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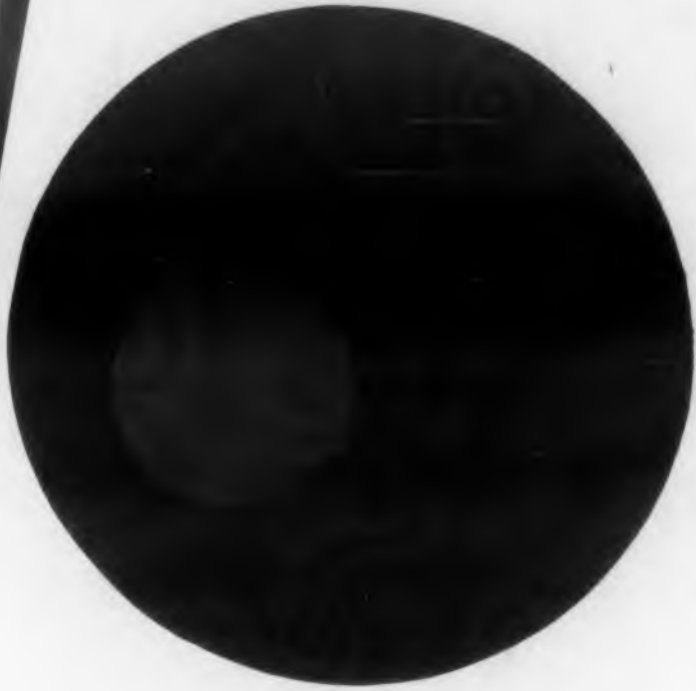
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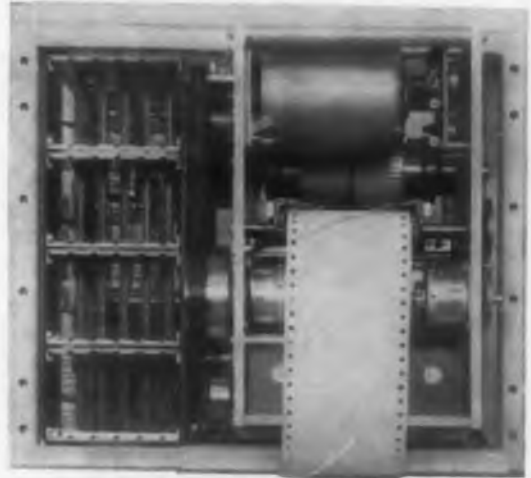
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Desk Top High Speed Printing . . . 28





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COVER STORY

Desk Top High Speed-Printer p 28

Our cover shows an artist's conception of a solenoid driven hammer about to strike the paper against the number wheel in this high speed digital printer. The entire circuitry is transistorized in this remarkably small, high speed printer.

Current-Carrying Capacitors p 22

Gives specific data on relative current carrying capacities of six popular base laminates for printed circuitry. Factors which affect design for conductor size and spacing are discussed, and design procedure is outlined.

Requirement Guide for Parts p 26

Presented in handy chart form, the data serves as a guide in design and selection of components for various environmental requirements of military electronic equipment.

Supplementary Transistor Chart 38

An end-of-year supplement to ED's annual transistor data chart, giving characteristics of all transistors announced since July, 1957.

