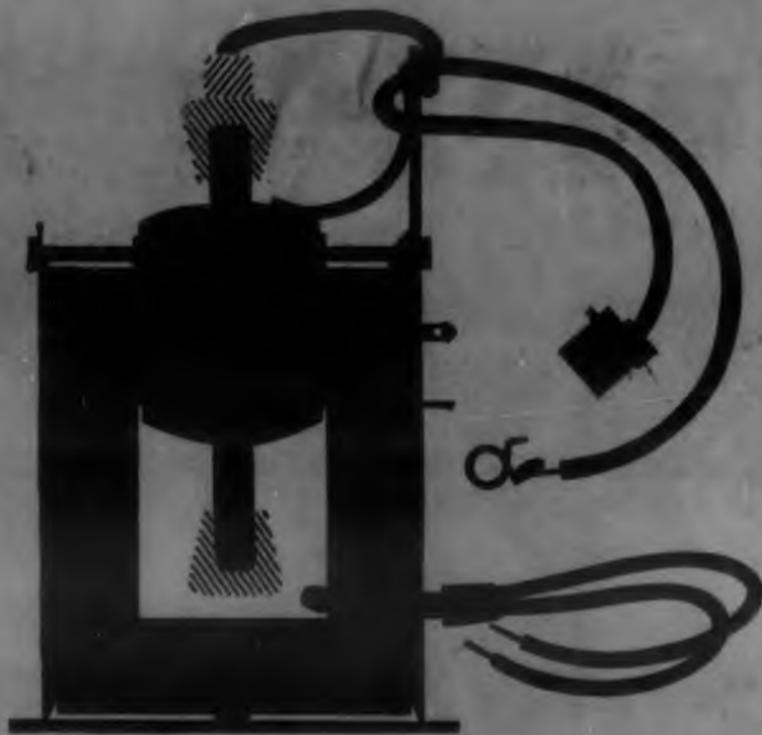
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high voltage ARC INHIBITOR by Guthman

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No. 7
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when time is short...



depend
on this
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8mc

COUNTER-CHRONOGRAPH

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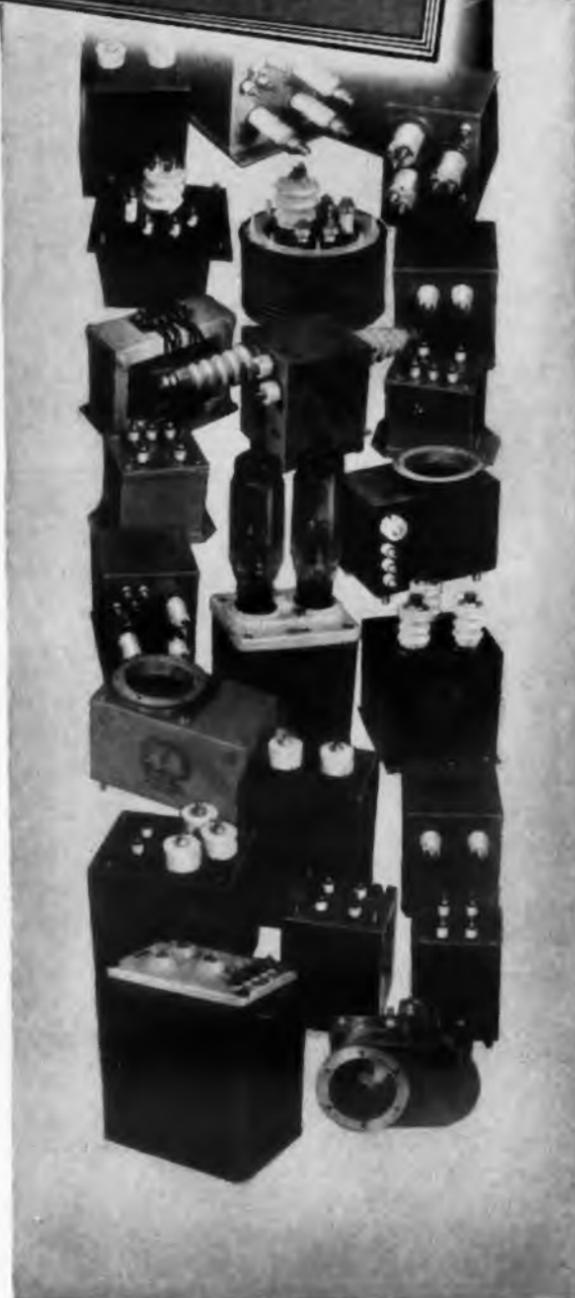
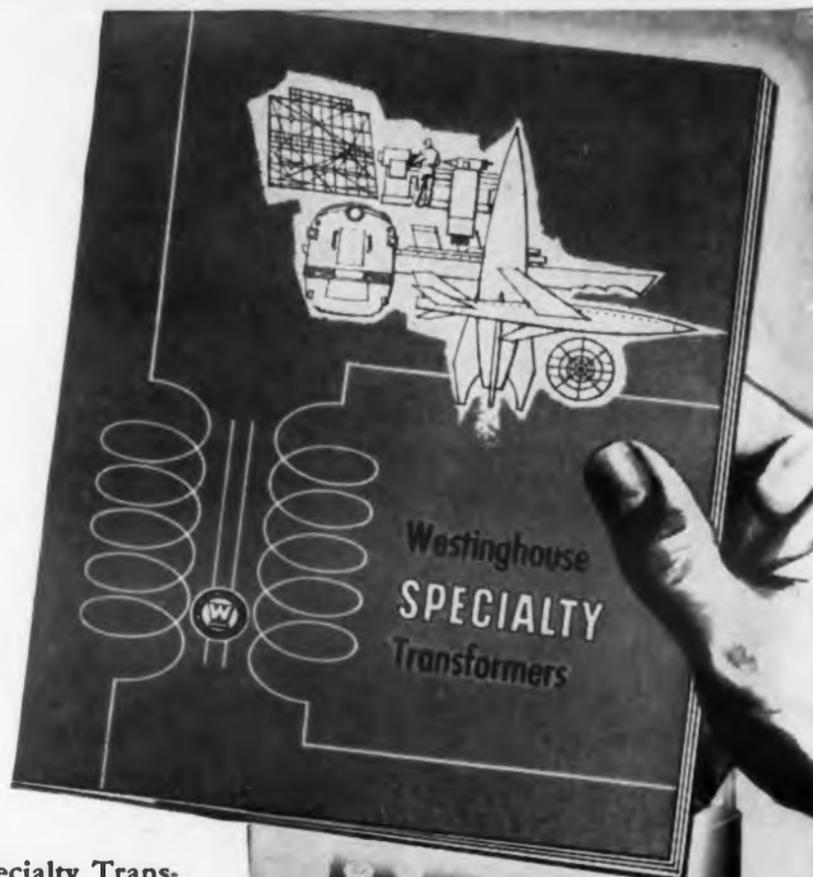


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Editorial . . .

Few electronic designers question the values of standards in the electronic industries. These invaluable guides make mass production possible, and indeed have been credited with being largely responsible for the growth of electronics in all its branches.

In the early stages of research and development in a particular field, standardization is not too important. But the moment a product or component gets out into the field and large numbers of engineers begin using it, standards are needed, in fact, unless they are formulated, wide scale distribution cannot take place.

A good example of what can happen when standards are lacking is the present situation in the field of transistors. At the AIEE Summer General Meeting in Atlantic City a Transistor Standardization Forum was held in which eight papers were presented covering this subject. Proposed AIEE-IRE standards on definitions and letter symbols, different equivalent circuit representations for the transistors (which have an important bearing on standardization), and the viewpoints of the transistor test equipment manufacturer as well as that of the transistor manufacturer were discussed.

Listening to these papers and the ensuing discussions one could appreciate the great amount of work being done and the even greater task yet to be done to achieve a set of standards that would enable both manufacturers of transistors and users to make wide scale use of this important device. The discussion indicated that although much work was being done, no standards were ready yet.

While all this discussion and standards formulation is going on, a fair number of manufacturers have been producing transistors commercially. A list of those we have reports on is shown on page 11 of this issue. Although there are some 30 types of transistors available commercially (and a number of these can be obtained in fair quantities), there are almost no devices incorporating transistors on the market, hearing aids being the one exception that comes to mind. One of the most important reasons for this situation we believe is the lack of standards.

The committees working towards standardization are performing an important task, and are doing the best job that they can. But they need help. They solicit your interest in the work they are doing, and would like to receive your comments, constructive criticisms, and suggestions on proposed standards and those already in existence. The more of these they get, the more nearly will the finally formulated standards conform to the needs of the electronic industries. These comments and suggestions should be sent to the Executive Secretary, AIEE, 33 West 39th St., New York 18, N. Y.; or to the Executive Secretary, IRE, 1 East 79th St., New York 21, N. Y., who will forward them to the proper committees in their respective organizations.

Engineering Review . . .

Engineer Shortage . . . Some interesting information on the shortage of engineers is reported in the *American Peoples Encyclopedia 1953 Yearbook* (179 N. Michigan Ave., Chicago 1, Ill.). According to the Yearbook article on "Engineering", by 1954 there will be 30,000 new engineering jobs in civilian industry alone, and only 12,400 new graduates to fill them. A major reason for the shortage is the large number of engineering graduates being inducted into the armed forces.

A survey of the supply of engineers conducted by the Engineers Joint Council, New York, shows that of 29,420 who received engineering degrees in the past year, 6100 were commissioned in the armed forces as a result of ROTC training; 1363 were enlisted members of the armed forces reserve or National Guard; and 6473 became eligible for draft upon graduation. Of the remaining graduates, 1836 indicated they were planning to continue full-time graduate studies.

Another survey referred to was one conducted by the National Society of Professional Engineers which indicated that in a large eastern utility company only 45% of its available engineering man-hours were actually being spent in engineering work. Only 70% of the engineers were doing technical engineering work, and even they devoted a third of their time to routine nonengineering jobs. Most of the engineers on non-engineering jobs were admitted qualified and available for engineering tasks.

The article also points out that according to the U. S. Office of Education, enrollments in engineering schools, which had been declining steadily, showed an increase in 1952, with 16.2% more freshmen than in 1951. This increase was attributed to an intensive campaign to attract more students to engineering.

Transistors in Toll Dialing . . . Test results show that the transistors and their circuits as used in the card translators for toll dialing systems are reliable, and their service life appears to be satisfactory, according to P. Mallery of the Bell Telephone Laboratories. (463 West St., New York, N. Y.). This was brought out in his paper entitled "Transistors and their Circuits in the 4A Toll Crossbar Switching System", which was presented at the Summer General Meeting of the American Institute of Electrical Engineers.

The card translator is heart of the switching system used in toll dialing, and its operation is based on

selecting a particular card from a stack of cards in accordance with input digits. It obtains the routing information from the output code registered on the card. The confidence with which this circuit is regarded is indicated by the fact that over 100 translators will have been shipped to jobs by June 1, 1953. These installations represent the first commercial application of transistors in the Bell System.

Ultrasonic Machine Tool . . . A newly developed ultrasonic machine tool employing magnetostriction oscillations can carve fancy shapes, drill holes, and make other cutting operations in hard steel, glass, ceramics, or even precious stones. The device is similar to a drill press, and the cutting tool itself can be made of relatively soft materials such as brass. The work is clamped in place, and the tool is lowered until it is in contact with the work. A liquid abrasive is flowed over the work surface in a continuous stream, and the power is turned on. The tool, oscillating at about 27kc, drives the abrasive particles at ultrasonic speeds and this action cuts away the material. Developed by Raytheon Manufacturing Co., Waltham, Mass., the device is capable of high accuracy, regardless of the material being cut. Tolerances are limited by the accuracy of the die being used, or the dimensions of the shaped tool, and the accuracy of the feed and ways of the machine.

TV in Puerto Rico . . . The first TV station in Puerto Rico, to be known as WKAQ-TV (channel 2) is expected to be installed and operating at San Juan early next year. Equipment costing almost \$500,000 (manufactured by General Electric Co., Electronics Park, Syracuse, N. Y.), is being purchased by Angel Ramos, owner-president of El Mundo and Radio El Mundo (leading Puerto Rican newspaper and radio station).

The station will operate from a 1750' transmitter site atop Marquesa Mountain, about 12 miles from the downtown studio, and will reach a potential audience of 1,700,000 people. The 5kw transmitter with 6-bay antenna will give the station an effective radiated power of 30kw. After the station is operating, it is planned to increase transmitter power to 35kw, giving the station an effective radiated power of 100kw. This will make WKAQ-TV one of the most powerful TV stations in Latin America.

NY "Skiatron" Tests . . . "Subscriber-Vision", a development of the Skiatron Electronics & Television Corp. (30 East 10th Street, New York 3, N. Y.) was recently demonstrated in New York City to gather data on audience reaction to this type of telecasting. The system consists of a "coder" (three portable units) installed at transmitting locations, which scrambles video and audio signals as they are sent out on the air; and a "decoder" home unit which unscrambles the signals so that they can be seen and heard by the home viewer.

Each decoder is a small unit which can be attached to any standard TV set. It has a slot at the top into which is inserted a program card containing a printed circuit which in conjunction with the decoder unscrambles the signals. These cards are sent each week to subscribers who pay only for those programs they select by means of a pushbutton arrangement on the decoder.

During the tests, programs were sent out over WOR-TV Channel 9 before regular broadcasting hours, and over closed circuits at other times. Moving pictures of major studios (MGM, RKO, Disney Productions, Inc., and Republic Pictures cooperated), an educational program, and a sports program were shown as examples of the type of material that would fit into the subscriber TV program.

The people who attended the demonstrations were asked to fill out a questionnaire giving their reactions to the tests. When and if the FCC issues a license for commercial operation of Subscriber-Vision, the company plans to use the facilities of existing TV stations, buying time and showing its special programs over regular channels. However, only those viewers who have the decoders and the weekly program card will be able to see and hear the programs properly. The program card also will make a record of the programs viewed which will be used by the company to bill the viewer.

Electronic Line Fault Analyzer . . . Operating from a powerhouse, transformer bank, or substation, a new electronic Line Fault Analyzer locates shorts, grounds, or open circuits at distances of 1/2 to 200 miles. The instrument (manufactured by Sierra Electronic Corp., San Carlos 2, Calif.) operates on radar techniques and sends a high amplitude pulse down the line under test. Discontinuities such as opens, shorts, grounds, etc. are located and a complete picture of the line is presented on a built-in radar-type "A" scope. Calibrated linear sweep ranges of 5, 25, 50, and 100 miles are provided.

For greater accuracy, a movable distance marker formed by a time base step can be ranged out from 5 to 100 miles. When the step is placed in coincidence with the fault, the distance is read directly from the dial. A sweep delay circuit is provided to extend the range of the instrument to 200 miles, or to allow a small section of the line to be displayed for study.

The LFE OSCILLOSCOPE Model 401 FEATURES:



PRICE \$895

- LINEARITY OF VERTICAL DEFLECTION
- HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER
- ACCURATELY CALIBRATED SWEEP DELAY
- BUILT-IN TRIGGER GENERATOR

Linearity of Vertical Deflection. The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection with negligible compression.

High Sensitivity and Wide Frequency Response of Y-Axis Amplifier. The vertical amplifier of the LFE Model 401 provides high sensitivity, 15 Mv./cm. at D-C and A-C, and wide band response to a 3 db. point at 10 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time.

Accurately Calibrated Sweep Delay. The accurately calibrated delay of the LFE 401 provides means for measuring pulse widths, time intervals between pulses, precisely calibrating sweeps and other useful applications of time measurement.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

Built-In Trigger Generator. Provides triggers from 500—5,000 cps. for internally triggering sweeps. These triggers are simultaneously available, delayed or undelayed, for external use.



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Graphical Aid for Amplifier Design

R. E. Ricketts

Senior Engineer, Instrument Div.

Allen B. Du Mont Laboratories, Inc., Passaic, N. J.

THE oscillograph has become a standard piece of precision test equipment for examination of wave shapes and amplifier tests. It is a very useful tool. However, the application of oscillographic methods of testing requires that the right type of oscillograph be used for such test purposes.

For example, a typical problem might be that of setting up a series of tests for a high quality audio amplifier. What kind of an oscilloscope should be used? According to the design parameters of the audio amplifier, the frequency response should be flat to 30kc. In addition, let us say that second order effects of distortion are believed to be negligible. If second harmonic distortion is to be examined on an oscilloscope, the instrument must have better frequency characteristics than the amplifier under test. Therefore, an oscilloscope that is essentially flat to 70kc in its sine wave response is required.

Let's suppose, however, that the only instrument available has a specification giving its response in terms of response to a pulse of $1\mu\text{sec}$. The chart shown in Fig. 1 permits the engineer to quickly convert this specification into a sine wave response. Going up along the "Y" axis to the $1\mu\text{sec}$ point, then projecting across to the curve and down to the "X" axis shows that the sine wave response of the oscilloscope is 350kc. Thus the engineer knows his test equipment is adequate.

Conversely, in working with pulses and square waves, if the response of the oscilloscope is given in terms of sine wave response, the graph permits rapid interpolation from sine wave response to pulse rise time. If the oscilloscope is flat ($\pm 1\text{db}$) to 5Mc, then going along the "X" axis to the 5Mc point and projecting up to the curve and across to the "Y" axis gives a pulse rise time value of about $0.07\mu\text{sec}$.

The designer of a video or wide band amplifier knows it is necessary to compensate for non-sinusoidal waveforms in most practical applications. However, many calculations are based on the sine wave response of an amplifier. For example, if one is interested in a television system, from the sine wave point of view, the present standard of 600 lines resolution requires a bandwidth of 7.7 megacycles. On the other hand, if one wished to pass a square wave with a rise time

of one microsecond through a video amplifier, the question arises, just what response is necessary?

Fortunately, in several articles¹ published on delay lines and spectrum analysis, a formula is readily available, from which a graph can be plotted to aid the designer. From calculations, it can be shown that the bandwidth can be calculated by means of the following relationship: $T.R. = 0.36/F$ where $T.R.$ is the rise time response and F is frequency (megacycles).

This formula is derived from rectangular bandwidth figures. For example, in a single transition between white and black areas, the rise time is related to the total area under the frequency response curve. However, in measuring distortion by means of a sawtooth, one should know roughly what to expect from an amplifier through which a sawtooth is passed. The TV horizontal scanning frequency of 15750cy sets a requirement (for sine wave response) of a bandwidth of 1.5Mc when a sawtooth is passed through such an amplifier if one is to observe the shape of the sawtooth without distortion. Conversely, if one knows the bandwidth of an amplifier and wishes to use a square wave or pulse to test the response of the circuit, the rise time of such a pulse can be directly determined from the formula as follows: $T.R. = 0.36/1.5\text{Mc} = 0.24\mu\text{sec}$.

Therefore a pulse with a rise time of $0.24\mu\text{sec}$ could be used with a suitable oscilloscope such as the Du Mont 303A to observe the responses of the amplifier designed for 1.5Mc bandwidth.

To make the engineer's task easier, this graph has been designed to permit accuracies of 5% in reading frequency response directly, as a function of pulse or square wave rise time. The chart has been extended into the millimicrosecond region. Note that for a rise time of 4 millimicroseconds, a bandwidth (response 3db down) of 90Mc is required.

In addition, when considering utilization of an oscilloscope with a given rise time response, the sync amplifier response should be as good as the "Y" amplifier. The chart will permit rapid interpolation of its response from its bandwidth characteristics with the rise time response of the "Y" amplifier.

¹"Spectrum Analysis and Transient Response", H. A. Samuelson, *Proceedings of I.R.E.*, Vol. 39 No. 2, Feb. 1951.