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Display	In-line, 5 digit readout
Reset	Manual or automatic recycling
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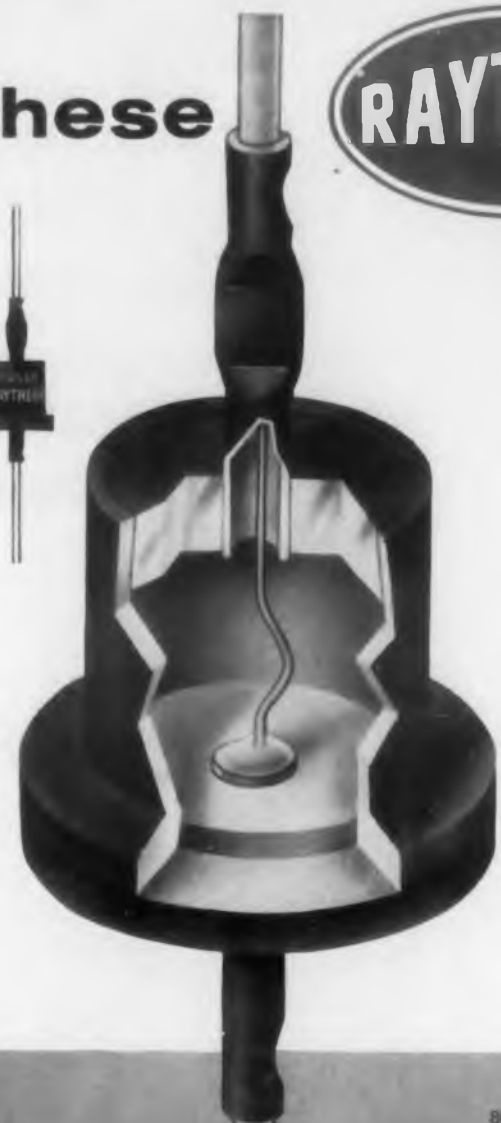
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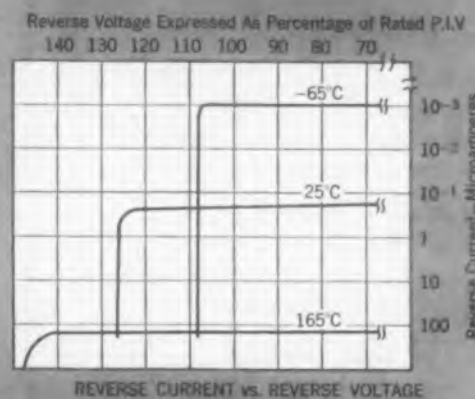
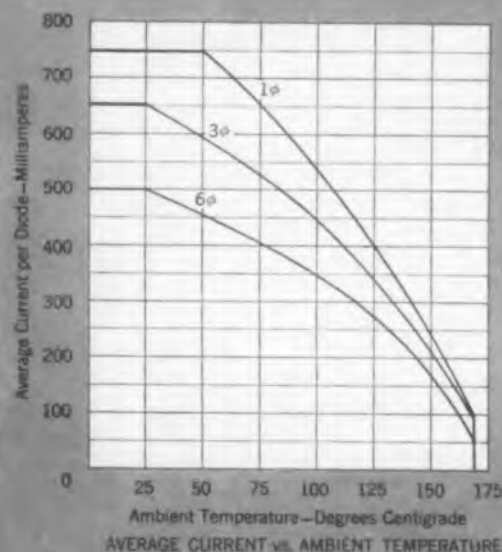
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EDITORIAL

Postscript to Design '58 Report

Whenever you edit a mass of information into an article of reasonable length, you run the risk of leaving something important out. In editing last issue's Design '58 report we picked up several impressions of what's happening in the industry that weren't stated in so many words. Several soft spots show up. We should recognize these as problems.

For the coming year there is a definite hopelessness about getting improved materials. Although the indications for improved products (better performance, greater stability, longer life, better stress resistance) were generally enthusiastically positive, optimism was belied considerably by the grave concern over the materials situation. Everyone, including the strictly commercial equipment designer, is crying for improved materials. Many are alarmed at the paucity of basic research. There seems to be no gap between basic and applied research. Designers are applying every bit of knowledge that is available. It is not that designers have caught up with research, but that research is not going at the proper pace. Research will have to be supported.

Reliability is on everyone's mind, but few have spelled out specific steps to be taken to improve products. Certainly more testing will be done so that we will know more about components. It is doubtful if enough tests will be run to come up with specific failure rates or other indexes adequate for reliability formulas. Component designers feel hard put to produce reliability indexes for each and every different condition that seems necessary to get prime reliability for specific operational uses. As one person put it, if we want reliability, we need more technicians and fewer bookkeepers. In 1958 reliability will be achieved only as the engineer can wisely pick parts without the ultimate in test data.

A problem that frequently gets out of hand is high costs. Commercial equipment manufacturers, component manufacturers, and many military producers are looking for lower costs in 1958. The emphasis on this was greater than in previous years. Before manufacturers can even convert from military to industrial products, costs will have to come down.

When asked what can others do to help you with your problems, the emphatic answer was, do a better job of supplying appropriate technical data on new products.

Research, reliability, cost, and communications should be watchwords for the coming year.