PULSE RISE TIME

FIGURES IN MILLIMICROSECONDS

FIGURES IN MICROSECONDS

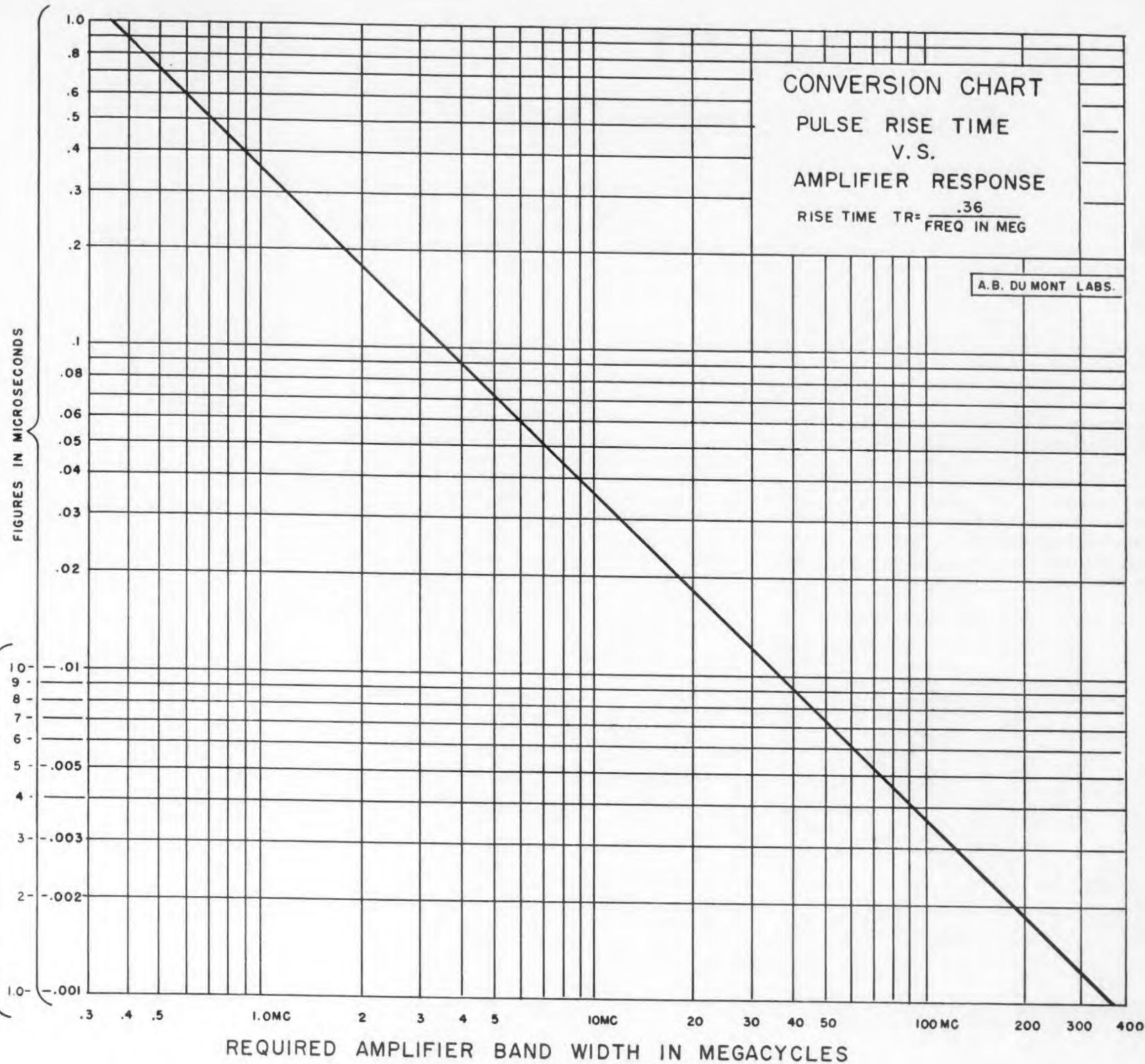


Fig. 1. Conversion chart which permits designers to convert pulse rise time to amplifier response and vice versa.

Type E1T

Decade Counter Tube

DESIGNED on the cathode-ray principle, the "Vidicount" *E1T* Decade Counter Tube provides a complete scale of 10 in the dimensions of a radio receiving tube. It is of special interest to electronic designers concerned with counting and indication of electrical pulses because it can replace a considerable number of tubes and their associated components as well as indicating devices.

The tube (available from Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, L. I., N. Y.), is shown in Fig. 1. Diagrams of the electrode structure and the symbolic circuit representation that is used are shown in Fig. 3. According to the number of counting pulses applied, the ribbon-shaped electron beam is shifted in a horizontal plane and passes in succession through the 10 apertures of a cylindrical anode, and impinges upon the fluorescent layer with which the envelope is lined. The number of pulses can thus be read on the outside of the envelope.

As the last position is passed, the beam is reset to its zero position and a counting pulse is applied simultaneously to the following tube. With several *E1T* tubes in cascade, any number of pulses can be read directly without the need for a special indicating device. A scaler capable of counting and indicating 30,000 counts/sec can be built in a cabinet less than 17" wide by 6-5/8" deep by 6-1/8" high with a total power consumption of only 77VA.

In Fig. 3, the various interior parts of the tube are indicated. They include the filament (*f*), cathode (*k*), screen (*s*), control grid (*g1*), beam forming electrode (*b*), accelerating electrode (*g2*), left deflection electrode (*D*), right deflection electrode (*D'*), auxiliary anode (*ah*), suppressor grids (*g3*, *g5*), slotted electrode (*g4*), reset anode (*a1*), anode (*a2*), and the conducting layer coated with fluorescent material (*l*). The 6.3v, 0.3amp heater (*f*) is mounted in a rectangular cathode (*k*), the front of which is



Fig. 1. The Type *E1T* Decade Counter Tube. A count is indicated by a rectangular luminous spot appearing next to one of the figures 0 to 9 on the circumference of the bulb.

oxide-coated. The electron beam is given the required shape by the action of the control grid (*g1*), the internally connected beam-forming electrodes (*b*), and the accelerating electrode (*g2*). By using a narrow, ribbon-shaped beam and other constructional features, the unit provides a beam current of about 1ma at only 300v, and the overall dimensions of the tube are similar to those of an ordinary receiving tube (1.417" diam x 3.268" high).

A circuit developed to provide the most reliable operation using the *E1T* is shown in Fig. 2. It consists of an input wave shaper (*A*), the counter circuit (*B*), a flyback circuit (*C*), and the power supply (*D*) which includes a precision voltage divider. The counter and flyback circuits (*B* and *C*) are repeated in successive stages (only two are shown).

The input wave shaper generates the proper triangular wave to step the tube to its 10 stable operating points. The wave shape required has an average amplitude of 13.6v, a rise time of 0.7μsec max, and a decay time of 7μsec min. The interstage flyback circuit serves to reset the tube to its zero position after it receives its 10th pulse and also triggers the next stage. The power supply is designed for feeding up to seven counter stages.

Typical operating characteristics for the *E1T* are listed below. All voltages are given with respect to the chassis. As long as the ratios of the supply voltages are strictly maintained by using a suitably designed voltage divider consisting of 1% precision resistors, there is no need to stabilize the supply unit. Voltage fluctuations of ±10% can be tolerated.

Heater	6.3v (±10%), 0.3amp
Supply voltage	300v
Cathode current	0.95ma
Cathode resistor	15k ±1%
Control grid voltage	11.9v ±0.15v

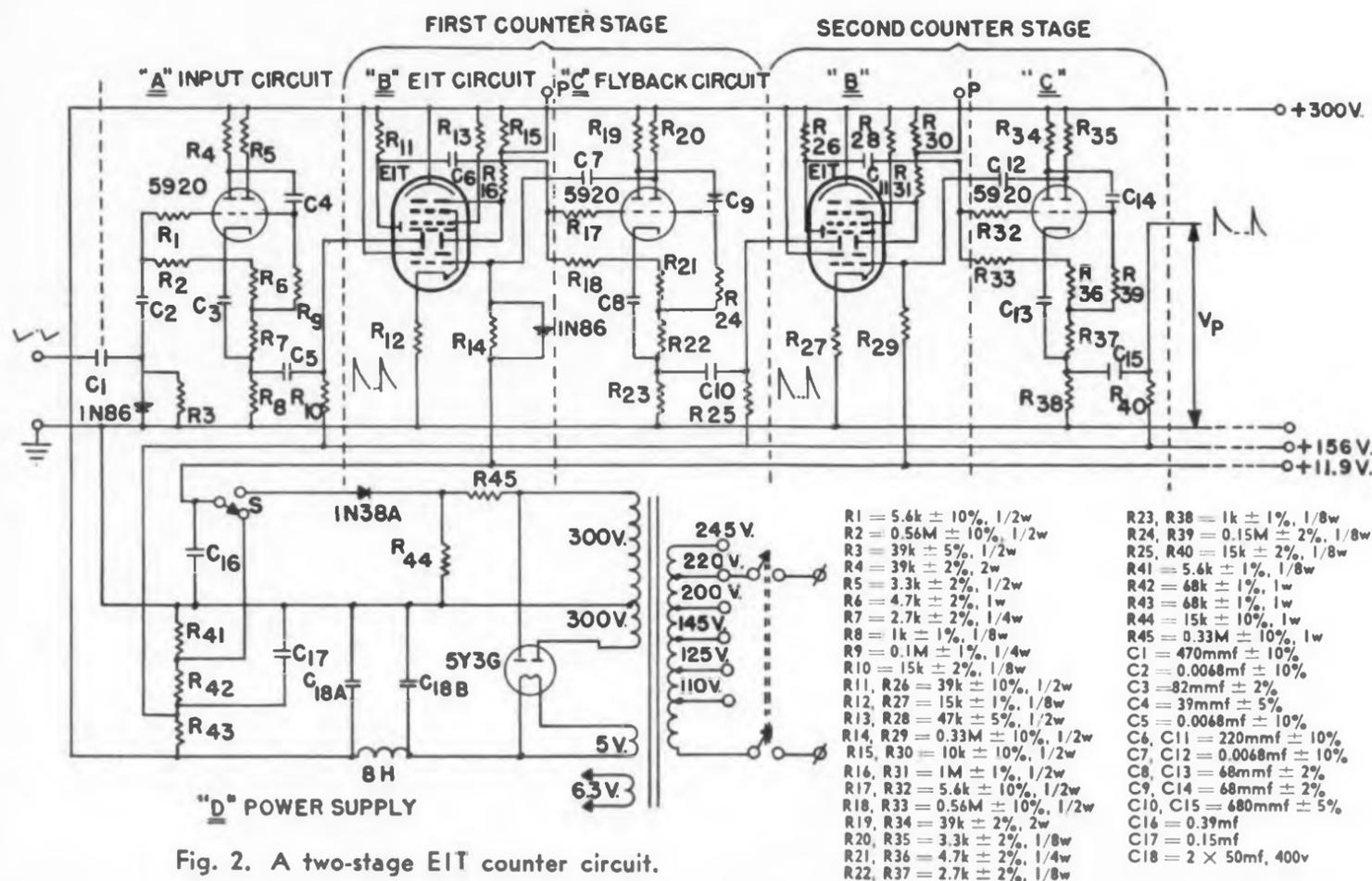


Fig. 2. A two-stage *E1T* counter circuit.

Accelerating-electrode voltage	300v
Left deflection electrode voltage	156v
Slotted-electrode resistor	47k ±5%
Conducting-layer voltage	300v
Anode resistor	1meg ±1%
Reset-anode resistor	39k ±10%
Accelerating-electrode current	0.1ma

A N O T H E R C B S - H Y T R O N F I R S T

CAN A TUBE BE A CHOKE?

Since the electron beam is sensitive to the influence of magnetic fields, the tube should not be operated where the density of such fields exceeds 2×10^{-4} webers/square meter (2 gauss) in any direction. The tube plugs into a duodecal socket (Amperex Type S-13264 or equivalent).

The counter stages shown in Fig. 2 can be built as small, interchangeable units to plug into a chassis containing the input pulse shaper and supply unit. With suitable preamplifiers, and the necessary output circuits, the circuit in Fig. 2 can be modified to operate from a wide variety of sources such as photocells, ionization gages and magnetic pickups to operate many kinds of actuators or signalling devices. Because of the economies of space, components, and power requirements afforded by the *Type E1T*, the tube should find wide application in many industrial and scientific applications.

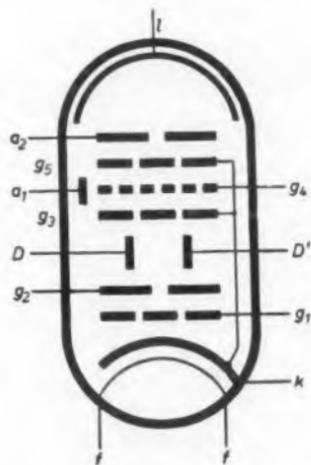
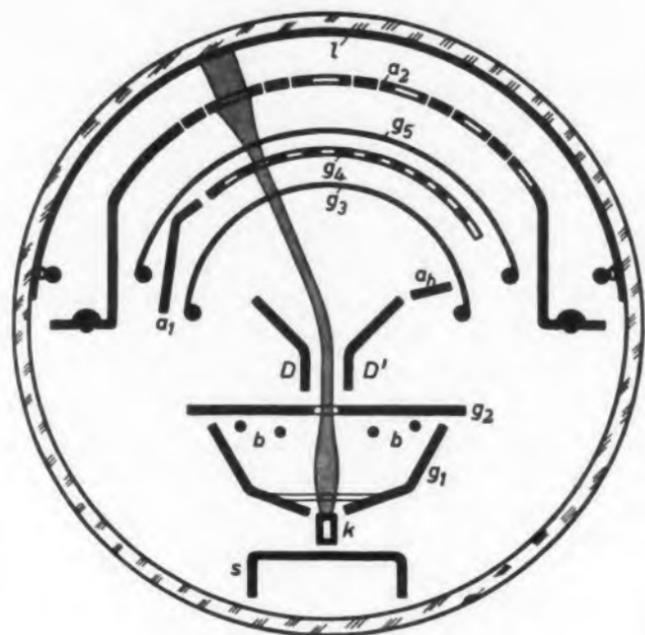


Fig. 3. Electrode structure and symbolic representation of the Type E1T Decade Counter Tube.

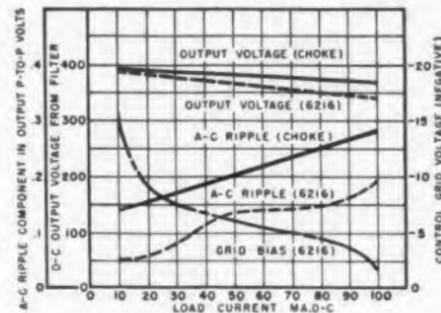
Yes, the CBS-Hytron 6216 . . . a 9-pin miniature, beam pentode . . . does the trick. The 6216 filter-reactor tube replaces a bulky, heavy, 12-henry choke rated at 100 ma., 350 ohms.

Light . . . compact . . . vibration-resistant . . . "ruggedized" (for impacts up to 625G), the 6216 is a natural for military airborne and vehicular equipment. Electrical design offers low d-c resistance (tube drop) and high a-c impedance (plate resistance). The two prime requisites of a good filter reactor.

Check the 6216's many features. Note the simple filter-reactor circuit. Compare performance of 6216 with that of an iron-core choke. Note also the many other possible applications for this versatile CBS-Hytron original. Write for complete data. Or order the CBS-Hytron 6216 today.

COMPARISON OF FILTERING ACTION 6216 vs. Choke — 12 Henries, 150 Ma.

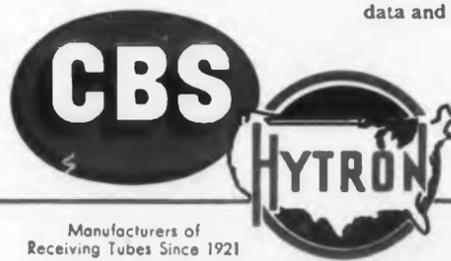
Operating conditions for 6216: Grid bias, see curve; screen voltage, derived from 400v through 60,000 ohms; filament voltage, 6.3v; unfiltered voltage applied to filter, 400v.



OTHER APPLICATIONS FOR CBS-HYTRON 6216

Special features of CBS-Hytron 6216 offer many advantages as: (1) Wide-band video amplifier. (2) Husky, vhf class C amplifier or frequency multiplier. (3) Class A or B amplifier. (4) Pass tube in electronic voltage-regulated power supply. (5) Passive switching tube, with low cut-off voltage requirement.

FREE DATA. Write for complete 6216 data and curves today.

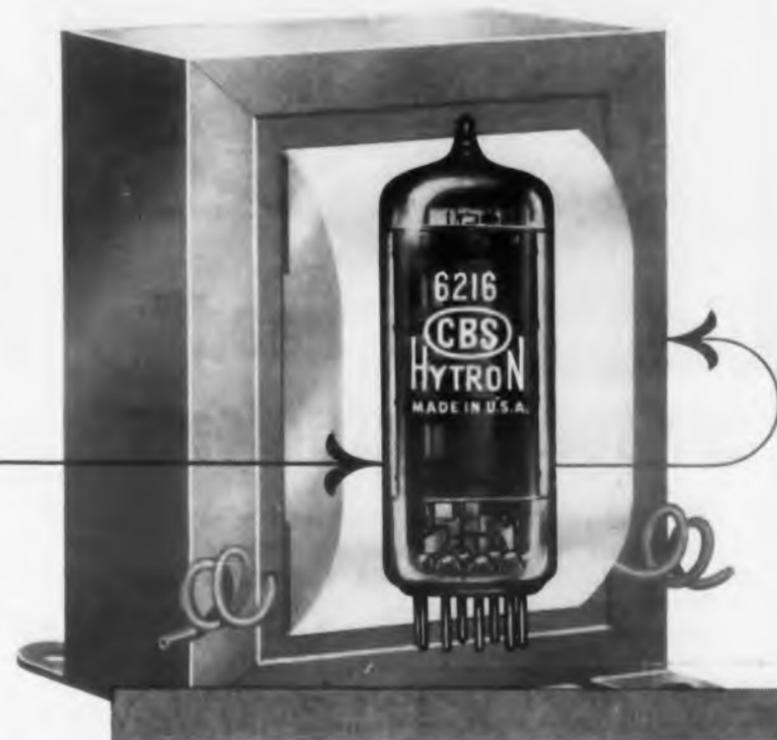


Manufacturers of
Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

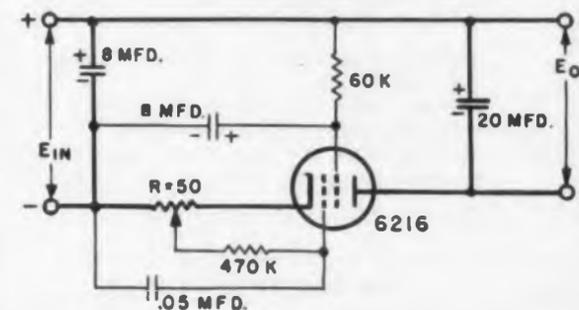
RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS
CIRCLE ED-5 ON READER-SERVICE CARD FOR MORE INFORMATION



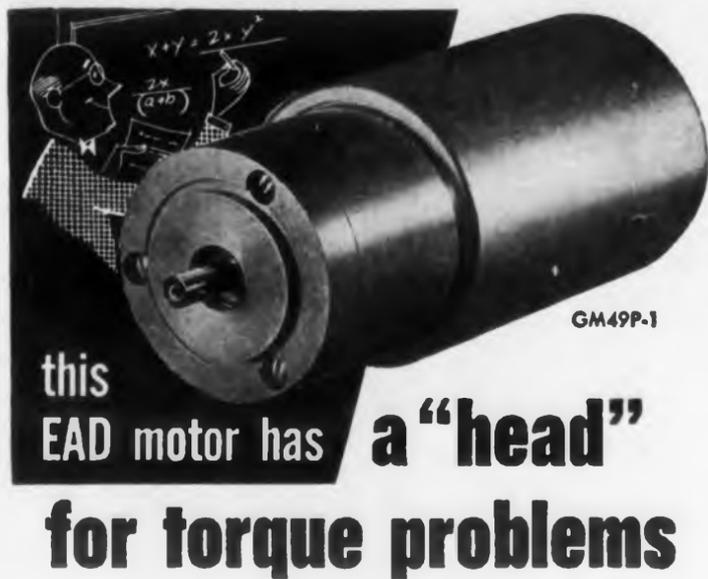
CBS-HYTRON 6216 FEATURES

1. "Ruggedized," vibration-resistant construction
2. Inhibited interface formation ("sleeping sickness")
3. Over-all characteristics optimized for maximum efficiency
4. Very high perveance
5. Extreme power sensitivity
6. Conservative ratings for reliable performance

TYPICAL FILTER-REACTOR CIRCUIT USING 6216

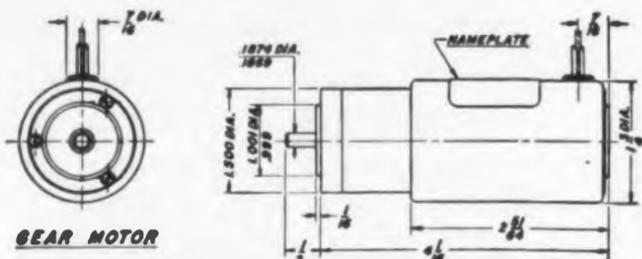


How the circuit works: High a-c impedance of 6216 . . . operated above knee of I_b vs E_b curve . . . is in series with load. Limits ripple current. Small voltage across lower portion of R is applied to grid through 0.05 mfd condenser. 6216 amplifies this voltage . . . which develops ripple voltage across load impedance in phase opposition to ripple voltage of load. Inverse feedback suppresses ripple still further. With two 6216's in parallel, d-c resistance is halved; load current for given IR drop and power sensitivity is doubled.



this
EAD motor has a "head"
for torque problems

A precision gear head combined with a miniature motor gives you the answer to high torque at low speed. The motor can be 60 cycle, 400 cycle or variable frequency—in single, two or three phase—with non-cooled or self-cooled frame types. The gear head is arranged to provide the output speed you require, with standard timing ratios of 60, 3600 or 8000 to 1 possible. High output torques, to drive, actuate or control, in confined areas, make this line of tiny gear motors ideal for a wide variety of applications on the ground and in the air.



SPECIFICATIONS FOR MODEL GM49P-1 400 Cycle Capacitor Run Induction Gear Motor

115 Volts • 400 Cycles • 1 Phase • 0.5 Amps.
Full Load Torque: 100 Oz.-In.
Starting Torque: Over 100 Oz.-In.
Gear Head Lubricated per Mil-G-3278
22 R.P.M. • 314 to 1 Gear Ratio • Reversible Rotation
Intermittent Duty: 15 Minutes on, 15 Minutes off
Ambient Temperature: -55° to +74° C

TYPICAL APPLICATIONS

Military and Aircraft • Follow Up Devices • Actuators
Instrument Controls • Automatic Controls • Automatic Pilot
• Radar Equipment • Electronic Control • Timers

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If your problem involves rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or design and produce a special unit to meet your most exacting requirements.

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585 DEAN ST., BROOKLYN 17, NEW YORK

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Two New Computer Components

THE entire arithmetic, program, control, and memory sections of any digital computer can be built using the two new computer elements shown in Fig. 1. Known as "Magnetic Decision Elements", they are completely basic, flexible building blocks and can be used for both serial and parallel systems—everything from simple flip-flops and binary counters, to large scale general purpose computers and digital differential analyzers.

The units are available in two types: "S" elements and "A" elements (from Minnesota Electronics Corp., 47 West Water Street, St. Paul 1, Minn.), and are designed with Hubbell "Interlock" connectors for rapid cascading in any desired performance pattern. These elements have different logical functions for computing applications. The "S" unit is essentially a negative coincidence circuit (it responds to a coincidence of 0's on all of its input lines). The "A" element is essentially a mixer. It generates an output pulse in response to an input pulse on any or all of its input lines.

Both elements have three inputs.

Two of these inputs have internally connected diodes. The third is an alternate that requires the use of input diodes (normally derived from another type of Magnetic Decision Element designated as "M"). Each "A" and "S" unit will function as a Decision Element for as many as six input variables

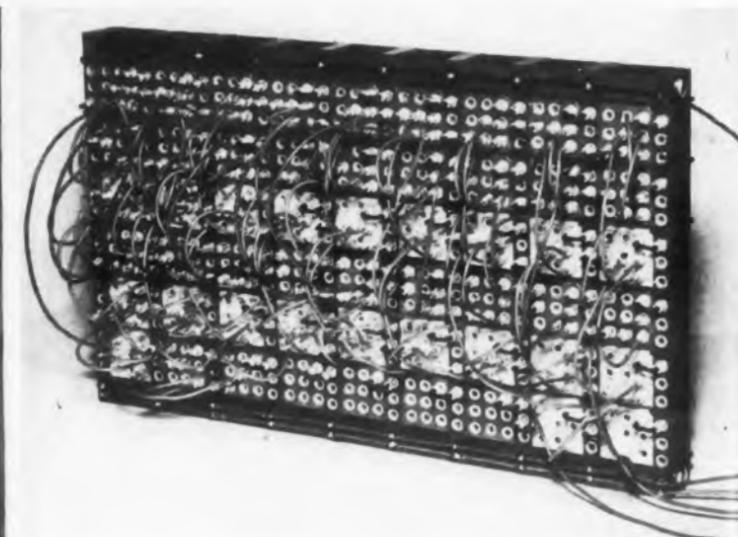
if suitable input diodes are linked together with the alternative input terminals.

A signal of about 25mw is required to drive the input circuits of the units, the useful output is about 10v at 15ma, and average power dissipation per element is less than 0.5w. An "A" element will drive a conventional plate circuit type relay directly, and with a suitable pulse transformer, can be used to operate a neon indicating light. Synchronization and power drive for computers built of these elements are derived from a central 200kc, 2-phase clock pulse generator (which furnishes rectangular clock pulses, 5μsec in duration with an amplitude of 25v to 35v), and the rate of information flow is 100kc. Static storage in each element makes it possible to turn the power off at any time with suitable clock switching facilities and retain all information in the machine indefinitely, including dynamic arithmetic operations.

"Magnetic Decision Elements" contain no tubes or transistors. All components are cast in an epoxy type of resin, resulting in a rugged structure that operates reliably over the wide range of temperatures (about -60°C to +75°C), humidity, vibrations, and shock encountered in military applications. They are exactly a cubic inch in size as designed for laboratory computing use. However, for special applications in fixed-purpose machines in aircraft and locations where size and weight are important, they can be furnished on special order in units measuring about 1/2 cu in. The racking arrangement shown in Fig. 2 as well as several special racking structures are available to suit special problems.

In addition to their application for end-use equipment, these "Magnetic Decision Elements" are very useful in research, design, and development work involving the empiric evaluation of systems. The cycle of design, use, re-design, and re-use in accordance with laboratory or field test techniques can be shortened greatly with these units, and waste or obsolescence of equipment is eliminated.

Fig. 1 (left). A handful of "Magnetic Decision Elements" showing their small size.
Fig. 2 (right). Racking arrangement showing how easily interconnections can be made.



Transistor Data Chart

THE chart shown here is a compilation of specifications on transistors which are in commercial production and generally available at this time. Transistors being produced for military consumption only, or those made for special users are not included. The data were obtained from information furnished by the manufacturers, and all specifications listed are tentative.

The following companies are listed as sources:

CBSH CBS Hytron, Danvers, Mass.
GE General Electric Co., Electronics Park, Syracuse, N. Y.
GP Germanium Products Corp., Jersey City 4, N. J.
RAY Raytheon Manufacturing Co., 58 Chapel St., Newton 58, Mass.
RCA Radio Corp. of America, Harrison, N. J.
RR Radio Receptor Co., Inc., 251 West 19th St., New York 11, N. Y.
S Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
TP Transistor Products, Inc., Snow & Union Sts., Boston 35, Mass.
W Westinghouse Electric Corp., Electronic Tube Div., Elmira, N. Y.

The column headings at the top of the chart stand for the following electrical characteristics:

V_c Collector voltage
I_c Collector current
W_c Collector dissipation
I_e Emitter current
α the "alpha" or current amplification factor
PG Power gain
PO Power output
NF Noise Factor
F_{co} Frequency Cutoff
C Type of circuit for which the characteristics are listed: "GE" being grounded emitter connection, and "GB" being grounded base connection.

All the junction transistors listed have maximum ambient temperature ratings of about 50°C except the Type WX4813 which is rated at 60°C. The point contact unit maximum ambient ratings range from 40°C to 60°C. Practically all units are available in plastic encapsulated form, some with metal cases as well. Several also can be furnished in hermetically sealed cases, and one manufacturer (CBS Hytron) has announced a new evacuated junction transistor.

Quantities in which these transistors are available and prices of the units have not been included because these factors are rapidly changing as production problems are being solved. For these details the reader is referred to the individual manufacturer.

Manu- facturer	Type No.	Class	Max. Ratings			Typical Operation							Application		
			V _c (Volts)	I _c (MA)	W _c (MW)	I _e (MA)	V _e (Volts)	I _e (MA)	α	PG (DB)	PO (MW)	NF (DB)		F _{co} (Mc)	C
Junction Transistors															
CBSH	2N36	P-N-P	-20	-8	50	1	-6	-1	45	40(a)		21	GE	Amp. (High Gain)	
	2N37	P-N-P	-20	-8	50	1	-6	-1	30	36(a)		18	GE	Amp. (Med. Gain)	
	2N38	P-N-P	-20	-8	50	1	-6	-1	15	32(a)		16	GE	Amp. (Low Gain)	
GP	RD-2517	N-P-N	30	5	50		4.5	1	11.5	37(b)	1.9	1.5	GE	Gen. Purpose	
	RD-2520	N-P-N	40	5	50		4.5	1		40(b)	2	22	3	GB	
	RD-2525	N-P-N	25	5	25		4.5	1	125	42(b)	1.9	5	GE		
RAY	CK721	P-N-P	-20	-5	30	2	-6			38(c)		22	0.8	GE	
	CK722	P-N-P	-20	-5	30	2	-6			34(d)			0.8	GE	
RCA	RCA-2N34	P-N-P	-25	-8	50	1	-6		40	40(e)				GE	Amp.
	RCA-2N35	N-P-N	25	8	50	-1	6		40	40(e)				GE	Amp.
RR	RR14	P-N-P	-25	-5	50		-1.5	-0.5	25	36(e)		22		GE	Low Level Audio
	RR20	P-N-P	-25	-5	50		-1.5	-0.5	40	40(e)		22		GE	Low Level Audio
	RR21	P-N-P	-25	-5	50		-1.5	-0.5	25		20(f)			GE	Low Level Audio
	RR34	P-N-P	-20	-5	30		-1.5	-0.5	10	30(e)				GE	Low Level Audio
S	2N34	P-N-P	-25	-8	50	1	-6		40	40(e)				GE	Amp.
TP	X-22	N-P-N	40	5	50	1	4.5			0.90				GB	Amp.
	X-23	N-P-N	40	5	50	1	4.5			0.95				GB	Amp.
W	WX4813	P-N-P	-30	-8	200		-6	to -2	30	30(g)				GF	Amp.
Point Contact Transistors															
CBSH	PT-2A		-40	-10	100	0.5	-30	-1.2	1.85	18(h)		55	2	GB	Amp.
	PT-2S		-40	-10	100		-30		1.85				2	GB	Switch
GE	G11		-30	-7	100	0.5	-25		2.2	17(i)		57		GB	Amp., Osc.
	G11A		-30	-7	100	0.5	-15		2.5			3		GB	Switch
RCA	RCA-2N32		-40	-8	50	0.5	-25		2.2	21(j)				GB	Switch
	RCA-2N33		-8.5	-7	30	0.3	-8		2.3	22(j)				GB	Osc.
RR	R1698				120								1.5	GB	Switch
	R1729					1	-30		2.5				5	GB	Gen. Purpose
	R1734				120								10	GB	Switch
S	2N32		-40	-8	50	0.5	-25		2.2	21(j)				GB	Switch
TP	2A		-50	-8	120	1	-30		1.5	20(m)				GB	Amp., Osc.
	2B		-50	-8	120	1	-30		1.5	20(m)			1	GB	Amp., Osc.
	2C		-50	-8	100	2	-15		2			(n)		GB	Switch
	2D		-50	-8	100	1	-30		1.5	20(m)			2	GB	Amp., Osc.
	2E		-50	-8	100	1	-30		1.5	20(m)				GB	Amp.
	2F		-100	-40	120	2	-15		2				(o)	GB	Switch
	2G		-100	-40	120	2	-15		2				(p)	GB	Switch
W	WX3347		-35	-4	100	0.3-0.8	-22.5		2	18(g)		2		GB	Gen. Purpose

(a) Source Z = 1000 ohms, Load R = 30,000 ohms
 (b) Load R = 4500 ohms, Distortion = 6%
 (c) Source Z = 650 ohms, Load R = 20,000 ohms
 (d) Source Z = 325 ohms, Load R = 20,000 ohms
 (e) Source Z = 500 ohms, Load R = 30,000 ohms
 (f) Source Z = 1000 ohms, Load R = 5000 ohms, Distortion = 10%
 (g) Source Z = 400 ohms, Load R = 10,000 ohms
 (h) Source Z = 425 ohms, Load R = 17,500 ohms
 (i) Source Z = 500 ohms, Load R = 20,000 ohms
 (j) Source Z = 500 ohms, Load R = 10,000 ohms

(k) Ratings given as follows:
 Off collector current = -2.2ma max (I_e = 0, V_e = -40v)
 On collector voltage = -4.0v max (I_e = 3ma, I_c = 5.5ma)
 (l) Ratings given as follows:
 Off collector current = -0.7ma max (I_e = 0, V_e = -7v)
 On collector voltage = -1.2v max (I_e = 3ma, I_c = -4ma)
 (m) Source Z = 500 ohms, Load R = 15,000 ohms
 (n) Rise time = 0.2μsec
 (o) Rise time = 0.15μsec
 (p) Rise time = 0.1μsec

A Data Reduction Instrument

ILLUSTRATED in Fig. 1 is an unusual data reduction instrument known as the Gerber "GraphAnalogue". An easy-to-use, manually operated, mechanical device, it has a wide range of uses for electronic design, development, and research engineers because it performs computations directly on graphs, curves, or recordings. It also is used on graphical work for reading, plotting, and interpolating.

The instrument, made by the Gerber Scientific Instrument Co. (89 Spruce Street, Hartford 1, Conn.), handles linear functions as well as arbitrary nonlinear functions directly, thereby eliminating much time and drudgery usually required for processing such data. It can divide a distance into any number of equal parts, into logarithmically proportional lengths, or into any arbitrary nonlinear proportion. It is very useful in data reduction where oscillogram recordings can be read directly in the final dimension, regardless of the shape of the calibration curve.

Heart of the "GraphAnalogue" is an accurate, triangular, calibrated spring, fixed at the left end, and attached at the right to a slide. Fastened in a similar manner is a round spring carrying little discs with numbers to facilitate easier reading of the triangular spring. When the slide is moved, both springs are extended the same distance and the same numbers

calibrate the same coils. The slide carries a hairline indicator to read values on 18 scales including logarithmic, probability, trigonometric, power, linear and reciprocal types.

A special graph paper insert is provided to read, plot, and interpolate graphs, curves, and scales involving nonlinearity. Typical applications include reading oscillograms or telemetering curves where a nonlinear calibration curve is necessary; plotting from curves; interpolating between families of curves where linear or logarithmic interpolations are too inaccurate; reading one set of data directly converted to another set; plotting nomograms; etc.

Using the "GraphAnalogue" is simple. For example, given a curve "A" of any arbitrary shape, and it is desired to plot a family of curves with values of say $0.2A$, $0.4A$, $0.6A$, and $0.8A$. The instrument is placed along any point x parallel to the ordinate with the 0 spring coil at $y = 0$, and the 100 coil at curve A. Points are marked off at the 20, 40, 60, and 80 coils. Then the device is moved to other stations along the x axis and the procedure is repeated. Curves are drawn through equal percent points. (See Fig. 2).

Where nonlinear calibration curves are employed such as in reading telemetering data, the nonlinear calibration scale is reduced to percent values by setting the 0 coil at one end of the scale and the 100 coil at the other end. Then the unevenly spaced calibration points between are tabulated and a percent calibration curve is plotted on the special graph paper which then is inserted in the instrument. Then a factor of proportionality called the "constant" is obtained, which establishes the relationship between the curve and the work. To read the value of any amplitude, the instrument is placed on the recording with the 0 coil on the reference line and the spring extended so that the "constant" is at the point on the amplitude in question. The corrected value then is read on the graph paper insert where the hairline intersects the curve.

Fig. 1. The "GraphAnalogue" Data Reduction instrument.

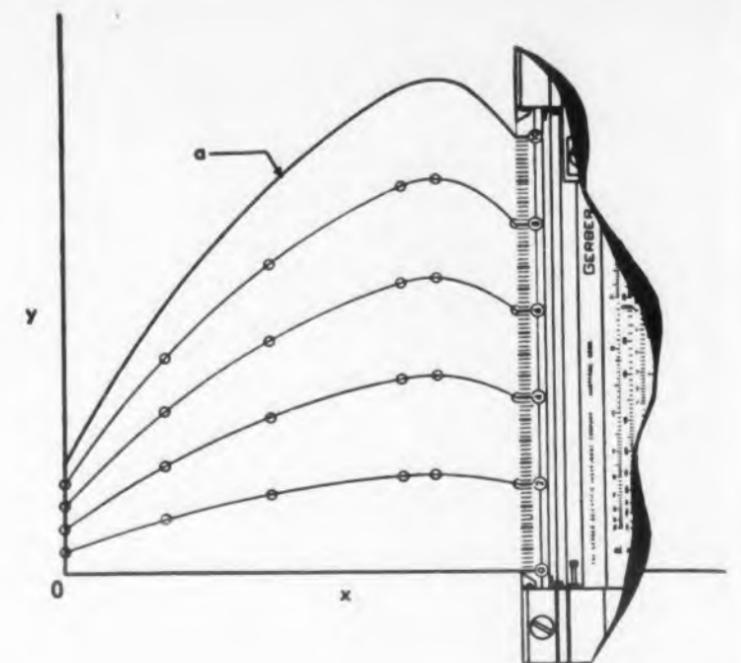
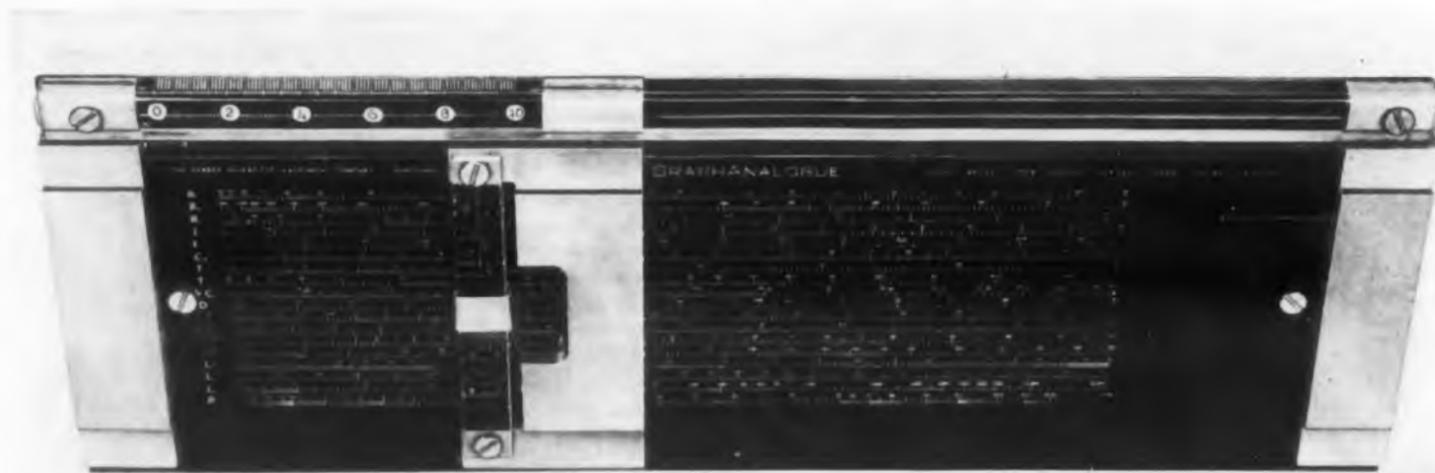
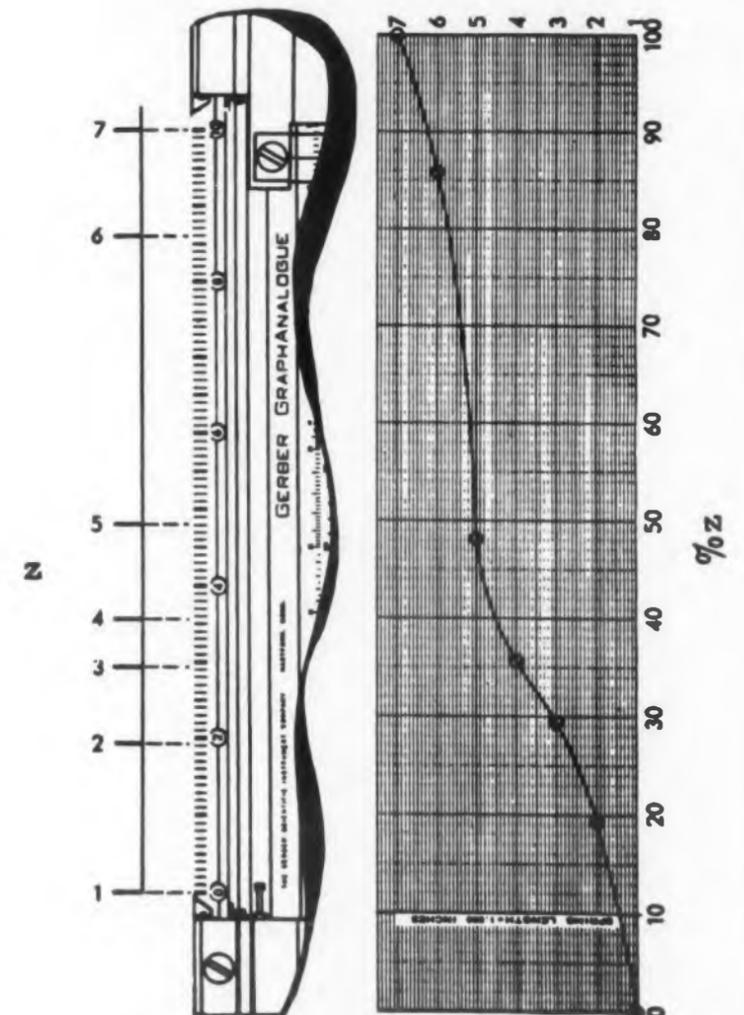


Fig. 2. The instrument in use. (Above) Here the device is being used to plot a family of curves from the single curve (a). (Below) By converting a nonlinear calibration scale (Z) to "percent values" and plotting these on the special graph paper shown at the right which is inserted into the "GraphAnalogue", the instrument then is calibrated to read corrected values directly from the original curve which might be in the form of telemetering data, oscilloscope tracings, etc.