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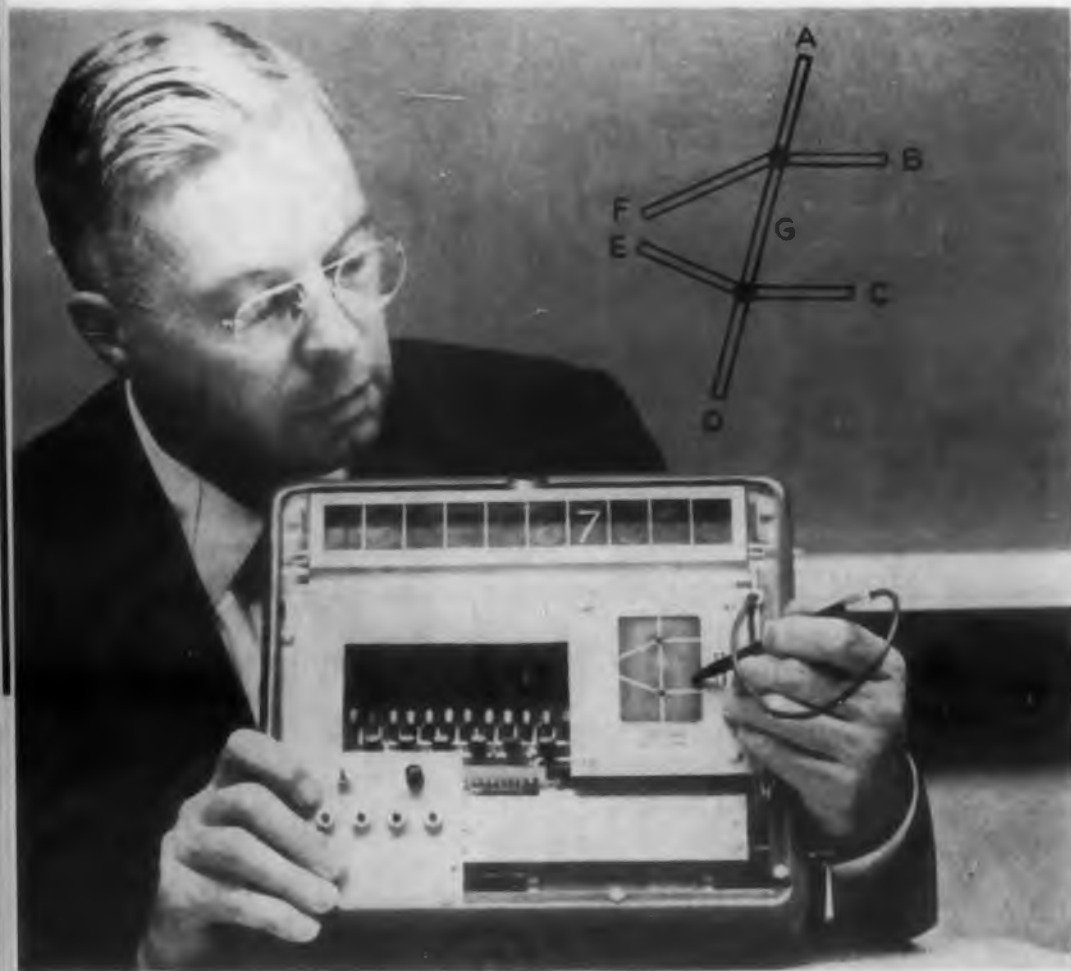
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ENGINEERING REVIEW

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



Experimental "Brain" Reads Handwritten Numerals —No Larger Than Portable Typewriter

This small machine is an experimental device which reads handwritten numerals. Mr. Tom L. Dimond of Bell Telephone Laboratories is shown holding a metal stylus, for writing the numbers, in front of the special writing plate. After they have been written, the numbers appear on the machine across the top. A number 7 is shown illuminated. Layout of the constraining dots and radius vectors, upon which operation is based, is shown inset.

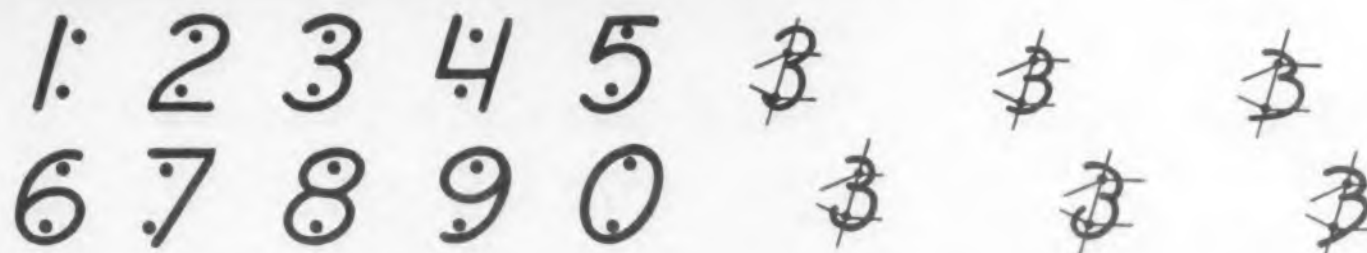
An experimental device the size of a portable typewriter, that can read handwritten numerals or identify numbers as they are being written, was announced at the recent Eastern Joint Computer Conference in Washington, D.C. The device was invented by Tom L. Dimond of Bell Telephone Labs' System Engineering Department. With some modifications the equipment could be used to read handwritten letters.