Laboratory Standard D-C Voltmeter

RUGGEDNESS, complete protection against overload, infinite input impedance, a resolution of better than 50mv over the entire range of 0 to 600v, —these characteristics generally are not common in laboratory standard d-c voltmeters. However, they do apply to the Model PVM-4 Laboratory Standard D-C Voltmeter (developed by Computer Corp. of America, 149 Church St., New York 7, N. Y.), which also features an accuracy of better than 0.2% and a linearity of better than 0.1%.

Essentially, this new instrument consists of a super-regulated power supply, an accurately calibrated attenuator, and a sensitive null indicator. The reference voltage for the power supply is furnished by a mercury battery with better than 1% per year stability. An internal Weston standard cell is provided for periodically calibrating the power supply to within 0.1% of absolute value. The attenuator consists of a 10-turn potentiometer of 0.05% linearity and fixed resistors matched within 0.025%. The null indicator is a ruggedized zero-center meter with a sensitivity of $1\mu\text{v}$ per division.

In use, the voltage to be measured is applied directly across one side of the null indicator. The attenuator then is adjusted so that its output, applied to the other side of the indicator, produces a null. At this point the two voltages are exactly equal, and the value of the unknown may be read directly from the attenuator setting.

Compared to the moving-coil laboratory standard voltmeter or the precision potentiometer type of instrument, which are generally used for precise measurements of d-c voltages, the Model PVM-4 has a number of important advantages. A typical moving-coil meter has 100 scale divisions, so that on a 0-500v scale each division represents 5v. The new instrument has 5000 divisions on this same range, each representing 0.1v, which gives much better resolution.

In addition to costing less than a moving-coil instrument of comparable accuracy, the meter covers ranges of 0-10v, 0-100v, 100-200v, 200-300v, 300-400v, 400-500v, and 500-600v d-c. In order to achieve comparable accuracy over these ranges, at least seven moving-coil standard meters would be needed. Also of importance is the ruggedness of the new unit which can withstand much mishandling without damage or

the need for recalibration. It can even be built into equipment to take the place of less accurate panel meters. At null, the instrument has an infinite input impedance which means that no current is drawn from the source. Off null, only a few microamperes will be drawn, making it possible to take accurate no-load voltage readings and to read the output voltage of low-current power supplies.

Linearity is less than 0.05% of full scale on any one range and less than 0.1% overall. Accuracy is less than 0.2% absolute or $\pm 20\text{mv}$ (whichever is more), on the 0-10v range; and less than 0.2% absolute or $\pm 200\text{mv}$ on all other ranges. Power requirements are 95-135v, 50/60cy, 20w; and the unit measures 8" x 9" x 11" and weighs 11 lb.

The 600v line in the unit is calibrated by means of a Weston standard cell which is mounted on the rear of the instrument and thermally insulated so that only normal room temperatures are encountered. The null indicator is a 3-1/2" hermetically sealed and ruggedized zero-center panel meter. It has a sensitivity of better than $1\mu\text{v}$ per division at center, dropping to about $10\mu\text{v}$ per division at half scale, and to $100\mu\text{v}$ at full scale.

In addition to the logarithmic scale, further protection is provided by a spring-return sensitivity switch. In normal position a large resistor is inserted in series with the meter, effectively reducing its sensitivity. After the attenuator has been adjusted to an approximate null, the switch can be held in the "High Sensitivity" position. This shorts out the resistor and permits final adjustment at maximum sensitivity. A diode meter compressor and a quick acting instrument fuse also protect the instrument from overloads.

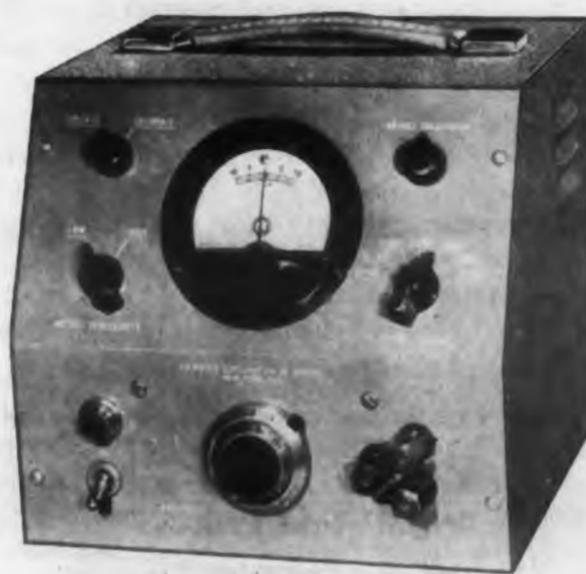


Fig. 1. The Model PVM-4 Laboratory Standard D-C Voltmeter, which has a range of 0 to 600v.



30% less space required with G-E drawn-oval capacitors

Savings up to 20% in cost possible
with dual-rated (a-c/d-c) G-E units

If you use fixed paper-dielectric capacitors in case sizes CP53 and CP70, it will pay you to consider General Electric drawn-oval units. They require minimum space and offer maximum mounting flexibility. In addition, they provide unsurpassed reliability and the opportunity of saving up to 20% in cost over rectangular units.

RATINGS range from 1 to 10 muf, 600 to 1500 volts d-c, or 330 to 660 volts a-c. Choice of mounting arrangements make them ideally suited for air conditioning units, electronic test equipment, motors and controls or other applications where units capable of meeting all electrical and mechanical requirements of MIL-C-25A specs except for case dimensions and markings are desirable.

DOUBLE-ROLLED SEAM attaches cover to drawn-steel case—producing a lighter, yet stronger capacitor. Actual savings in size and weight vary with case style and rating but can amount to as much as 30%. Depending upon case style and quantity ordered, prices average 10 to 20% lower than rectangular capacitors.

For more information on the new G-E Drawn-oval capacitors, see your G-E apparatus sales representative or write for Bulletin GEA-5777, General Electric Company, Section 442-11, Schenectady 5, N. Y.

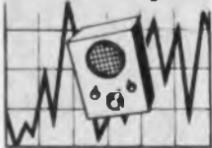


You can put your confidence in—

GENERAL  ELECTRIC

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What is your Delay or Regulating Problem?



For the most effective solution use the
SIMPLEST, MOST COMPACT
MOST ECONOMICAL
HERMETICALLY SEALED

AMPERITE THERMOSTATIC DELAY RELAYS

Provide delays ranging from 2 to 120 seconds.

- 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



STANDARD

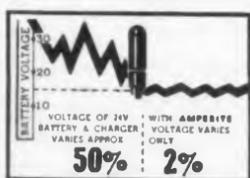


MINIATURE

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.



Maximum Wattage Dissipation:
T6½L—5W. T9—10W.

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



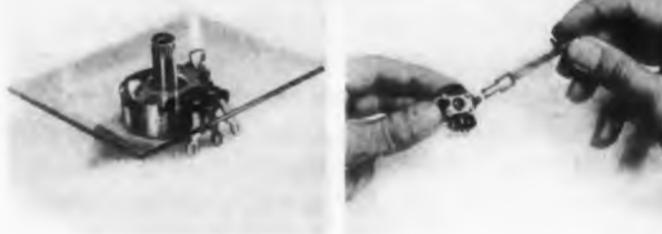
T9 BULB



AMPERITE CO., Inc. 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 2B

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New Products . . .



Potentiometers

Ear-Mounted TV Types

These new Potentiometers have been designed for mass production applications such as in TV receivers. They feature an unusual method of mounting that eliminates the usual threaded bushing and mounting hardware (see photos on cover).

The controls are held rigidly to the chassis panel by means of two metal mounting ears that are twisted to hold the controls in place. The Type PH45 (shown at the right) can be used where only screwdriver adjustment is required, or with a detachable flat plug-in shaft for finger adjustment. This feature permits the control to serve in several different kinds of TV applications because shafts can be purchased separately in increments of 1/8" ranging from 1" to 2" and plugged into the control after installation in the chassis.

Type PM45 has an insulated shaft for TV hot chassis applications and Type P45 is provided with a plated metal finger-knurled and recessed slot shaft for screw driver or finger adjustment. Both controls are manufactured in shaft lengths of 1/2" or 5/8" beyond the mounting surface.

The three types are available in standard resistance ranges and are all rated from 1/4 to 1/2 watt depending upon the resistance value required. They are quite compact, requiring very little space behind the panel since they measure only 15/16" in diameter x 29/64" deep. Chicago Telephone Supply Corp., Dept. ED, Elkhart, Indiana.

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION

Bright Gold Process

Abrasion and Corrosion Resistant

A bright, pore-free Gold Process that provides twice the hardness of conventional gold plating, can be used on all sizes and shapes of radio, telephonic, and electronic parts, where abrasion and corrosion resistance

are important. Electrical resistivity of the gold plating is low, and it resists attack by salt spray and most chemicals.

The process consists of plating from a high cyanide, low temperature electrolyte which operates at low current density. Because of low temperature operation, the bath is extremely stable. Cathode efficiency approaches 100%, which allows accurate deposits required in specification plating. Interior surfaces and deep recesses of bends and other intricately shaped pieces can be uniformly plated without an interior anode because of the excellent metal distribution and "throwing power" of the process. Sel-Rex Precious Metals, Inc., Dept. ED, Belleville, N. J.

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

Variable Inductors

Potted in Casting Resin



The Model PA-63 Variable Inductor is a manually-variable, high-frequency, saturable-core reactor, with improved stability obtained through use of a permanent-magnet bias. In many f-m and sweep applications

this feature eliminates the problem of assuring an extremely well-regulated supply of d-c to the control winding, and has a number of valuable by-product advantages such as operation at a lower temperature, stability and reliability, and operation at high frequencies and high Q without the constant presence of high saturating currents. Control-current changes of the order of 0 to 10ma will accomplish inductance changes of several hundred percent.

The unit is potted in casting resin, which adds further to its ruggedness and immunity to ambient conditions. Another feature is the provision for manual tuning by moving a metal slug to shunt the magnet bias. The unit is manually tunable over about half its total range and can still be swept, or frequency modulated, about its center frequency with good linearity by means of the control winding. It is shown here with the cover removed. Vari-L Co., Inc., Dept. ED, P. O. Box 1433, Stamford, Conn.

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

Electromagnetic Focus Coil

Serves as Precision Standard



Designed for use as a precision standard for checking the distortions in production focus coils and as a component in units or applications requiring sharpest focus, this Type F10 Electromag-

netic Focus Coil fits e-r tubes having a 1-1/2" maximum neck diameter.

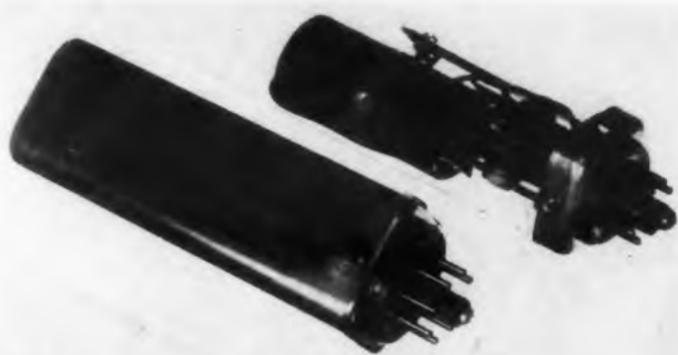
Applications for the device are to 18kv accelerating potential. Spot distortion is eliminated by 1/10" wall machined case. External magnetic fields are completely eliminated by the nature of the design, so that there is no distortion or beam bending in the magnetic gun. There is no beam shadowing or interference with other components. The unit may be used for centering the beam.

The unit is obtainable over a wide range of coil resistances. Its large ID assures sharp focus for high beam currents. Syntronic Instruments, Inc., Dept. ED, 100 Industrial Rd., Addison, Ill.

CIRCLE ED-13 ON READER-SERVICE CARD FOR MORE INFORMATION

Heater Rectifier

Reduces Hum in Amplifiers



The small Rectifier-Filter circuit shown here was developed especially for reducing hum by supplying d-c heater current to the first stage of low level amplifiers. It is provided with an octal plug for convenient mounting and occupies a space above the chassis of only 1-3/8" x 1-3/8" x 4".

Since its rated input voltage is 6.3v to 7.5v a-c, the device can be connected directly to the available a-c filament supply. It provides up to 0.3amp d-c, and the d-c output voltage is about 85% of the a-c input voltage at 0.3amp load, and 95% at 0.15amp load. Filtering is adequate to reduce the a-c component in the load over 20db. The small size of the unit permits its use with existing amplifiers. Vector Electronic Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 1953

Molded Tubular Capacitor

For TV Applications



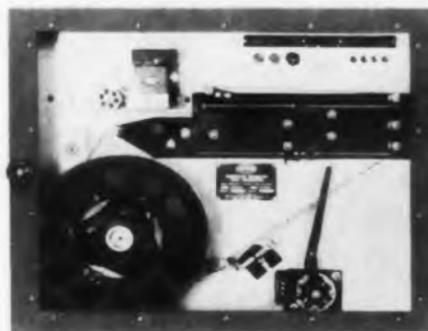
The "Telechief" Molded Paper Tubular Capacitor, designed for TV applications, employs "Humiditite", a new molding compound with high moisture resistance characteristics. The device meets the minimum moisture resistance requirements of the proposed MIL-C-91A specification.

A new impregnant holds the unit to rated capacity under all conditions and provides additional strength. Sangamo Electric Co., Dept. ED, Marion, Ill.

CIRCLE ED-15 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Tape Mechanism

Records and Stores Digital Data



This Computer Magnetic Tape Mechanism, designed for recording and storing digital data, is a single, compact unit incorporating all the elements needed for precise, high-speed handling of half-inch magnetic recording tape. It may be operated automatically by pulsed input signals, or controlled manually by a front panel switch.

The device moves from stop to start or vice versa in less than 5 milliseconds, with smooth acceleration, deceleration, or reverse. The magnetic head has six channels, narrow gap, with high frequency response, and is readily interchanged or replaced.

The unit has a built-in power supply, self-contained, and can operate the mechanism at 110v to 125v. Normal variations up to 5% are tolerated without appreciable changes in dynamic performance. Control is attained by a servomechanism in which tachometers attached to the reel drive assembly and a variable reluctance or microslyn device, detecting displacement of the floating carrier of the slack absorber, serve as error signal sources. Slack and tension control is automatic. The reel assembly features two 1000' reels mounted side-by-side on coaxially-driven shafts with 2-reel motors, gear drives, and tachometers. Raytheon Mfg. Co., Dept. ED, Waltham 54, Mass.

CIRCLE ED-16 ON READER-SERVICE CARD FOR MORE INFORMATION



WHY USE THESE EthoLoc® CABLE CLIPS?

1. Made of tough, durable Ethyl Cellulose plastic—no danger of shorts or grounds
2. Flexible and easy to apply—no sharp edges
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4. Low in cost

15% reduction in prices on many popular sizes. We thank our customers for large volume that made price reductions possible.

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WECKER COMPANY

5253 N. Avondale Ave. • Chicago 30, Ill. •



CIRCLE ED-7 ON READER-SERVICE CARD FOR MORE INFORMATION

A timely tip on timing

Won't you take a timely tip on timing and take your timing problems to a company with a proven performance record. The A. W. HAYDON CO. has repeatedly been called upon by industry to solve the most difficult timing problems.

Regardless of how difficult your timing problems may appear to be, remember there has to be a solution. The A. W. HAYDON CO. are past masters at solving the most difficult and exacting of these problems.

Past performances prove future accomplishments... take a timely tip on timing and call The A. W. HAYDON Co. . . . their engineer consultants will gladly talk over any problem you may have.



Preferred Where Performance Is Paramount

CIRCLE ED-17 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW Servotrol POT-kit



.. instantly ready for setting up single or ganged, linear or non-linear potentiometer assemblies.



Price:
\$295.00

Experimental laboratories and design engineers! . . .

... Servotrol's Pot-kit provides you with a versatile assortment of "Unitized" Type RVC2 potentiometers, mounting plates and clamp rings. With this set of transducers mechanical shaft rotation can be converted to almost any linear or non-linear electrical relationship.

Versatility of the Pot-kit eliminates delays!

Any of the fourteen linear potentiometers may be converted to non-linear functions by connecting shunt resistors of proper value across the three equally spaced taps on the winding. The Pot-kit enables you to translate your ideas to conclusions without delay.

The extreme versatility of Servotrol's Pot-kit B simplifies breadboarding and speeds decision as to the needed potentiometer or assembly for your prototype systems.

Immediate deliveries:

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CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

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There is an Electrical Distributor in your territory who carries comprehensive stocks of SUPERIOR ELECTRIC Voltage Control Equipment. He is a specialist carefully selected for his knowledge of your requirements and his ability to give you prompt, courteous service. He is as near as your telephone. Call him for your voltage control requirements.

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SUPERIOR ELECTRIC designs, engineers and manufactures Voltage Control Equipment specifically to meet today's demands. A wide range of standard types in numerous capacities and ratings are offered. In addition, The Superior Electric Company — thoroughly experienced in the field of voltage control—offers to work with you in developing special equipment to meet your special needs exactly.

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CIRCLE ED-19 ON READER-SERVICE CARD FOR MORE INFORMATION

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VARIABLE TRANSFORMERS

STABILINE

AUTOMATIC VOLTAGE REGULATORS

VOLTBOX

A-C POWER SUPPLIES

VARICELL

D-C POWER SUPPLIES

SUPERIOR 5-WAY

BINDING POSTS

New Products...

Precision Potentiometers

Have 0.01% Linearity



NEW, UNIQUE SERVOCALCULATOR included in the kit

Calculating values of shunt resistors and effective potentiometer resistance accomplished in a matter of seconds with direct readings from the disc scales. Eliminates time-consuming computations.

360° Sine Function

A sine function potentiometer with a complete 360° function angle of rotation is provided to broaden the range of experimentation with the Pot-kit.

a continuous linearity curve is supplied.

Resistance range is 2000 ohms to 300,000 ohms, with a standard resistance tolerance of $\pm 1\%$. Lower resistance values, down to 500 ohms, are available at reduced linearity (0.02%). Temperature range of operation of the standard unit is 0° to 80°C. Low temperature coefficient resistance wire (0.00002 parts per degree C), and thermal cycling are used to stabilize resistance value. Depending on the resistance value, the resolution is as great as 0.0024%.

The unit may be servo or panel mounted. Its torque and inertia characteristics are adapted to servo requirements. The case is accurately concentric with the shaft so that the unit may be cradle-mounted and driven differentially. Birklan Corp., Dept. ED, 200 E. 3rd St., Mt. Vernon, N. Y.

CIRCLE ED-20 ON READER-SERVICE CARD FOR MORE INFORMATION

V-H-F Coaxial Line

50 ohm, Teflon Type



The Series 600 50 ohm V-H-F Teflon Coaxial Line manufactured in accordance with RTMA-134 standard incorporates RTMA anchor insulated connectors for better positioning of the inner conductors, as well as other features that provide better VSWR and attenuation characteristics than outmoded 51.5 ohm lines.

Service-proven and pin-type insulated, it serves as a standard in coaxial transmission lines for many microwave applications. Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N. J.

CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

Only!

DAVEN SWITCHES

Have This Advanced Feature...



The "Knee-Action" ROTOR

DAVEN's patented "Knee-Action" Rotor permits a greater number of switch positions and poles in a smaller space than was ever possible before.

This exclusive DAVEN feature, developed by DAVEN's skilled engineering staff, is but one of the many contributions which DAVEN has made to solve difficult switch problems.

DAVEN also supplies switches from thousands of standard units or will engineer a special switch to meet your particular needs.

For any and every switch problem, CALL ON DAVEN!

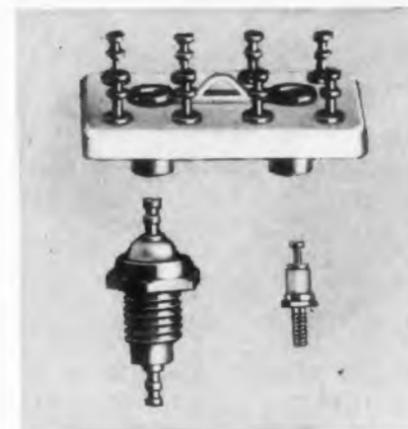
THE **DAVEN CO.** 169 Central Avenue
Newark 4, New Jersey

Write for FREE copy of DAVEN's new, 28-page brochure on SWITCHES!

CIRCLE ED-22 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

Approved Ceramic Insulated Units Meet Rigid Government Specifications



Users of electrical and electronic components are finding the C. T. C. line of ceramic insulated terminals, feed-throughs, and terminal boards an excellent one to rely on for units used in manufacturing military electronic equipment.

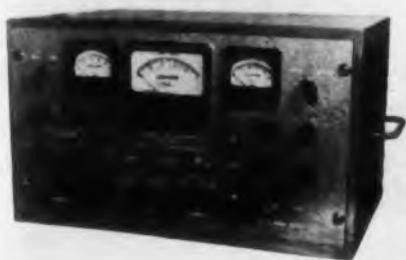
This manufacturer of ceramic insulated components has had long and successful experience in meeting government requirements. Most exacting government standards are maintained . . . for materials, tolerances, finishes, moisture prevention, anti-fungus treatment and so forth. Finishes on metal surfaces, for instance, can be hot tinned, electro-tinned, cadmium plated, silver plated or gold plated to your requirements. All ceramic units in our standard line are grade L-5, silicone impregnated.

C.T.C. will gladly furnish specifications and prices on request. The company offers a consulting service at no extra charge to help you solve special problems. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 1953

Transistor Analyzer Measures Current Gain

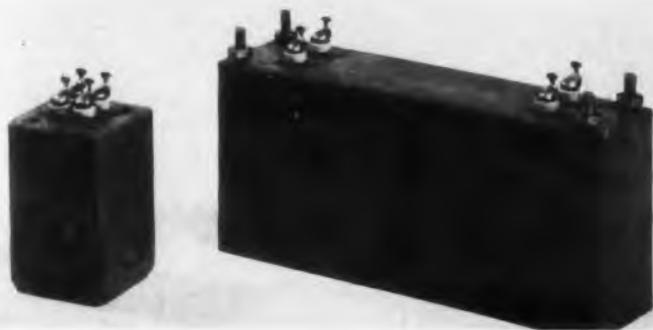


The Model TA-1 Transistor Analyzer is a current gain meter and curve tracer used to measure emitter-to-collector current gain (α) of point contact transistors, and the base-to-collector current gain (called β) of p-n-p and n-p-n type transistors directly on a panel meter.

When used with an oscilloscope, the unit will produce curves of emitter-to-collector current gain (α) against emitter current (I_e) and base-to-collector current gain (β) against base current (I_b). Constant collector voltage is obtained from a regulated power supply, whose output is available for external use. The instrument is housed in an oak cabinet and incorporates a front panel suitable for relay rack mounting. Polyphase Instrument Co., Dept. ED, 705 Haverford Rd., Bryn Mawr, Pa.

CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION

Single Side-Band Filters For Receiving Equipment



This series of Single Side Band Filters has been designed for use in single side band receiving equipment in communication applications. These units can replace the more expensive and hard to get crystal filters in most applications.

The units employ a system which has a 25kc carrier and toroidal coils in a circuit of temperature stabilized and temperature compensated components, which produce the sharp-sided curve required. Typical dimensions for the units are 1-5/8" x 6" x 2-5/8", and weight is 1-3/4 lb.

In addition to the carrier, lower side band, and upper side band filters for 3.5kc pass bands, a low pass filter for the demodulation circuit also is available, as well as 6kc units for wider band operation. Burnell & Co., Dept. SB, 45 Warburton Ave., Yonkers, N. Y.

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

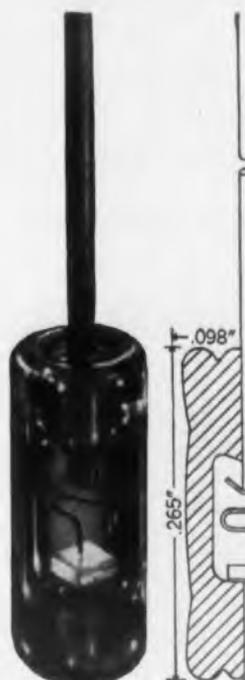


Photo
enlargement
six times
actual
size.

ELECTRONIC DESIGN • July 1953

Hughes
Diodes
are
**FUSION
SEALED
IN
GLASS**
for electrical
stability

GLASS-TO-METAL fusion sealing for electrical stability is an exclusive feature of **HUGHES GERMANIUM DIODES**. The final seal in precision assembly operations is made at a temperature exceeding 700° C.

Proved in billions of vacuum tubes, the glass-to-metal seal has been incorporated to full advantage in diode manufacture for the first time by the Hughes-developed process of fusion sealing. The result is a unique germanium diode whose elements are encased in a rigid *one-piece* glass envelope, which assures permanent freedom from moisture penetration.

THE HUGHES GERMANIUM DIODE, developed by Hughes Research and Development Laboratories, employs no wax or solder, and has no mechanical joints or pressed-in parts to shift position.

To insure the satisfactory operation of **HUGHES DIODES** under adverse conditions of moisture, vibration, and severe shock, a 100 per cent testing procedure has been devised which *invites* instabilities to occur prior to shipment and assures rejection of every defective diode. *Each HUGHES DIODE* is humidity-cycled, temperature-cycled, and **JAN** shock-tested.

HUGHES GERMANIUM DIODES have proved consistently able to meet exacting requirements in airborne electronic equipment for navigation, fire control and guided missiles.

Volume orders for most types of **HUGHES DIODES** can be filled from stock. Diodes are also tested to special specifications, including high-temperature electrical requirements.

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.					
Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ -150 v
	1N68A	130	100	3.0	0.625 @ -100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ -5 v; 0.050 @ -50 v
	1N99	100	80	10.0	0.005 @ -5 v; 0.050 @ -50 v
	1N100	100	80	20.0	0.005 @ -5 v; 0.050 @ -50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ -5 v; 0.100 @ -50 v
	1N97	100	80	10.0	0.008 @ -5 v; 0.100 @ -50 v
	1N98	100	80	20.0	0.008 @ -5 v; 0.100 @ -50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ -50 v
	1N117	75	60	10.0	0.100 @ -50 v
	1N118	75	60	20.0	0.100 @ -50 v
General Purpose	1N90	75	60	5.0	0.800 @ -50 v
	1N95	75	60	10.0	0.800 @ -50 v
	1N96	75	60	20.0	0.800 @ -50 v
JAN Types	1N126 ^{**}	75	60	5.0	0.050 @ -10 v; 0.850 @ -50 v
	1N127†	125	100	3.0	0.025 @ -10 v; 0.300 @ -50 v
	1N128‡	50	40	3.0	0.010 @ -10 v

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.
^{**}Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A.

Semiconductor
Sales Department

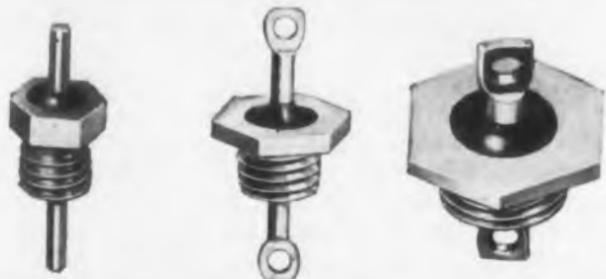
Hughes

AIRCRAFT COMPANY
CULVER CITY
CALIFORNIA

Address inquiries to Dept. D

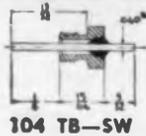
Threaded Bushing FEED THROUGH Terminals

Where vibration exists, these terminals combine the strength of a mechanical and soft solder seal. If soldering cannot be used, the precision threaded bushings can be screwed into a threaded hole or pulled tight with a jam nut in a plain hole.

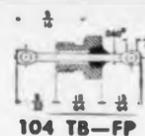


104 TB-SW 105 TB-FP 109 TB-FP

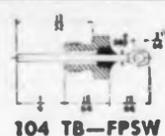
104 TB-Series 1000V (RMS) 8-32-NC-2 3/16" Hex



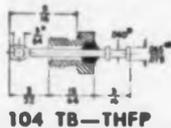
104 TB-SW



104 TB-FP



104 TB-FPSW

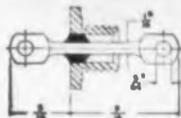


104 TB-THFP

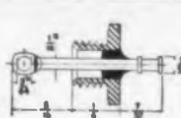


104 TB-THSW

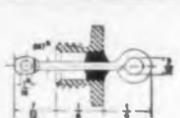
105 TB-Series 1500V (RMS) 1/4-28NF-2 3/8" Hex



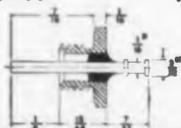
105 TB-FP



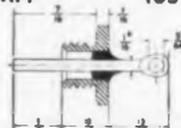
105 TB-THFP



105 TB-LFP

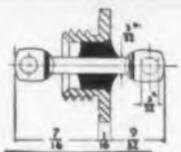


105 TB-THSW

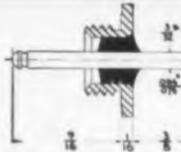


105 TB-FPSW

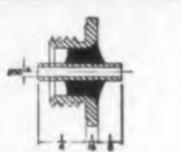
109 TB-Series 2500V (RMS) 3/8-24NF-2 1/2" Hex



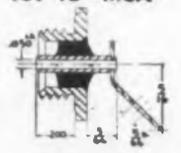
109 TB-FP



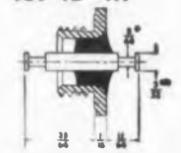
109 TB-MCA



109 TB-HT



109 TB-HTL



109 TB-TH

Write Dept. L4 for free catalog of Fusite line and free sample terminal.



THE FUSITE CORPORATION
6000 FERNVIEW AVENUE
CINCINNATI 13, OHIO

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

New Products...

Hermetically Sealed Connectors In 3- and 6-Contact Arrangements



The "U" Series of Sub-Miniature Hermetically Sealed Connectors, available in the round shell design, have been designed for application on miniature sealed and unsealed instrument switches, relays, transformers, amplifiers, and other components and equipment. The units are available in 3- and 6-contact arrangements.

Contacts are designed for 5amp current, with a minimum flashover of 1,700v d.c. Polarization is achieved by a flat-top design, and engagement is effected by the bayonet and "J" slot. The 3-contact plug weighs 0.0088 lb and is 1-1/16" long, with a 17/32"diam (max). Cannon Electric Co., Dept. ED, 3203 Humboldt St., Los Angeles 31, Calif.

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

Frequency Converter With 400cy Power Supply



The Model 400 Frequency Converter is a 400cy power supply unit operating from a standard 60cy line. It is capable of delivering up to 100VA and is especially suitable for laboratory use in the development of low-power aircraft equipment.

Basic components consist of a standard high-power audio amplifier, an adjustable tuned circuit, and an adjustable bridge circuit which controls the voltage output. Output voltage of the instrument can be varied by a front panel control from 105v to 130v, and regulation is better than $\pm 1\%$. Frequency is adjustable from 380cy to 420cy, with less than $\pm 1\text{cy}$ drift, and the total harmonic distortion is less than 3%.

These characteristics (voltage regulation, frequency drift, and harmonic distortion) operate independently of the power factor. Avion Instrument Corp., Div. of American Car and Foundry Co., Dept. ED, 293 State Highway No. 17, Paramus, N. J.

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



Electrically-Actuated COUNTER with INSTANT RESET

- All digits return instantly to zero when reset button is depressed.
- Measures only 4" x 1 1/4" x 3/4".
- Designed for flush panel mounting.
- Counting rate 10 per second.
- Coils available for any impulse voltage between 4 and 150 volts D.C.
- Power requirements about 2 watts.

WRITE FOR FULL INFORMATION

LANDIS & GYR, INC. 45 W. 45th St., New York 36

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

ANOTHER FAMOUS MARKET PLACE — Central Market (Halles Centrales)

ELECTRONIC Design

... pin-points its attention on the **Electronic Designer**

... presents him with concise but comprehensive Design Data

... brings him feature articles, nomographs, composites, tabulations, charts and graphs.

* Market Place for Electronic Design Innovations

Vacuum Tube Voltmeter

Has 50mv to 500v d-c Range



The Model VM-81 Vacuum Tube Voltmeter is a wide range instrument with excellent stability and high sensitivity. Its high internal impedance makes the unit useful for measuring across diodes and

across the output of photo transistors directly.

Specifications include a range of 50mv to 500v d-c (11 ranges); an input impedance of 50 megohms on all ranges; an accuracy of 3% of full scale on all ranges; and a power input of 115v, 60cy a-c and 25w (approx).

The meter is a 4-1/2" panel type. Scientific Specialties Corp., Dept. ED, Snow and Union Streets, Brighton Station, Boston 35, Mass.

CIRCLE ED-39 ON READER-SERVICE CARD FOR MORE INFORMATION

Hermetically Sealed Relay

Withstands up to 500cy Vibrations



The Series R Hermetically Sealed Relay is a miniature aircraft type 4pdt unit providing a wide range of variations to meet the critical requirements of such applications as guided missiles, jet engine controls, communications, radar, fire control, and geophysical and computer apparatus.

It occupies 1.6 cubic inches and weighs 3.76 oz. Further specifications include an operational shock resistance of up to 50G's and higher; temperature ranges from -65°C to $+200^{\circ}\text{C}$; and interelectrode capacitance of less than 5mmfd between contacts and case (less than 2-1/2mmfd between contacts, even with plug-in type relay and socket).

It has a vibration range of 0cy to 500cy and upward at 15G's without chatter. At 30G's operational shock resistance, the sensitivity of the unit approaches 100mw.

Contact ratings are available through 7.5amp (resistive) for 100,000cy (30amp resistive for 100cy) at 30v d-c or 115v a-c. Coil resistances up to 50,000 ohms can be furnished, as well as a variety of mounting arrangements. Hart Mfg. Co., Dept. ED, 110 Bartholomew Ave., Hartford, Conn.

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

NOW YOU CAN HAVE the Tungsten and Chemical Components that help make Sylvania Picture Tubes so popular



Seven out of the ten leading television set makers are today using Sylvania Picture Tubes. Why this overwhelming popularity? Much of the credit will be found in the splendid quality and scientific purity of Sylvania's Tungsten and Chemical Components. And NOW, these products, based on 15 years research and special skills, are offered to you! For example:

Picture Tube Phosphors by Sylvania are superior because they are carefully controlled for particle size, brightness, and uniformity of color. Sylvania offers a number of these quality phosphors for black and white television. Of special interest is the phosphor blended for maximum cross-burn resistance. Also available are phosphors for color television picture tubes and cathode ray tubes. All may be obtained in 1000 lb. lots to eliminate any color-matching problems.

Potassium Silicate is produced by Sylvania with exact control of the ratio of the two elements involved, thus assuring optimum wet-screen strength. Its high chemical purity helps maintain screen brightness and good color. Each container of this Sylvania quality chemical guaranteed to contain 28% total solids.

Stranded Tungsten Coils for Vacuum Metalizing. With Sylvania Tungsten Coils, you can depend on highest performance at lowest cost. These stranded coils provide a uniform deposit of metal where needed. They're sturdy too... reduce mechanical breakage in the loading of filaments. Sylvania Tungsten Coils also give you more shots from each filament, and the best heat for evaporation.

Tungsten Wire for Cathode Heaters. Sylvania controls and quality checks its tungsten wire production, from ore to finished product. With Sylvania Tungsten Wire, you can be sure of good retention of shape and other desirable characteristics after treating and coating.

Triple Carbonate Cathode Emission Coatings. These Sylvania coatings comply with the highest standards of purity. Made by Sylvania's improved methods, these coatings are offered in a range of exact chemical compositions and particle sizes to meet the requirements of any manufacturer.

New illustrated booklet, T C-5, gives detailed information concerning the quality and money-saving advantages of Sylvania's Tungsten and Chemical Components for TV Picture Tubes. For your file copy write to: Sylvania Electric Products Inc., Dept. 3E-4007, 1740 Broadway, N. Y. 19, N. Y.



SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION



REDHEADS... tops for tape recording

The Brush BK-1090 record-reproduce head has the standard track width designed for dual track recording on 1/4 inch tape. It provides unusually high resolution and uniformity over an extended frequency range. Cast resin construction assures dimensional stability, minimizes moisture absorption, and affords freedom from microphonics.

The BK-1110 erase head has the same basic construction. Its outstanding feature is its efficient erasing at low power consumption—less than 1/2 voltampere. For complete information write Brush Electronics Company, Department J-7, 3405 Perkins Ave., Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

formerly
The Brush Development Company.
Brush Electronics Company
is an operating unit of
Clevite Corporation.



CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

The new Ametron

ANALOG DATA RECORDER

simplifies exact measurement
and numerical printing of
many Analog quantities

TEMPERATURE
•
WEIGHT
•
PRESSURE
•
VOLTAGE
•
LIGHT INTENSITY
•
CURRENT
•
PH CONCENTRATION
•
RESISTANCE
•
R.P.M.
•
STRESS-STRAIN
•
DISTANCE
•
ANGLE
DISPLACEMENT
•
Plus Many Others



The versatile Analog Data Recorder provides visual or printed records of virtually any physical quantity converted into a corresponding voltage through various functionally operated sensing devices—thermocouples, photocells, tachometer generators, etc. Prints accurate numerical quantity in full figures on tape, tickets or cards.

Write for new brochure AN-38

STANDARD OF ACCURACY SINCE 1888

STREETER-AMET COMPANY

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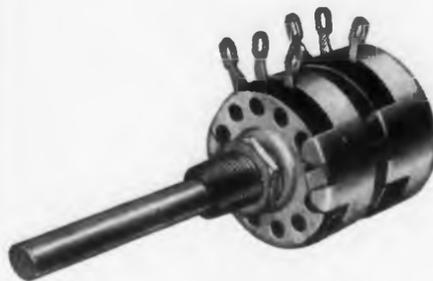
Branches in Pittsburgh, Pa., Allentown, Pa. and Birmingham, Ala.

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

New Products...

Tandem Mounted Potentiometers

Electrically Independent



The Dual Type AB Molded Composition Potentiometer consists of two units mounted in tandem and controlled by the rotation of one shaft. This 2w unit has

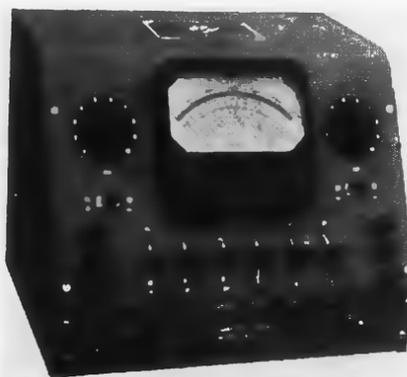
been designed for laboratory, radio, TV, and electronic applications where reliability is important.

The resistance element is a thick, solid-molded ring that is heat-treated under pressure. The dual units have a 2" long, round shaft, and independent electrical connections. Available in the linear curve type, the units are furnished in seven resistance values, ranging from 10,000 ohms to 1 megohm. Ohmite Mfg. Co., Dept. ED, 4897 Flournoy St., Chicago, Ill.

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

Transistor Tester

For Junction and Point-Contact Transistors



The Model TT-11 Transistor Tester provides a means of testing transistors or other semiconductor devices on a direct reading "go no-go" basis. The unit tests both junction and point-contact transistors and is not

obsoleted by new transistor types. Both static and dynamic tests can be performed, and results are independent of voltage and temperature variations. These features make the unit suitable for laboratory development work as well as factory production.