Numbers are recognized as they are being written, and the device indicates the numeral by lighting up the correct digit on a numbered panel. The writing is done with a metal stylus on a specially-prepared writing surface. Two dots one above the other, are used as reference points. Seven sensitized lines extend radially from these two dots. Numerals are recognized by the machine, depending on which lines are crossed. To clear the device for the next number the writer touches the stylus to a special plate, and this causes the previous number to be "erased."

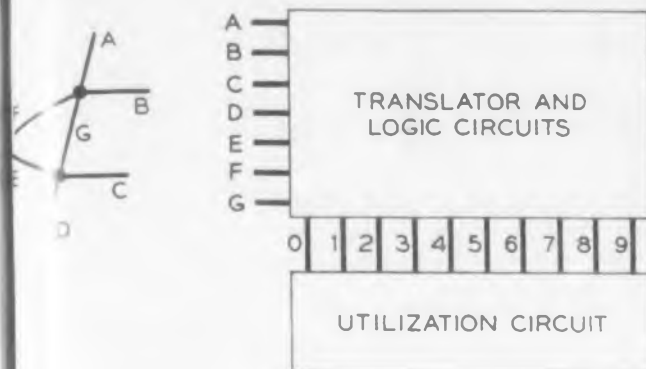
The device is operated from flashlight batteries and requires no outside power source. Its small size is made possible by the use of transistors.

Details of Operation

In order that written numerals may be read with a minimum possibility of error, mild restrictions must be placed on their size and form. The constraints consist of two vertically-aligned dots, around which the numerals must be formed. Three radius vectors extend out from each of these dots, and a seventh joins the two. Numerals



At left is shown how 2-dot constraint serves to guide the formation of numerals 1 to 0. Wide variations are permissible in forming the numeral 3 as shown at right.



Basic operation block diagram of the handwriting-recognition machine for character recognition. Information on the seven radius vector crossings is fed to the translator and logic circuits which determine the numeral being written or read. The number indication is then sent to the utilization circuit, which uses this information in the desired manner.

are then sensed by determining which of these radius vectors are crossed.

The two guide dots and seven radius vectors on the writing surface are made of conducting material, embedded in plastic. Whenever the metal writing stylus crosses a conductor, information as to which vectors have been crossed is transmitted to a translator, which contains transistorized logic circuits. Since each numeral has a corresponding set of crossings which is unique, the translator needs only to be able to distinguish each of the sets in order to produce a different output for each numeral. The outputs are employed in the utilization circuit to illuminate a number, operate a teletypewriter, feed the information to a computer, or perform any other desired operation.

To recognize written numerals, a specially-prepared plate is employed on which each radius vector appears as a closely-spaced, insulated parallel set of conductors. The numerals must be written with a conductive pencil on a sheet of paper or a card. When this writing is superimposed on the printed plate and properly oriented, the appropriate sets of conductors are shorted out. The information thus obtained is fed to and analyzed by the translator and logic circuit, which determines the proper number and transmits the identification to the utilization circuits.

This technique has been extended to permit the identification of handwritten letters. To properly read such letters, it appears that a four-dot constraining system with twelve radius vectors is necessary. However, to identify letters as they are being written is somewhat simpler, since advantage can be taken of the order in which the radius vectors are crossed. By utilizing this information, it is possible to identify either letters or numbers as they are being written by using the 4-dot constraining system as for numerals.

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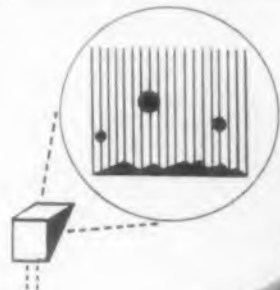
... applied to complex radar systems



ELECTROSTATIC DEFLECTION 5" DIAMETER

With two writing guns. Representative applications: multiple "B" scan radar, oscillography, and armament control radar.

... applied to "B" scan projection



ELECTROSTATIC DEFLECTION 3" DIAMETER

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Complete technical information—specifications, operating characteristics, suggested circuitry, etc., will be sent you on request. Write: HUGHES PRODUCTS, Electron Tubes, International Airport Station, Los Angeles 45, California.