The instrument utilizes a bridge method for comparing the characteristics of the unknown with known reference transistors. Variation from standard for a given test is read directly on a "Good-Bad" meter scale. Static tests include forward diode (emitter-base) characteristics and reverse diode (collector-base) characteristics, and dynamic testing includes both amplifying and oscillation condition comparison with the reference transistor. The internal d-c power supply is adjustable to both positive or negative readings. Electronic Research Associates, Dept. ED, Box 29, Caldwell, N. J.

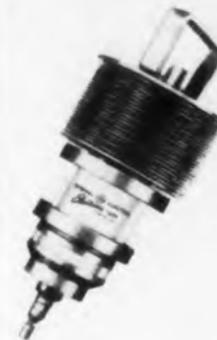
CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

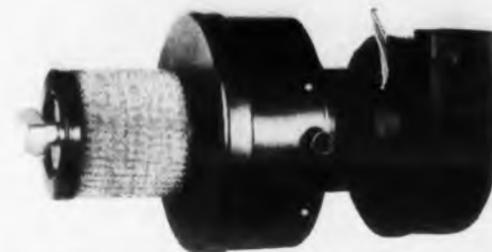
COMBINATION BLOWER/TURBINE FOR COOLING NEW GE POWER TETRODES

ONLY ONE SINGLE DRIVING MOTOR INDUCTION TYPE—3400 RPM—1φ, 3w

IMMEDIATELY AVAILABLE



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- QUIET
- SIMPLE



SPECIALLY DESIGNED BLOWERS FOR EACH TYPE OF TUBE

GE TUBE	ROTRON PART # (ABBREVIATED)	TURBINE SECTION		BLOWER SECTION	
		CFM	SP	CFM	SP
#6183	A4-6502/505	3	4.5"	20	0.75"
#6283	K3-6503/404	14	6"	60	1.5"
#6182	A5-701	35	5"	NONE	
#6019	K5-6502	15	6"	NONE	

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

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programs in Microwave*

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COMPONENTS
MAGNETRONS
TR TUBES**

We need Senior and Junior Electronics Engineers and Physicists with background and interests in the above categories. Positions are available in Research, Design, Production Engineering. Previous experience in Microwave or UHF region desirable. Engineers now working on duplexers and mixers are especially suited to our needs.

Our young company offers tremendous growth opportunities along with paid vacations, free life insurance, free hospitalization for both employee and dependents. Write now for a descriptive brochure. Why not drop in during your vacation for an interview. Send resumé to "Director of Engineering" at address below:

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A 50% affiliate of American
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22 Cummington Street., Boston 15, Mass.

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

NEW!



COMPRESSION MOLDED Plastic Toroids

*Meet JAN temperature and humidity requirements

We consider this development as revolutionary as the development of the molded mica capacitor. The bothersome mounting problems and fragility of the uncased toroid have been entirely eliminated. Complete uniformity of dimensions are maintained by precision molds. To keep mounting pressure off the plastic, a bushing of brass is molded into the center. Type "A" provides a center hole to clear a 6-32 screw. Type "B" is threaded for a 6-32 screw. Tooling is complete for molding any of the .90 x .40 coils. The complete unit is compact, measuring only $1\frac{1}{8}$ " by $\frac{1}{2}$ " thick.

Complete data available on request; samples will be furnished for your evaluation.

COMMUNICATION
ACCESSORIES

Company

HICKMAN MILLS, MISSOURI

CIRCLE ED-30 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 1953

Electronic Tachometer

Accurate, Compact Unit



This Electronic Tachometer has been designed to measure rate, frequency, or speed by counting discrete pulses for an accurately timed interval (1sec). A clear, sharp, compact read-out is provided by the use of a cold cathode glow transfer tube.

Features of the instrument include an accuracy of count of ± 1 , an accuracy of time base of 1 part per million, power requirements of 100w, a compact size of 12" x 8" x 12", and a simplified unit construction. Primary emphasis in design has been placed on making the instrument reliable and service-free. It can be operated from any photoelectric, magnetic, electrical or electromechanical means that produces pulses of from 0.2v to 115v without marked multiple peaks. Basic components can be rapidly replaced whenever necessary. Standard Electric Time Co., Dept. 201, Springfield 2, Mass.

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

Step Variable Delay Line

With Range from 0.2 to 2.2 μ sec



The Type 601 Step Variable Delay Line, consisting of 44 sections of lumped-parameter L-C networks, provides faithful reproduction of input signal pulses,

complete freedom of time jitter, and no limit on repetition rate. The unit is suitable for incorporation with any instruments where variable time delay is needed.

Each section of the 44-section network is designed to give a linear phase shift up to 70% of its cutoff frequency and a frequency response curve that is Gaussian in shape. Specifications include a time delay that is variable in step of 0.2 μ sec up to 2.2 μ sec; a characteristic impedance of 190 ohms nominal for both input and output; a rise time of less than 0.2 μ sec; a cutoff frequency of 6.37Mc nominal; a maximum input voltage of 500v peak; and an accuracy of $\pm 1\%$ of the total delay. Advance Electronics Co., Dept. ED, P. O. Box 394, Passaic, N. J.

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

THE *Mayhill* PLATING PROCESS GUARANTEES ACCURATE PLATING IN ELECTRONICS!



Since 1946, M-W LABORATORIES has electroplated precious metal for suppliers to the U. S. Army, U. S. Navy, Atomic Energy Commission and to leading manufacturers in the electronics industry.



M-W LABORATORIES, featuring their Mayhill Plating Process, are equipped to plate these precious metals: gold, silver, rhodium, palladium, albaloy and indium.



Controlled thickness, smoothness, color, hardness and adhesion of plating is assured through constant testing by our own chemists and engineers, in our chemical and metallographic laboratory.



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M-W Laboratories, Inc.
1824 N. Milwaukee Ave.
Chicago 47, Illinois

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

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ROTARY

MIDGET

TELEPHONE

ONE MILLION RELAYS

Over 1000 Types
24 HOUR DELIVERY FROM OUR STOCK!

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Our relay stock, which is the world's largest, has been carefully built up over a period of several years. Nothing but first run, professionally selected items are carried.

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Send us your relay requirements. You will receive immediate quotations.

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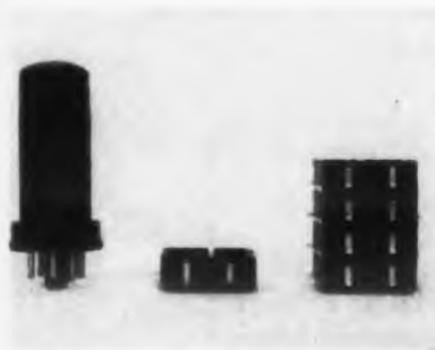
4721 W. MADISON STREET

Circle ED-51 on Reader-Service Card for more information

New Products...

Multiple Scaler

Counts Pulses Down To Any Ratio



The "Perma-Memory" Multiple Scaler is a counting device permitting incoming pulses to be counted down to any desired ratio, whether the pulses are repetitive or random. Applications

for the unit include nuclear counting, precision timing pulse generation, telemetering and missile projects, TV synchronizing systems, digital computers, analog digital converters, counters, etc.

Only one triode per binary stage is needed, and the count accumulated is stored permanently in a magnetic memory with the triode acting only for triggering action. Features include pulsed operation, long operating life, low power consumption, low output impedance, simple construction, reliable operation, and small size and light weight. Shown above are a binary scaler (center) and a decade scaler (right) compared with a Type 6V6 tube (left). Wang Labs., Dept. ED, 296 Columbus Ave., Boston 16, Mass.

Circle ED-53 on Reader-Service Card for more information

High Power Load

Maintains Uniform Power Dissipation



Type 311 High Power Load consists of a stainless steel jacket containing a lossy material which is compound tapered to maintain uniform power dissipation, as well as to achieve a low VSWR. Electrical characteristics include a frequency range of 1.15 to 1.25 kilomegacycles, a maximum VSWR of 1.08, a maximum average power of 1000w, and a maximum peak power of 1 megawatt.

The lossy material is impregnated to prevent varying ambient humidity from affecting load performance adversely, and the absorbed power is dissipated by heat-radiating fins surrounding the jacket. Forced air cooling of the load is not required up to full rated power. Bogart Mfg. Corp., Dept. ED, 315 Siegel St., Brooklyn 6, N. Y.

Circle ED-54 on Reader-Service Card for more information

Another **FLASH-O-LENS** at work
...checking pigment dispersion at
B. F. Goodrich



The inspection tool that *lights and magnifies*—FLASH-O-LENS—is in daily use at The B. F. Goodrich Company in making laboratory checks on the dispersion of pigments in milled rubber stocks.

The built-in bulb of a FLASH-O-LENS brightly illuminates the inspection area—the accurately ground lenses give sharp, detailed enlargement. Result: quick, simple inspection!

Battery and plug-in models from \$10.65. Write for free literature on applications, types, prices.

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the only practical gold plating process for electronic use!



BRIGHT GOLD PROCESS



Now . . . all the advantages of gold plating for precision components without the common faults of ordinary gold. Here is the first real advance in industrial gold plating. Components that require surface or sliding contacts can be gold plated to any desired thickness without altering the finish of the basic metal. Finish is hard and durable.

- ✓ Produces uniformly thick, smooth bright deposits over entire surface regardless of the shape of the piece.
- ✓ No scratch brushing or buffing needed.
- ✓ Gold is exceptionally durable and overcomes tendency to gall.

Sel-Rex Bright Gold Process now used by many leading electronic firms. Write today for complete literature.

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Send FREE literature and specifications on SEL-REX BRIGHT GOLD PROCESS.

Co. _____

Name _____

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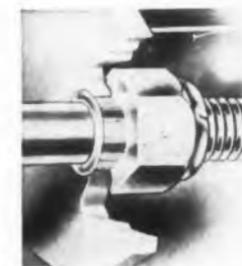
City _____ Zone _____ State _____

Circle ED-52 on Reader-Service Card for more information

clinch type ELASTIC STOP nuts



for attachment to thin section metal components



- Permanently installed by simple clinching or swaging.
- Self-locking and vibration-proof—because all ESNA Clinch Nuts have the famous red elastic locking collar.
- Permit precise screw adjustments: prevent loosening of component parts.

- WRITE for design information on Clinch Nuts and other special and standard ESNA fasteners. Address Dept. N35-757.



ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
Circle ED-56 on Reader-Service Card for more information

ELECTRONIC DESIGN • July 1953



Hermetic Seal Connector

Withstands rugged operating and assembly conditions

M-7500 Series Blue-Glass Seal Connector gives complete protection to circuits of hermetically sealed electronic or electrical devices under roughest handling, assembly, and operating conditions.

For example, Blue-Glass hermetic seal withstands:

- Mechanical shock of 100 G's.
- Thermal shock from -300°F . to $+500^{\circ}\text{F}$.
- Bonding temperatures as high as 1500°F .
- Operating pressures up to 7000 p.s.i.
- High potentials of over 1000 volts.

In addition, connector is impervious to moisture, corrosion (salt, acid, oil, etc.), rare atmosphere, fungus and vibration.

One end of connector mates with standard AN (MIL) types. Other end has tapered and serrated surface so connector is mechanically anchored against turning when pressed into device housing.

Strength of mechanical anchor plus high melting temperature of connector's Blue-Glass insulation permit use of any common method of bonding connector to housing—soft solder to welding. No need for special assembly jigs and staking tools . . . no danger of breaking or melting seal.

M-7500 Connectors are also available with special alloy shells and mounting arrangements.

For shell sizes, insert arrangements, and other information, send this coupon.

GENERAL ELECTRIC COMPANY
Wiring Device Department N-7
95 Hathaway Street, Providence 7, R. I.
Please send catalog information on Monowatt M-7500 Series Connectors.

Name

Title

Company

Address

City Zone State

CIRCLE ED-57 ON READER-SERVICE CARD

Rosin Filled Solder Provides Continuity of Flux

"Cen-Tri-Core" is a Rosin-Filled Solder consisting of a solder wire coated with rosin, over which is formed the outer solder sleeve. This construction prevents a rosin void, assures continuity of flux, and reduces the possibility of cold joints and rejects.

Principle feature of the material is the speed with which the "energized" rosin works. Simultaneous wetting-flow and "take" also are characteristic of the solder, and it is non-corrosive and electrically non-conductive. It also is resistive to extremes of temperature and humidity. Alpha Metals, Inc., Dept. ED, 56 Water St., P. O. Box 34, Bergen Station, Jersey City 4, N. J.

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

U-H-F Tuner A Component For TV Sets



The "Cavi-Tuner"—a u-h-f tuner, has been designed as a component for TV sets to permit reception of u-h-f stations in addition to the present v-h-f channels.

The unit consists of three cavities, two functioning as a band pass pre-selector, while the third controls the local oscillator frequency. The pre-selector is essentially an over-coupled double-tuned transformer. Two antenna inputs are furnished, either for use with the common 300 ohm twin lead-in (balanced) or the shielded 75 ohm coaxial lead-in (unbalanced). The local oscillator tunes below the signal frequency for double superheterodyne or converter applications, and mixing takes place in a low noise diode, with an i-f appearing at v-h-f channels 5-6. The i-f output has a frequency of 76Mc to 88Mc (channels 5-6), but equipment is being developed to operate at 41Mc.

Features of the unit include no moving electrical contacts, completely shielded construction, excellent frequency stability because of rigid mechanical structure, negligible spurious responses, uniformly broad bandwidth and high selectivity, three point tracking, and a high tuning element Q that insures low noise figure and high gain. Radio Receptor Co., Inc., Dept. ED, 251 W. 19th St., New York 11, N. Y.

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

No. VC1 (.5 to 6 mmf.)
Glass Dielectric
No. VC5 (.5 to 5 mmf.)
Quartz Dielectric
No. VC11 (1 to 10 mmf.)
Quartz Dielectric
No. VC11G (.5 to 12 mmf.)
Glass Dielectric
No. VC20 (.5 to 1.9 mmf.)
Glass Dielectric



JFD MFG. CO.
BROOKLYN 4, N. Y.
BENSONHURST 6-9200

world's largest manufacturer
of tv antennas & accessories

leading manufacturers use
JFD PISTON TYPE VARIABLE TRIMMER CAPACITORS
in both civil and military equipment



NO OTHER LIKE IT!

- Spring loaded piston made of special invar alloy having extremely low temperature coefficient of expansion.
- Silver band fused to exterior of precision drawn quartz or glass tube serves as stationary electrode.
- Piston dimensional accuracy is held to close tolerance maintaining minimum air gap between piston and cylinder wall.
- Approximately zero temperature coefficient for quartz and ± 50 P.P.M. per degree C. for glass units.
- "Q" rating of over 1000 at 1 mc.
- Dielectric strength equals 1000 volts DC at sea level pressure and 500 volts at 3.4 inches of mercury.
- 10,000 megohms insulation resistance minimum.
- Operating temperatures, -55°C . to $+125^{\circ}\text{C}$. with glass dielectric. And -55°C . to $+200^{\circ}\text{C}$. with quartz dielectric.
- Over 100 megohms moisture resistance after 24 hours exposure to 95% humidity at room temperature.

Write for Form No. 199

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

Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.

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



control motors...

for extremely low inertia and high frequency response

10 Watt



Rotor Inertia 0.23 oz-in.²
Weight 4.3 lbs.

HIGH VOLTAGE MOTORS

60 Cycle, 1 1/2 - 5 - 10 watt models
Designed specifically for electronic systems—operate directly in the plate circuit of a vacuum tube amplifier.

LOW VOLTAGE MOTORS

60 and 400 Cycle, 2 1/2 - 5-10 watt models
Recommended for normal two-phase applications.

advantages

- Linear torque—voltage characteristics
- Linear torque—speed characteristics
- Withstand continuous stalling
- High torque efficiency
- Flexibility of mounting

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

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

For quick latchlocked plug-in it's the **XL** series

Quality microphone manufacturers use Cannon XL connectors as standard equipment. Designed for microphones, amplifiers, tape recorders, and similar applications, the moderately priced XL series incorporates many Cannon quality features—including full-floating socket contacts for perfect alignment and positive engagement.

XL connectors are available in 14 shell designs in plugs and receptacles, all with the exclusive easy-to-release latchlock. 1,400 v and 1,600 v ac maximum flash-over. Two insert arrangements available—three 15 a or four 10 a contacts.

Available from Cannon's franchised distributors or any recognized radio parts distributor. Write for new XL Bulletin.

CANNON ELECTRIC
Since 1915

CANNON ELECTRIC COMPANY, LOS ANGELES 31, CALIFORNIA
Factories in Los Angeles, Toronto, New Haven. Representatives in principal cities.
Address inquiries to Cannon Electric Co., Dept. G-143, Los Angeles 31, Calif.

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

**CANNON
PLUGS**



New Products...

Frequency Controlled Converter Portable, Has Manual Control



This Frequency Controlled Converter, a portable d-c to a-c power source, has been designed especially for use in broadcast tape recorders, heavy duty electronic

measuring devices, and tape recorder a-c motor driven camera combinations. Sufficient frequency constant, a-c power is available to operate this type of equipment from d-c lines or battery source.

The rheostat control and frequency meter are mounted in an aluminum housing with a noise filter available, although the latter is not usually necessary for operating recorders, amplifiers, or other audio devices. Filtering is required when radios or other r-f circuits are operated from the unit. A recessed d-c male plug is furnished for 32v, 64v, 115v, and 230v d-c input models. The 12v, 24v, and 28v models are equipped with heavy stranded input leads for battery connections, and a flush a-c mounted receptacle is supplied on all models for quick a-c hook-up.

With manual frequency control, the unit is designed to deliver a 60cy output at full rated load at the highest input voltage. Carter Motor Co., Dept. 30, 2664 N. Maplewood Ave., Chicago 47, Ill.

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

TV Picture Tube Of Metal-Cone Construction



The face plate is of frosted neutral gray glass and relatively flat, to reduce ambient light reflections as well as reflections within the face plate itself, for better picture contrast.

The unit employs magnetic focus and deflection and

a single-field ion-trap magnet. Electrical characteristics include a heater power of 6.3v at 0.6amp; an anode voltage of 18,000v max; a grid No. 2 voltage of 500v; and grid No. 1 voltages of 125v (negative bias), 0v (positive bias), and 2v (positive peak value). Westinghouse Electric Corp., Electronic Tube Div., Dept. ED, Elmira, N. Y.

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

Magnetic Tape For Accurate Data Recording

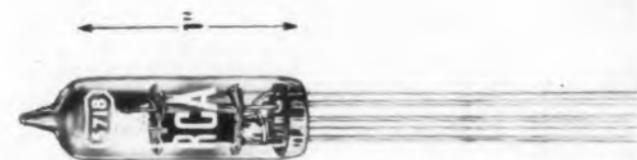
Type 109 "Scotch" Brand Data Recording Magnetic Tape is intended for application in instrumentation: data recording, telemetering, shock and vibration measurements, geophysical and computer work, and industrial research.

The tape is factory tested and pre-selected for minimum count of nodule or surface imperfections. In the past these imperfections have caused large amplitude variations (or dropouts) and have restricted the use of magnetic tape for accurate data measurements.

Shipped in hermetically sealed containers, the tape comes in widths of 1/4", 1/2", 3/4" and 1" and up to 4800' in length. It has been developed by Minnesota Mining & Mfg. Co. Audio & Video Products Corp., Instrumentation Div., Dept. ED, 730 Fifth Ave., New York 19, N. Y.

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

Medium-Mu Triode For U-H-F Applications



Type 5718 Medium-Mu Subminiature Triode has been designed especially for use as an r-f power amplifier and oscillator in u-h-f applications where a prime consideration. It is capable of giving a useful dependable performance under shock and vibration is power output of nearly 1w at 500Mc, and operation with full input is permissible up to 1000Mc.

Features of the device include a high transconductance, a tungsten heater to give long life under conditions of frequent on-off switching, and a compact design that provides increased mount strength to resist shock and vibration.

Because of its high transconductance, the unit is suitable for use in cathode-follower, multivibrator, and blocking-oscillator circuits. It is also useful as a resistance-coupled amplifier. Radio Corp. of America, Dept. ED, Harrison, N. J.

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



get 3-way utility
with the
BERKELEY
model 5500

universal Counter & Timer
for laboratory or production line,

the versatile, direct-reading Model 5500 provides, in one compact instrument, facilities for faster, easier and more accurate:

- 1. TIME INTERVAL MEASUREMENT**, with a range of 40 microseconds to 100,000 seconds, with a possible accuracy of ± 10 microseconds.
- 2. EVENTS-PER-UNIT-TIME DETERMINATION** with selectable time base of .0001, .001, .01, .1, 1 and 10 seconds. Counting range is 20 to 100,000 cps; accuracy ± 1 count.
- 3. STRAIGHTFORWARD COUNTING** at rates to 100,000 cps with absolute accuracy.

features:

DIRECT-READING decimal presentation of information reduces operator fatigue, minimizes error. No interpolation required.

AUTOMATIC OPERATIONAL CHECK can be made in two seconds.

PRINTED READOUT available for permanently recording data on standard adding machine tape.

applications:

- Relay and Switch Timing
- Viscosity Measurements
- Timing of Photographic Components
- Ballistic Measurements
- Elasticity Measurements
- Accurate Low Frequency Measurements
- Tachometry
- Frequency Characteristic Measurements
- Frequency Ratio Measurements
- Secondary Frequency Standard
- Telemetry
- and many more. Our engineering staff will gladly assist in adapting this versatile instrument to your special needs.

BRIEF SPECIFICATIONS

	Frequency Counting	Time Interval Measurement	Period Measurement
● Range:	20 cps to 100 kc	40 μ s to 100,000 sec.	0 cps to 10 kc
● Accuracy:	± 1 count (1 sec.) $\pm .0001\%$ (10 sec.)	$\pm 10 \mu$ s	$\pm 10 \mu$ s
● Input Sensitivity:	0.2 to 20 v. RMS	1 v. peak with 1 v. per μ s rise time	0.2 v. peak, d. c.
● Gate Time (or freq.):	.0001, .001, .01, .1, 1 and 10 sec.	100, 10, 1 kc, 100, 10, 1 cps	1 or 10 cycles of input signal
● Crystal Stability:	1 part in 10^6 (temp. controlled)		
● Power Requirements:	117 v., $\pm 10\%$, 50-60 cycles, 200 watts		
● Accessory Socket Connections:	External reset; ± 100 v., 5 ma; + 290 v., 25 ma; 6.3 v. a.c., 2 amps; ground		
● Display Time:	Continuously variable from .5 to 5 seconds		
● Dimensions, Weight:	20 $\frac{3}{4}$ " wide x 12" high x 15" deep; 84 lbs.		
● Price:	\$980.00, f.o.b. Richmond, Calif.		

* For complete data, please request Bulletin D-7.

Berkeley *division*

BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND, CALIF.

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

New Literature . . .

Nuclear Devices 74

A 16-page bulletin presents complete design and technical specifications on the company's line of boron trifluoride counters, flow counters, linear amplifiers, scalars, nucleometer, and radiation safety devices. Each instrument is illustrated, and chassis views of electronic circuits are presented. A current price list also is included. Radiation Counter Labs., Inc., 5122 W. Grove St., Skokie, Ill.

Germanium Diode Chart 75

A germanium diode interchangeability chart is now available in the form of a file folder for standard letter-size files. It includes a listing of standard diodes, along with their manufacturers, and a listing of the company's replacement types. Some 30 types are indicated, and specification information includes minimum forward current, peak inverse voltage, continuous reverse voltage, and maximum reverse current. General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.

Printed Circuits 76

A 4-page, 2-color brochure describes "Formica" printed circuit material for use in electronic assemblies. Features of the material are included in the description. Formica Co., Spring Grove Ave., Cincinnati 32, Ohio.

Magnetic Iron Powders 77

An 8-page, 2-color technical bulletin describes some of the company's magnetic iron powders, for use in radar, TV, and radio, with their many component parts. Some of the types described include annealed carbonyl iron powders, hydrogen reduced iron powders, and magnetites. Charts and photographs provide additional information. Magnetic Powders Inc., P. O. Box 247, Johnsonburg, Pa.

Tape Wound Cores 78

Bulletin WC-353 (12-page) describes the company's tape wound cores for saturable reactors, power transformers, and other electronic and electrical applications. Both rectangular "C" and round toroidal types are covered. Specifications and value graphs are provided, covering the wound cores in 12 mil oriented silicon-iron for 60cy applications, and in 4 mil for 400cy and higher applications. Also shown by graph is "OrthoSil's" orthographic characteristic, providing an extremely rectangular hysteresis loop. Dimensional drawings also are included. Thomas & Skinner Steel Products Co., Inc., 1157 E 23rd St., Indianapolis, Ind.

Picture Tube Data Chart 79

This recently released 8th edition of the "Picture Tube Data Chart" lists complete specifications for more than 150 picture tubes of all manufacturers. It incorporates all newly manufactured 21-, 24-, and 27-inch tubes registered with the RTMA at the time of printing. Typical data listed for both magnetic focus and electrostatic focus types include: basings; bulb dimensions; deflection angle; radius of face curvature; envelope and contact; ion trap magnet; maximum design center values; application notes; and comparative focus current. Printed on heavy stock, the chart is suitable for wall hanging and is also folded to notebook size. Allen B. Du Mont Labs., Inc., 750 Bloomfield Ave., Clifton, N. J.

U-H-F Tubes 80

A 16-page, 2-color brochure describes the company's line of u-h-f tubes, Type 6AN4 and Type 6T4. Information includes mechanical and electrical data and typical operating characteristics. Each type is illustrated by circuit diagrams, charts, and photographs. Other applications also are indicated. Sylvania Electric Products Inc., 1740 Broadway, New York, N. Y.

ELECTRONIC DESIGN • July 1953

"Mylar" Polyester Film 81

Technical bulletin No. 1-2-53 (14-pages) contains information on the physical, electrical, and chemical properties of "Mylar" polyester film, along with suggested applications. In addition to a detailed table on the physical properties of "Mylar", the bulletin compares these properties with those of other films (cellophane, polyethylene, and acetate). Information is provided on such electrical properties as dielectric strength, insulation resistance, and volume and surface resistivity, as well as such chemical characteristics as tensile strength and tear resistance. E. I. Du Pont de Nemours & Co., Wilmington 98, Del.

Wire-Wound Resistors 82

Bulletin C-1 is a 12-page, 2-color brochure that provides comprehensive data on the company's line of tubular and flat power wire-wound resistors. Information includes adjustable features, brackets, characteristics, coating, dimensions, derating, insulation, specifications, tolerances, and windings. Photographs, diagrams, detailed charts and graphs are included. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Switches 83

A 16-page catalog, No. C-11, includes a description of more than 150 types of the company's switches, including toggle and leaf, miniature, plunger, roller and wafer, vacuum pressure, circuit breakers, timers, and other switches. General information for these items is provided. Wells Sales, Inc., 333 W. Chicago Ave., Chicago 22, Ill.

Electronic Components 84

A 16-page, 2-color brochure describes electronic components that include resistors, fixed composition resistors, molded winding forms, iron coil forms, iron cores, insert iron cores, and iron sleeve and cup cores. The construction of the units is indicated, along with a reference chart providing specifications. Characteristics are described, and additional information includes color coding and derating of the fixed composition resistors, permeability and recommended frequency range of iron core grades, etc. Speer Resistor Div., Speer Carbon Co., St. Marys, Pa.

Test Equipment Kits 85

This 32-page, 1953 catalog contains a description of a number of test equipment kits including oscilloscope; electronic switch; voltage calibrator; vacuum tube voltmeter; grid dip meter; "Q" meter; condenser checker; signal tracer; signal generator; tube checker; TV alignment generator; power supply; impedance bridge; audio generator; audio oscillator; square wave generator; audio frequency meter; intermodulator analyzer; a-c vacuum tube voltmeter; decade resistance; and decade capacitor kits. Specification and feature data are provided, as well as application information for this test equipment. Heath Co., Bentley Harbor, Mich.

Vacuum Metals and Alloys 86

Several of the company's vacuum melted metals and alloys are described in two data sheets, and information on vacuum melting of "Ferrovac-52100" is included in a third 4-page brochure. "Cuprovac-E" and "Ferrovac-52100" are described in the data sheets. They are respectively a gas-free high-purity copper with properties suited for vacuum tube manufacture, and a gas-free alloy bearing steel, free of inclusions, with greatly improved fatigue properties. Vacuum Metals Corp., subsidiary of National Research Corp., 70 Memorial Drive, Cambridge 42, Mass.

Electroforming Data 87

An 8-page brochure describes the What, Where, and Who of electroforming (the reproduction or production of a formed article by electrodeposition of metal onto the surface of a removable mandrel or pattern of predetermined shape, size, and finish). Applications are indicated and illustrated by photographs, along with feature information. Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.

Component Housings 88

A 4-page, 2-color brochure provides information on the company's precision-engineered housings whose applications include transformers, electronic components, instruments, automatic controls, power supplies, mobile transmitters, experimental equipment, and MIL-T-27 applications. Information on features and specifications is provided. Olympic Metal Products Co., Inc., Alpha, N. J.

Attention!...
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with the **NEW EUREKA "SNAPPER"**

THERMAL TIME DELAY RELAY



• features... **SNAP ACTION.**

Single Pole Double Throw. Light-weight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Low heater current. Durability and long life.

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6.3, 26.5, 115 volts (A.C. or D.C.) or as required.

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- 60°C. to + 80°C.

ENVELOPE... Miniature (7 and 9 pin), or octal (8 pin) metal.

TIME DELAY PERIODS... Preset from 5 seconds up.

VACUUM... Evacuated, inert gas filled.

HEIGHT... 1 1/4" maximum seated.

EUREKA PRESENTS POSITIVE

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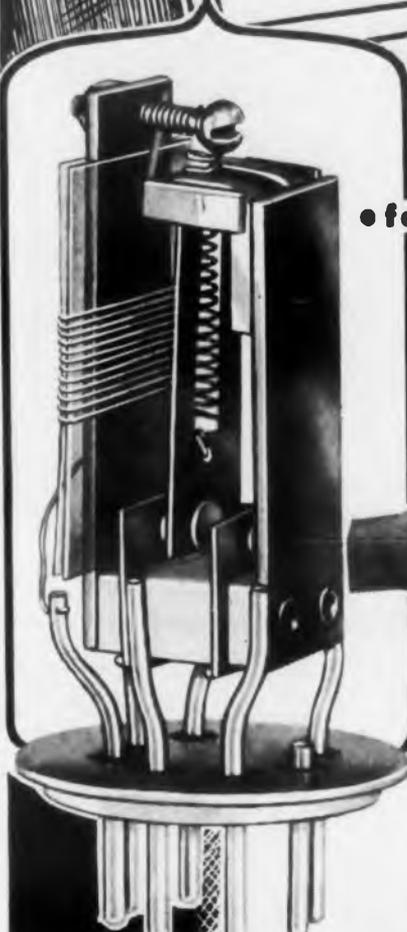
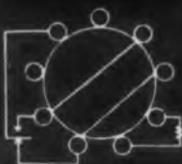
The **ELIMINATION OF CHATTERING** is accomplished with the incorporation of "**POSITIVE SNAP ACTION**" in the **EUREKA "SNAPPER"**... **LEADING ELECTRONIC MANUFACTURERS** have acknowledged the new **EUREKA "SNAPPER"** as a major advancement in this field, and have already accepted this relay as a standard component of their latest equipment.

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Manufacturers of Cathode-Ray Tubes and Electronic Products

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HAWTHORNE 7-5800**



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Elkhart 45, Indiana

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to minus 70°F or minus 95°F**

A new improved model of the efficient HUDSON BAY® Utility Cabinet at a lower price! Your choice of two temperature ranges in 3, 6 and 9 cu. ft. capacities, for all testing and production requirements. Full visibility control panel, counter-balanced lid, stainless steel chamber. Air-cooled, requires only simple electrical connection.



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- Custom Cabinets for all Individual and Government Specifications

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

New Literature ...

U-H-F Measurements 92

A 6-page foldover 2-color brochure provides a description of the company's u-h-f measuring equipment, which includes slotted line, admittance meter, constant-impedance adjustable line, connectors, adaptors, voltmeter indicator, voltmeter rectifier, heterodyne frequency meter, bolometer bridge, and other instruments. Features and specifications are included, along with photographs illustrating each item. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Gold Bonded Diodes 93

A 4-page, 2-color brochure (Bulletin TE1300), provides complete technical specifications on the company's line of gold bonded germanium diodes, whose general design follows JAN-1A specifications. Features and characteristics are indicated by means of curves, charts, and descriptive matter. Transitron Electronic Corp., 403-407 Main St., Melrose 76, Mass.

Electronic Components 94

Supplement No. 134 has been added to the company's 1953 Catalog No. 131. Consisting of 48 pages, the supplement features new popular electronic components, parts, and equipment. The items listed include u-h-f converters and antennas, sound systems, phonographs, receiving tubes, phonograph components, tools, test equipment, and high-fidelity systems. An index is included. Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.

Electronic Information 95

"Solid State News" is the title of a new house organ of interest to electronic design, development, and research engineers. The Vol. 1, No. 1, 8-page issue includes brief discussions on photometrics, quartz-crystals, infra-red cells, chemical research, technical report abstracts, technical news items, and an abstract of a paper on the application of an ideal photon receptor to astronomy. Solid State Research Institute, Inc., 155 E. 44th St., New York 17, N. Y.

Glass Apparatus 96

A 32-page catalog, No. 22, describes the company's standard and special glass apparatus for research and development laboratories. The brochure is divided into three sections: Standard Scientific Glass Apparatus; Special Scientific Glass Apparatus; and Scintillation Crystals and Liquids, Special Chemicals, Gases and Accessories, and Thin Films. Each item is illustrated and described, and price information also is included. Wakefield Industries, Inc., 5108 W. Grove St., Skokie, Ill.

Terminal Blocks 97

Catalog No. 14 (20-page, 2-color) presents a description of the company's line of terminal blocks, special Navy terminal blocks, and aircraft and electronic switches. Many models and types are included, along with photographs, dimensional drawings, and charts. Specifications, materials, ratings, and electrical properties are indicated. Kulka Electric Mfg. Co., Inc., 633-643 S. Fulton Ave., Mt. Vernon, N. Y.

Transistor Bulletins 98

Several data sheets on the company's line of transistors have been issued. Bulletins E-204 and E-206 (2-page, 2-color) describe Type PT-2S and Type PT-2A point contact transistors. Bulletin E-209 covers Type 2N36, 2N37, and 2N38 junction transistors. Mechanical and applications data are indicated, as well as electrical and specifications information. Diagrams, charts, and photographs provide further illustrations. CBS Hytron, Danvers, Mass.

Radiation Instruments 99

A 24-page catalog presents information on the company's complete line of radiation detection and counting instruments. The instruments described include complete counting systems, proportional counter converters, scaling units, conversion chambers for filter-paper counting, an air monitor, and such accessories as register, timer, and bubbler assemblies, high-voltage condensers, standard and special transformers, and center-wire assemblies. Application and specification data are provided. Nuclear Instruments Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.

Sealed Capacitors 100

"PG-3" is a 20-page, 2-color catalog describing the company's line of hermetically sealed miniature tubular paper capacitors. Engineering data presented include construction, application, temperature range, capacitance tolerance, power factor, voltage breakdown test, terminals and leads, insulation resistance, and life tests. Charts indicate typical electrical characteristics, and photographs illustrate various construction styles. Especially described are the inserted tab and extended foil types of capacitors. A reference graph includes information on insulation resistance. Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.

Plated Circuitry 101

An 8-page brochure describes a number of design ideas in photo wiring, photo forming, photo etching, and plated circuitry. These processes, used in the production of such electronic devices as band pass filters, single and multiple switches, commutators, and counters, are briefly outlined and illustrated. Specification data are provided. Allen D. Cardwell Mfg. Corp., Plainville, Conn

Computing System 102

A 7-page brochure describes the company's Model 120 "Elecom" electronic computing system, developed for military and, more recently, civilian uses. Features of the instrument are outlined: internal memory, auxiliary memory, input-output, word structure, circuitry, coding, manual control, test facilities, and checking. Operating characteristics information also is provided. Electronic Computer Div., Underwood Corp., 35-10 36th Ave., Garden City, L. I., N. Y.

Engraving Machine 103

Catalog No. 53 is a 14-page, 2-color brochure describing the company's portable pantograph engraver, which is used for two- and three-dimensional engraving and precision duplicating. Also illustrated and described are many component and accessory parts, including a cutter grinder. Mico Instrument Co., 75 N. Trowbridge St., Cambridge 38, Mass.

CIRCLE ED-104 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 1953



NEW 38-PAGE ILLUSTRATED CATALOG

Describes technical and mechanical characteristics, Special Features and Construction of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. Write today for your copy.

TYPE 41, JAN-R-94, Type 412
1/4 watt, 1 1/2" diameter variable composition resistor. Also available with other special military features as covered by JAN-R-94 including automatic shut feature construction. Attached photo can be supplied.



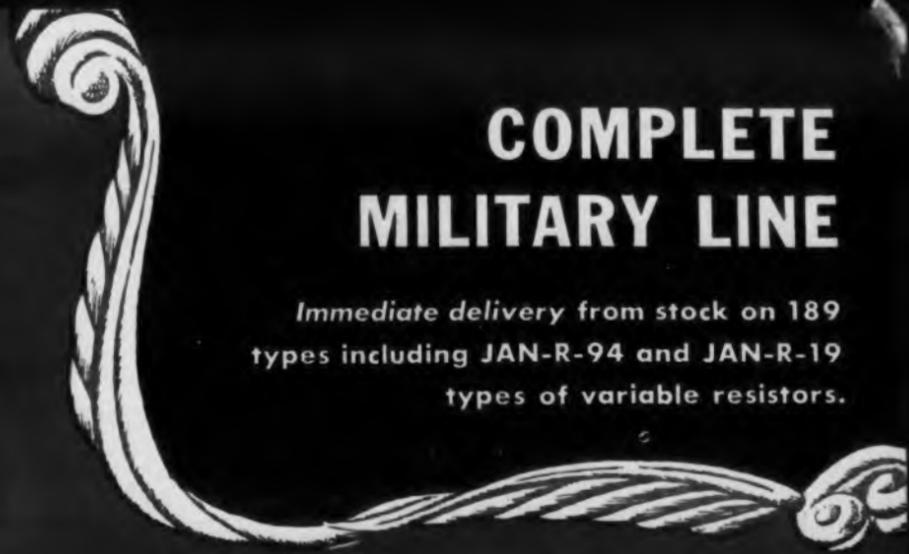
TYPE 42, JAN-R-94, Type 422
1/2 watt, 1 1/2" diameter variable composition resistor. Also available with other special military features as covered by JAN-R-94 including automatic shut feature construction. Attached photo can be supplied.



TYPE 43, JAN-R-94, Type 432
1 watt, 1 7/8" diameter variable composition resistor. Also available with other special military features as covered by JAN-R-94 including automatic shut feature construction. Attached photo can be supplied.



TYPE 44, JAN-R-94, Type 442
2 watt, 2 1/4" diameter variable composition resistor. Also available with other special military features as covered by JAN-R-94 including automatic shut feature construction. Attached photo can be supplied.



COMPLETE MILITARY LINE

Immediate delivery from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.



TYPE 45, JAN-R-94, Type 452
1/2 watt, 1 1/2" diameter variable composition resistor. Also available with other special military features as covered by JAN-R-94 including automatic shut feature construction. Attached photo can be supplied.

RESISTOR TYPE	WATTAGE	DIAMETER
JAN-R-94	1/4	1 1/2"
JAN-R-94	1/2	1 1/2"
JAN-R-94	1	1 7/8"
JAN-R-94	2	2 1/4"

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Special features for military and civilian use. Includes automatic shut feature construction. Attached photo can be supplied.



CHICAGO TELEPHONE SUPPLY Corporation

Specialists in Precision Mass Production of Variable Resistors

Miniaturization Engineers

**FOR RESEARCH,
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OF
SUBMINIATURIZATION
TECHNIQUES**

Significant advancements in the fields of guided missiles, airborne electronic systems and commercial electronic computers are requiring further applications of miniaturization techniques in the Hughes Advanced Electronics Laboratory. Positions are open for engineers qualified in this work.

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The personnel are presently engaged in the development and production of advanced electronic systems and devices.

AREAS OF WORK

Techniques involved are those dealing with printed and etched circuits, encapsulation, plastics, metallurgy, dip-soldering, spot-welding, electrochemistry and materials. Development activities are concerned with plug-in units, auto-assembly techniques, potted units, new wiring methods, electromechanical de-

vices, hardware and production techniques. These techniques are used to achieve compactness, reliability, ease of manufacture, serviceability and interchangeability.

THE FUTURE

Engineers who enjoy a variety of developmental problems find outlets for their abilities and imaginations in these activity areas. New semiconductor components are opening new avenues of miniaturization and are certain to have widespread application commercially in the next few years. Hughes engineers will have full benefit of working experience in this fundamental development.