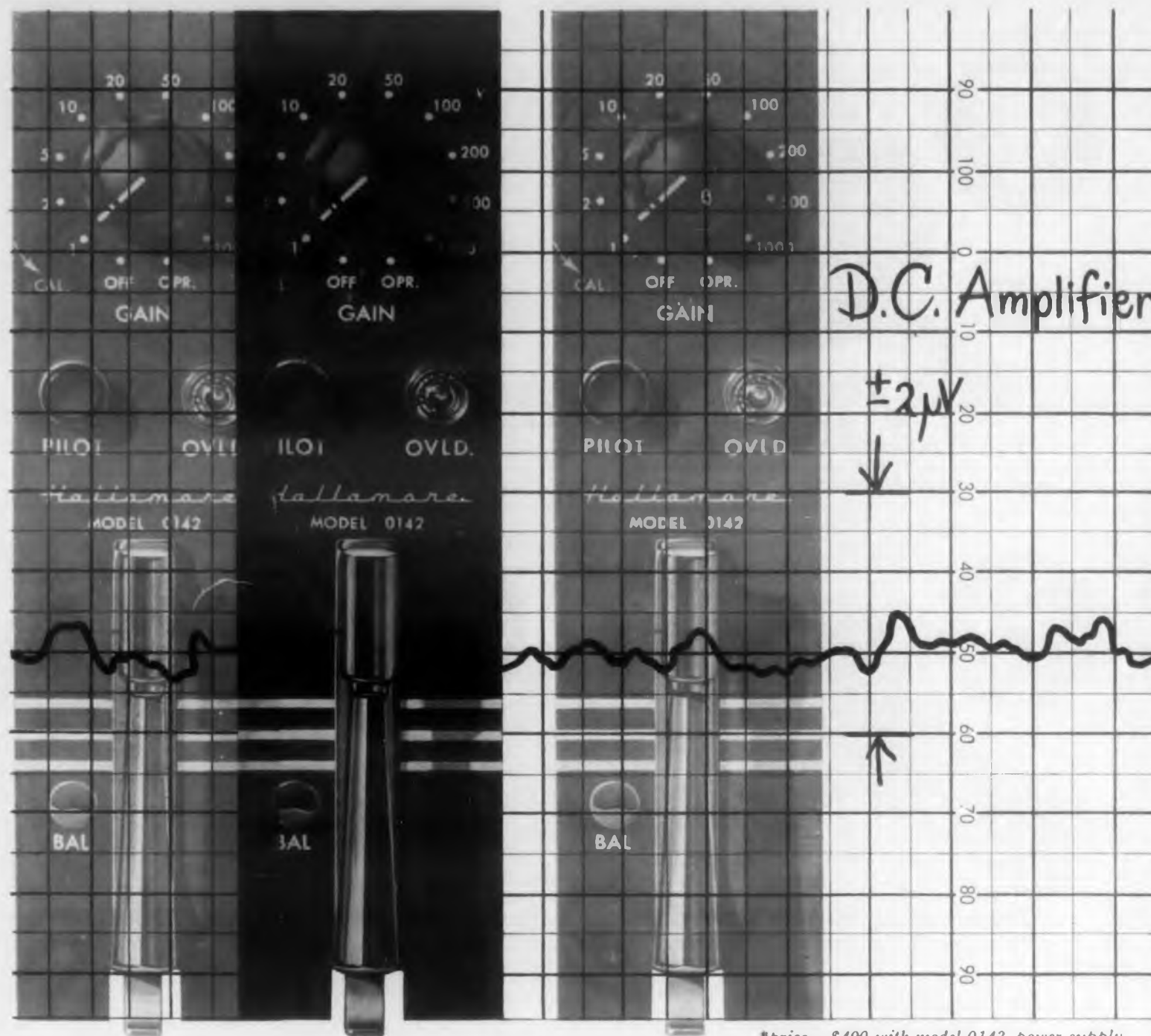
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HALLAMORE ELECTRONICS COMPANY



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This photograph, taken by means of an electron microscope, shows the oxide whiskers that grow on the surface of stainless steel when it is corroded at high temperatures by pure mixtures of water and oxygen.

Strange Crystal Growth May Explain Steel Failures

Crystals, which grow as delicate plates, form on the surface of stainless steel, may explain a destructive failure of metal. This new theory known as "stress-corrosion cracking," was revealed by Dr. Earl A. Gulbransen, advisory chemist at the Westinghouse Research Laboratories, Pittsburgh, Pennsylvania.

Stress-corrosion cracking can occur in metal structures which are chemically corroded while under an internal or applied stress, such as a pull or twist. It can cause complete failure of the structure. Stress-corrosion cracking can be triggered even by such mildly corrosive substances as steam or human perspiration; and it occurs in objects subjected only to the internal stresses left in them during their manufacture. Stainless steel pipes, turbine blades, even coffee urns and cooking vessels can fail because of stress-corrosion cracking.

Dr. Gulbransen described the newly discovered crystals as "submicroscopic platelets of chromium oxide." They form on strongly stressed stainless steel specimens which are exposed to corroding atmospheres containing traces of negatively charged chlorine atoms more properly referred to as chloride ions.

It is believed that this unique crystal growth has an important bearing on the whole general problem of stress corrosion. It has suggested a mechanism on the atomic scale, to explain such corrosion. This growth of platelets on the surface of the steel could lead to a chemical cutting of the metal. Minute crevices, could grow downward into the metal surface as the platelets thrust themselves above it. The concentration of the stresses at the base of the crevices could cause the metal to fail.

In a typical experiment, a small piece of stainless steel wire, nine thousandths of an inch in diameter is subjected only to the residual stresses it normally possesses. Exposure to a carefully controlled atmosphere of oxygen and water at a red-hot temperature of 1100 d F. After corrosion by the hot atmosphere, the wire is examined and photographed with the electron microscope. The pictures which result are studied.

Using very pure oxygen and water vapor, the surface of a typical sample of stainless steel erupts with billions of oxide "whiskers." Only about one or two millionths of an inch in thickness, these whiskers grow to a height 300 or 400 times their diameter.

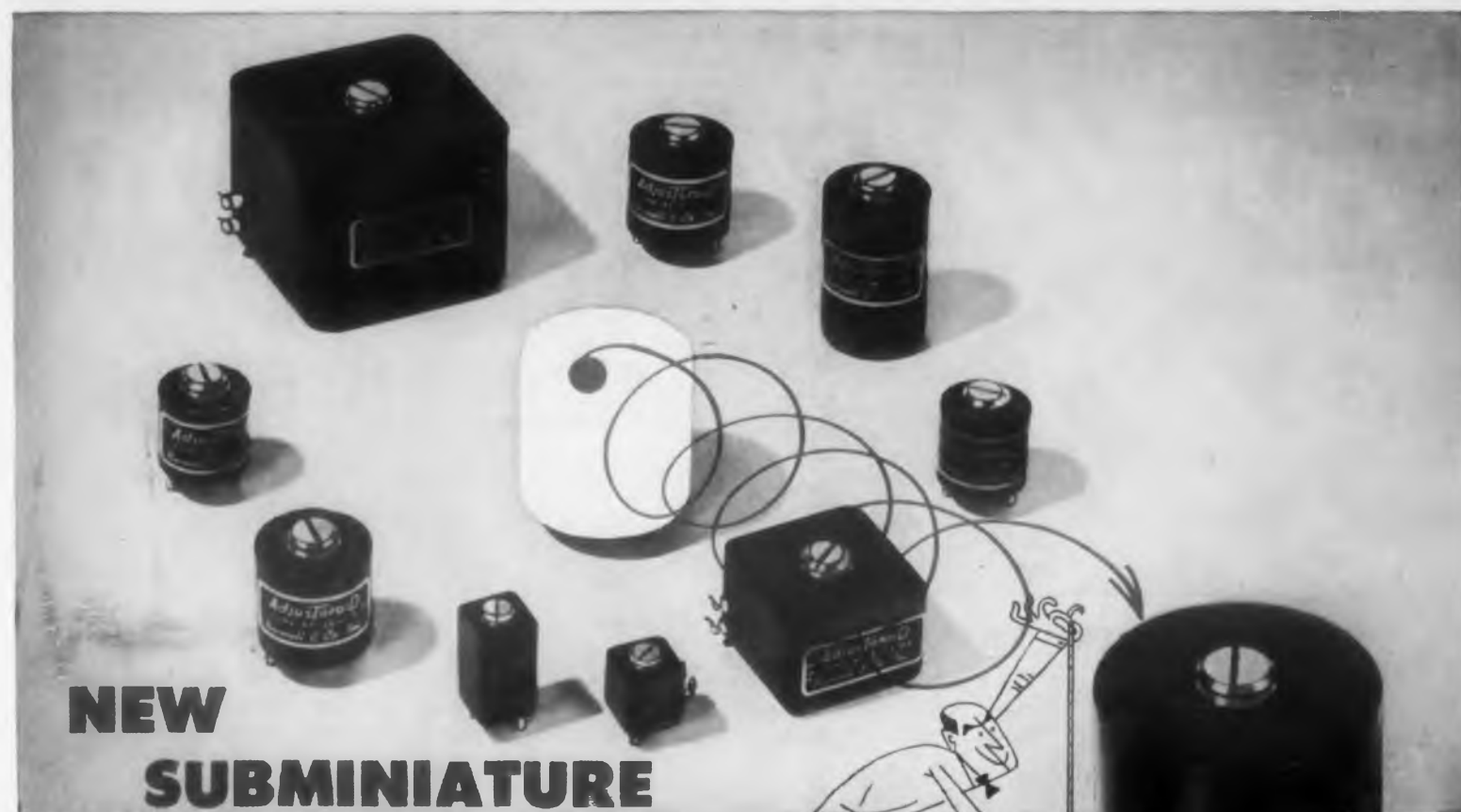
Completely unexpected changes occur in this crystal growth simply by prestressing the stainless steel and adding only the slightest trace less than five parts per million of chloride ions to the atmosphere. Instead of long thin filaments, there appears rows of thin, upright, parallel plates which grow along a definite crystallographic direction.