How to apply

Write today, giving details of qualifications and experience. Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

Scientific and Engineering Staff

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RESEARCH
AND DEVELOPMENT
LABORATORIES

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City,
Los Angeles
County,
California*

New Literature...

Logarithmic Converter 109

A 4-page, 2-color brochure with an additional specification sheet describes the company's logarithmic converters. Features of these instruments, which are intended for use in electronic computing, are outlined and illustrated. Such characteristics are indicated as average d-c characteristics, and logarithmic time base. The enclosed specification sheet provides a circuit description, operational controls, specifications, and mechanical construction data for Model 121. Kalbfell Labs., Inc., 1090 Morena Blvd., San Diego 10, Calif.

Sealed Connectors 110

A catalog sheet with further information on the company's M-7500 Series of hermetically sealed connectors has been released to be added to Catalog D-1, described in the April 1953 issue of *ELECTRONIC DESIGN* (page 27). To complete the catalog, a new contents table and Section I index divider also are provided. General Electric Co., Monowatt Dept., 95 Hathaway St., Providence 7, R. I.

Comparison Bridge 111

A 4-page, 2-color brochure describes the company's Model E-1 Comparison Bridge, an instrument for comparing resistors, capacitors, and audio-frequency inductances with standard units and obtaining percent deviations directly. Information includes applications of the unit, special features, a circuit description, and electrical and mechanical specifications. Also provided is a simplified schematic diagram of the instrument. Southwestern Industrial Electronics Co., P. O. Box 13058, 2831 Post Oak Rd., Houston 19, Tex.

"Vidicon" Components 112

A 16-page booklet supplies technical information on deflection-circuit components for the company's Model 6198 "Vidicon", a small camera tube for industrial TV applications. The components described (deflection yoke, focusing coil, alignment coil, etc.) permit the design of either a combined camera unit and control unit, or a camera unit separated from its control unit. Recommended circuits for these components are provided, along with dimensional outlines, etc. RCA Tube Dept., Commercial Engineering, Harrison, N. J.

Engraver Type Styles 113

Bulletin 32T (4-page, 2-color) illustrates 15 styles of letters and numerals in master type sets for use in the many styles of lettering designs required in mechanical engraving. Also shown are technical symbols, Greek upper and lower case alphabets, circle templates, and special master brass templates. The complete sets include numerals and punctuation marks and are coded as to sizes available. Also shown are reversed master type sets available for engraving on the back of transparent materials and for dye and mold work. Illustrations of the various types are included, and information includes size range of the type styles, price, and number of characters per set. Green Instrument Co., Putnam Ave., Cambridge 39, Mass.

Transformers 114

Catalog TR-53 is a 28-page, 2-color bulletin listing more than 500 of the company's TV components and industrial transformers, including toroids, pulse transformers, transistor transformers, and other miniature type units. Application and characteristic data are provided, along with photographs and drawings of the units. Power components are included, as well as amplifier kits. There is also a geophysical section with specification information on the company's geophysical transformers including input, interstage, output, and A.V.C. output units. The catalog has a standard 3-hole punch for convenient reference filing. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Thermister Bolometers 115

"Servotherm Thermister Bolometers" is the title of a 4-page technical bulletin that discusses various features of these devices, which are used to detect infrared radiation. The brochure discusses information of interest to the electronic designer, including such items as static characteristics, dynamic characteristics, noise level, window considerations, and circuit design considerations. Curves showing typical thermister bolometer resistance characteristics, response of these units to sinusoidally varying heat signal, and effect of ambient temperature characteristics are presented, as well as a typical bolometer circuit. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

MORE POWER FROM MINIATURE MOTORS

Results from these many
lamination designs!

Key to higher miniature motor efficiency is correct lamination design which insures utmost use of available magnetic materials. American Electric now has tooling for over 80 different miniature lamination designs, which specifically answer the requirements of almost every conceivable drive problem, supplying maximum power to weight ratio.

QUIET, light in weight, extremely rugged and reliable these miniatures are available in production quantities.

Available for 60, 400 or 2000 c.p.s. operation or variable frequencies 320 to 1200 c.p.s.

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Silver Spring (Md.), Chicago, New York, Los Angeles



INDUCTION AND
SYNCHRONOUS TYPES
(Hysteresis and Reluctance)

MINIATURE BLOWERS
single and double end



PROPELLER FANS



CIRCLE ED-116 ON READER-SERVICE CARD FOR MORE INFORMATION

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New York 22, N. Y.

New Books...

Review of Input and Output Equipment Used in Computing Systems . . . Paper bound, 142 pages
American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N. Y. \$4.00.

Some time ago (December 10-12, 1952) the Joint AIEE-IRE-ACM Computer Conference was held in New York City to discuss the characteristics and performance of input-output equipment as it applies to large scale electronic digital computers. The conference was held under the direction of a joint committee appointed by the Committee on Computing Devices of AIEE, the Electronic Computers Committee of IRE, and the Council of the Association for Computing Machinery. The booklet, whose title appears at the head of this review, is a compilation of the papers presented at this conference and represents a fairly complete documentation of the input-output art as it exists at present. It is a sequel to a publication resulting from a conference held in Philadelphia, Pa., in 1951, entitled "Review of Electronic Digital Computers".

The first group of papers describes the basic building blocks which are used to construct a matching system between a man and a high-speed computer. These are followed by papers on the SEAC, UNIVAC, RAYDAC, and the IBM 701, and the Ferranti Digital Computer input-output systems. The last group of papers is concerned with the output equipment used with computers.

Nomography and Empirical Equations . . . By Lee H. Johnson. 150 pages. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$3.75.

The purpose of this book is to explain two useful techniques for handling experimental and test data, namely, nomographs, which provide quick graphical answers where numerical data are substituted into formulas, and empirical equations, which are the mathematical expressions of data plotted in the form of curves. The first part of the book deals with nomographs and includes an introduction to the subject, as well as discussions of parallel scale nomographs, Z-charts, parallel and perpendicular index lines, concurrent scales, recurrent variables, and combined nomographs.

The second section covers empirical equations and discusses methods of curve fitting, and curves of two, three, and four constants.

In his discussions, the author presents a method of analyzing an equation and its variables before plotting in nomographic form in order to determine the best arrangement of scales. He also covers the effect of scale arrangement on the accuracy of a nomograph. A large number of problems, covering a wide range of fields is included in the book which is well written and easy to follow.

WET OR DRY

Resistance is high

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miniature hermetic terminals!

TESTS PROVE—Lundey series #199 miniature hermetic terminals give excellent performance under conditions of high humidity.

In an average test the following results were tabulated:

Relative Humidity	Temp.	Insulation Resistance
90%	80°F	1,000,000 megohms
50%	80°F	3,000,000 megohms

OTHER FEATURES

- Mounting in simple drilled or punched holes . . . no extrusion needed.
- Effective spring loading
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- Minimum mounting — 15/64" on centers
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A great aid to your miniaturization program



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MOUNT IN 15/32" HOLE
ALL LENS COLORS

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with any midget flanged
base lamp types*

*Complete blackout
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DIMMER**
No. 11-1930-621

THESE ASSEMBLIES LOGICALLY REPLACE
LAMPS NO. 319, 320, and 321

REPLACE
WITH THIS



NOT
THIS



OR
THIS



PLASTIC PLATE (EDGE) LIGHT ASSEMBLIES

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DIALCO No. TT-51 (Red filter-black top)
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ACTUAL
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Patents . . . by John Montstream

Pulse Generator . . . Patent No. 2,629,823.
P. E. Grandmont, E. Orange, N. J. (Assigned to Westinghouse Electric Corp.).

This patent deals with a new pulse generator which is powered from a low voltage source and generates extremely short, rectangular, high voltage pulses which are adjustable as to their duration. The generator is also adapted to be synchronized by a periodic low voltage signal over a wide range of frequencies.

The generator circuit includes an inductor (3) and a triode (4) connected in series across a source of voltage supply. The control grid of the triode is normally maintained positive by a bias source (11) so that the triode passes current and charges the inductor. The positive bias on the control grid is overcome by negative pulses from a generator (10) of saw tooth or other

suitable form of pulse, and this generator is coupled to the control grid through a transformer (8). The triode therefore passes current for relatively long periods of time and is cut off by a negative bias on the control grid for relatively short periods. The sudden cutting off of current through the triode causes generation of a voltage of self inductance across the inductor.

The voltage across the inductor is applied to the load (R_L) which is shunted by a thyatron (15). When the triode (4) is cut off, the junction point (22) becomes positive after a delay introduced by the inductance (20) and a firing potential appears on the control electrode of the thyatron (15). This reduces the voltage across the load to zero. Thereafter the triggering voltage (9) at the transformer (8) decreases to a point at which the triode again becomes conducting and the cycle repeats.

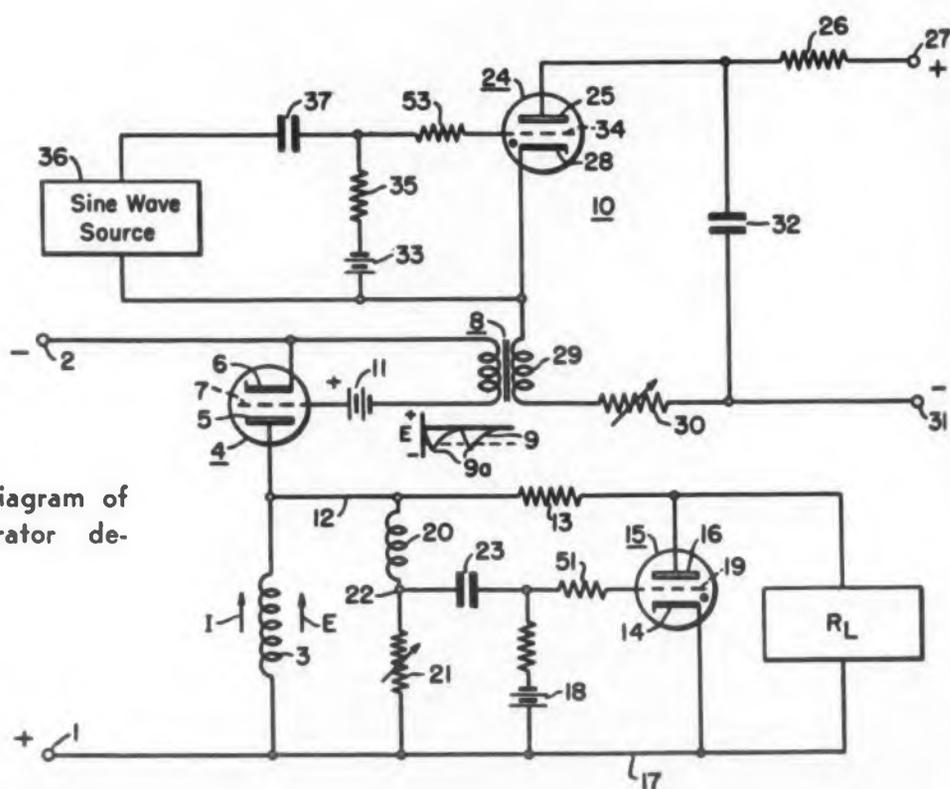


Fig. 1. Circuit diagram of the pulse generator described above.

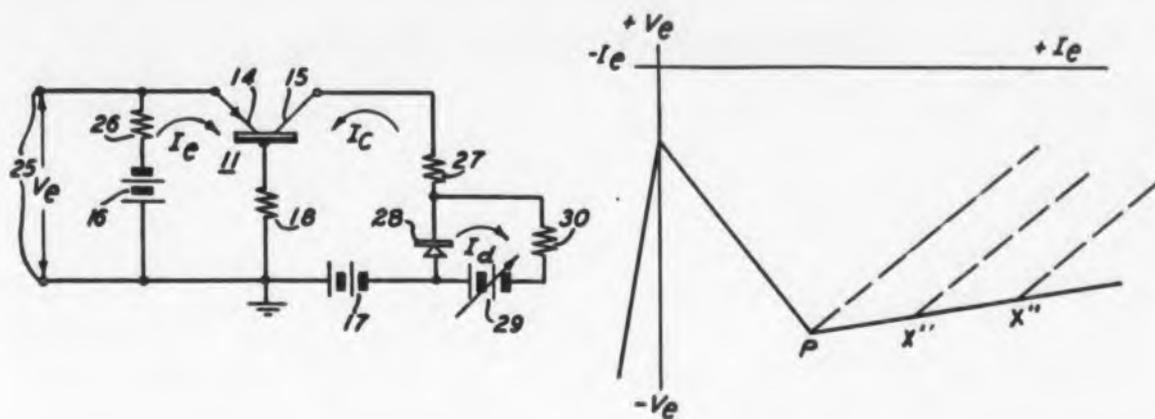


Fig. 2. Transistor Trigger circuit with current-voltage characteristics shown alongside.

The frequency of the pulses is controlled by the frequency of the synchronizing or triggering pulses.

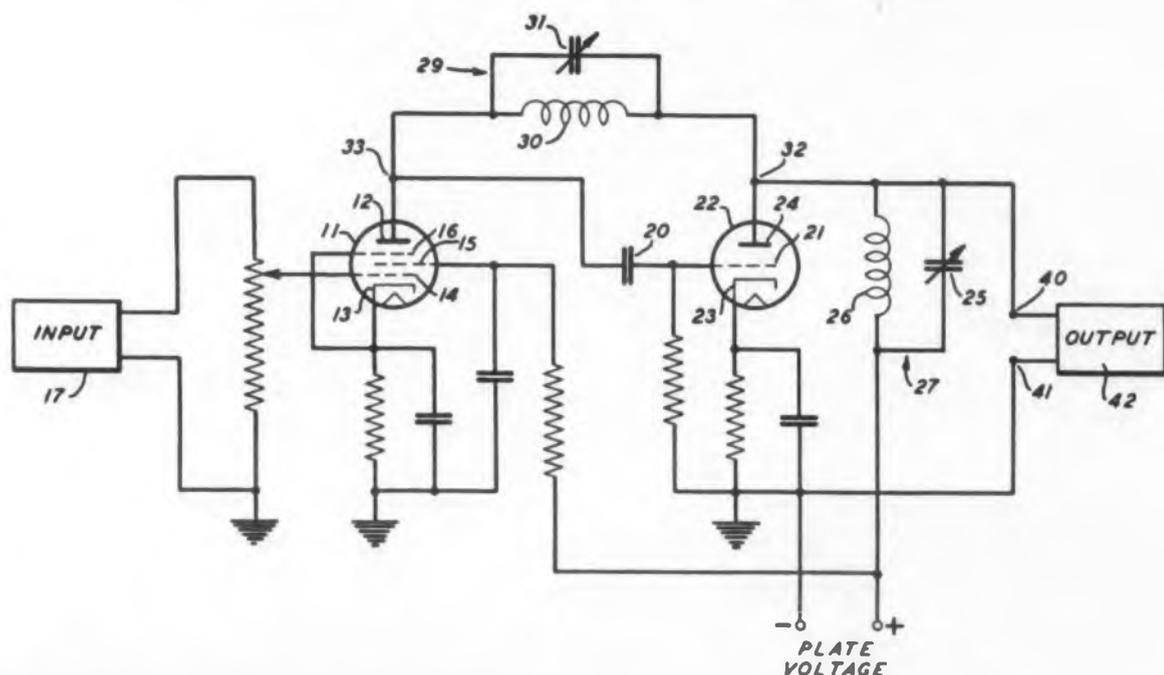
Transistor Trigger Circuits . . . Patent No. 2,629,833. R. L. Trent, Far Hills, N. J. (Assigned to Bell Telephone Labs., Inc.)

Transistor circuits operate as a negative resistance over some portion of their operating range and the purpose of this invention generally is to modify the current-voltage characteristics of the circuit so that a desired slope is secured over certain regions of the characteristics. The circuit has particular application in transistor trigger circuits and in this application in an open circuit stable type of circuit it is desirable to modify the slope in a positive portion of the characteristic.

Fig. 2 illustrates a transistor trigger circuit embodying the invention and alongside are the current voltage characteristics unmodified (solid line) and modified in three ways (dashed lines). The emitter circuit is made up of the battery (16), resistor (26), emitter electrode (14) and transistor (11). A feed back resistor (18) is connected with the base electrode (13). The collector circuit includes the battery (17), resistor (27), collector electrode (15), and to modify the slope of the characteristic, an asymmetric device (28) such as a germanium crystal diode is inserted in series with the collector and poled for easy current flow in a direction opposite to normal collector current flow. The diode is biased by a battery (29) and resistor (30) forming a loop.

The bias is applied to the diode in such a way that it will be at its low resistance

Fig. 3. Circuit diagram of the frequency selective amplifier.



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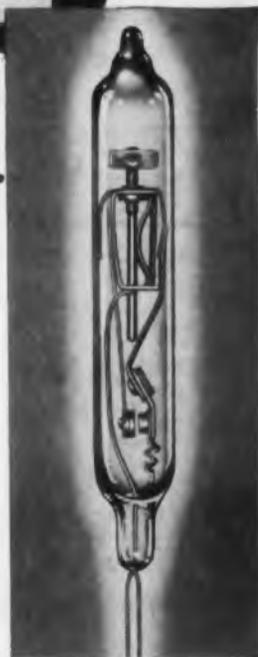
The Beckman Model V Micro-Microammeter—for the precise measurement of extremely small electrical currents. Beckman Instruments, Inc., South Pasadena, California.

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Patents . . .

or conducting state until a desired turnover point P , X' or X'' is reached whereupon the collector current exceeds the biasing current flow in the loop and the diode operates in its high resistance condition to increase the slope as shown by the dashed lines.

Frequency Selective Amplifier

. . . Patent No. 2,629,785. H. A. Tooker, Allentown, Pa. (Assigned to Western Electric Co., Inc.).

The circuit described relates to a frequency selective amplifier which operates without loss of overall gain. It has particular applicability for detecting unbalance in a-c bridge circuits where harmonics from extraneous sources introduce measuring errors when the bridge is near balance.

The amplifying circuit is two stage, the tube for the first stage being a pentode and the second stage tube may be a triode. The plate of the pentode is connected with the grid of the triode through a blocking condenser. The plate circuit of the triode (22) includes a tuned parallel circuit (27) and a second tuned parallel circuit (29) connects the plates of the two tubes to provide degenerative feed back for components of frequencies other than that to which the circuit is timed. Such components are therefore sharply reduced and essentially only the resonant frequency will appear at the output terminals.

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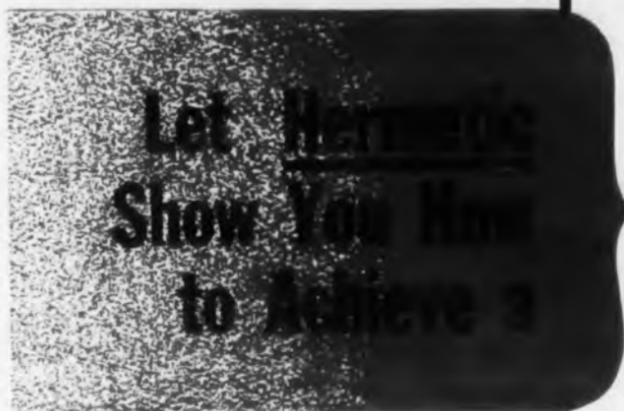
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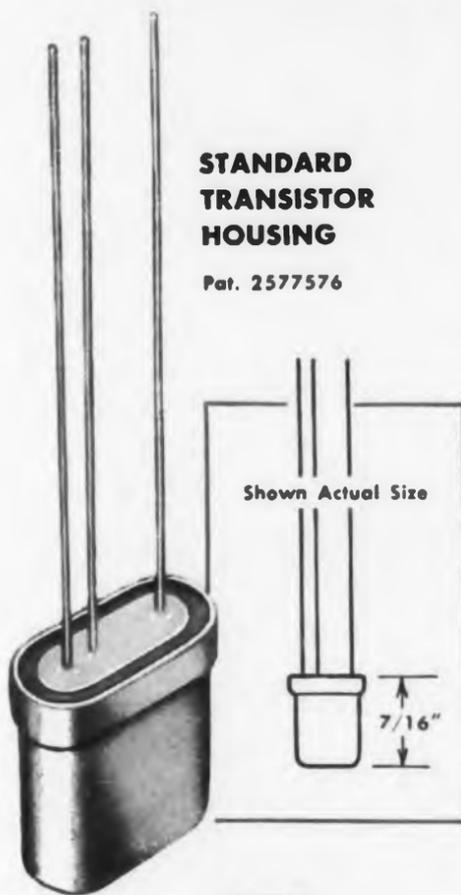
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