For some time scientists have known that the chloride ion is a major factor in producing stress-corrosion cracking of stainless steel. It would now appear that chloride ions could stimulate the growth of these unique, plate-like crystals in a strongly stressed metal, which might result in cracking and the ultimate failure of the steel.

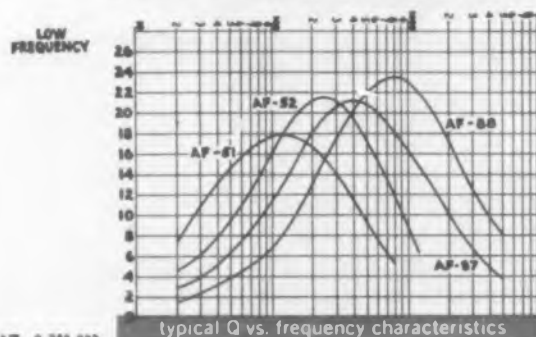
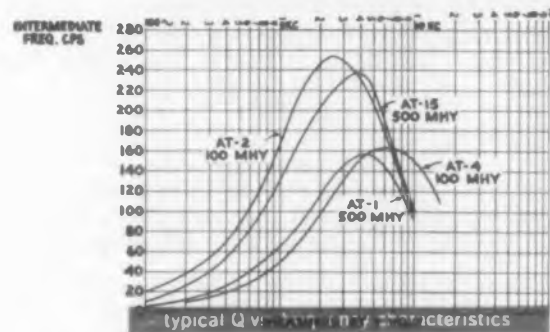
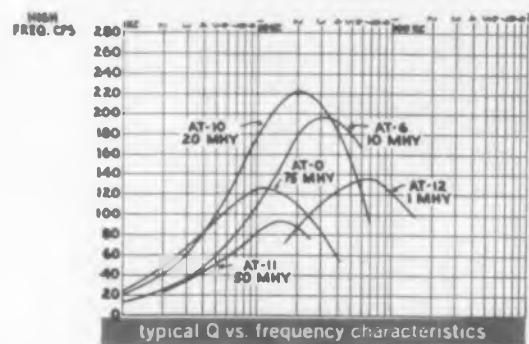
Man's Quest for Knowledge

The University of Pennsylvania's Computer Center received a \$1,440,000 Univac system as a gift from the Sperry Rand Corporation. The computer is to be devoted more to basic research than any previous computer installation. According to Dr. Saul Gorn at the Computer Center, projects planned range from "what makes people buy what things" to "a new plan for correlating the paper work of the building industry."

A research program to investigate the patterns of creativity in the sciences has been established by New York University's Division of General



NEW SUBMINIATURE BURNELL ADJUSTOROID* HANDLE BIG JOBS



The new subminiature Burnell Adjustoroids® utilizing an ingenious patented method of magnetic biasing cover a wide range of frequencies, occupy less space and are available at low cost.

New Burnell Adjustoroids possess all the outstanding characteristics of non-adjustable TOROIDS!

Precise continuous adjustment of inductance over a 10% range.

No need for external control current.

Hermetic sealing to meet Government MIL E # 15305-A specifications.

If your adjustoroid needs can't be met from our stock catalogue, we'll be glad to manufacture to your specifications.

	Length/ Dia.	Width	Hgt.	Wt.	Useful Freq. Range	Max Q	Max L in hys
AT-0	1 1/8"		1"	2 oz	1 kc to 20 kc	10 kc	3 hys
AT-1	1 3/4"	1 3/4"	1 1/4"	7 1/4 oz	2 kc to 10 kc	4 kc	15 hys
AT-2	2 3/4"	2 3/4"	2 1/4"	24 oz	Below 2.5 kc	2.5 kc	125 hys
AT-4	1 1/8"		1 1/4"	4 oz	1 kc to 16 kc	6 kc	15 hys
AT-6	1 1/8"		1"	2 oz	10 kc to 100 kc	30 kc	.75 hys
AT-10	1 1/8"		1 1/4"	4 oz	3 kc to 50 kc	20 kc	.75 hys
AT-11	4 5/8"	4 5/8"	3/4"	.83 oz	2 kc to 25 kc	15 kc	5 hys
AT-12	4 5/8"	4 5/8"	3/4"	.83 oz	15 kc to 150 kc	60 kc	.5 hys
AT-15	1 3/8"		1 7/8"	14 oz	Below 5 kc	4 kc	125 hys
AF-51	1 1/8"		2"	5 oz	30 cps to 500 cps	120 cps	1000 hys
AF-52	1 1/8"		2"	5 oz	50 cps to 1 kc	250 cps	1000 hys
AF-87	4 5/8"	4 5/8"	1 1/4"	1.7 oz	90 cps to 2 kc	400 cps	80 hys
AF-88	4 5/8"	4 5/8"	1 1/4"	1.7 oz	1.6 kc to 4 kc	800 cps	42 hys

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first in toroids, filters and related networks

EASTERN DIVISION
10 PELHAM PARKWAY
PELHAM MANOR, N. Y.
PELHAM 8-5000
TELETYPE: PELHAM 3633



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720 MISSION STREET
SOUTH PASADENA, CALIFORNIA,
RYAN 1-2841
TELETYPE: PASACAL 7578

*PAT. 2,762,020

CIRCLE 7 ON READER-SERVICE CARD

These Little

E - FORM
Trade Mark

Pellets Will

REVOLUTIONIZE



YOUR ENCAPSULATION PROCEDURES

UNTIL TODAY . . .

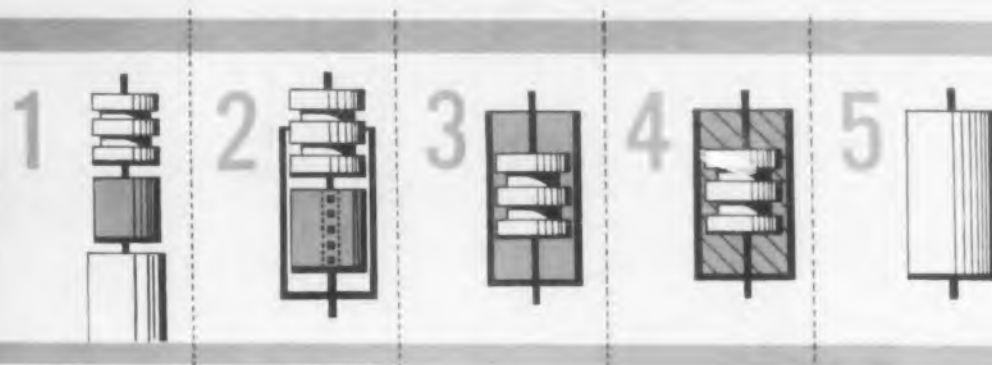
The trouble of tedious mixing and measuring of hardener and resin, the danger of toxicity, the waste of material due to the instability of the compound . . . all of these factors combined, make epoxy encapsulation an extremely inefficient operation.

NOW . . .

A dry, stable, non-toxic pellet of preformed, premixed Epoxy compounds, tailored to your exact requirements, can make encapsulation one of the simplest operations in your manufacturing process.

Developed by Epoxy Products' experienced staff of plasticists, these pellets, though designed primarily for use in conjunction with Epoxy "E-CASE" Shells, are being widely used wherever epoxy resins are required for bonding, sealing or encapsulation.

The
prescribed
technique
for
encapsulating
components,
using "E-CASES"
and "E-FORMS":



The "E-FORM" pellet and electronic component are inserted into the "E-CASE" in that order. The assembly is then subjected to heat, with a gentle pressure exerted on the component. The heat causes the pellet to liquefy and flow around the component. Further heating gels and then cures the epoxy. The result is a completely epoxy-encased unit, resistant to humidity, temperature variations and corrosive influences.

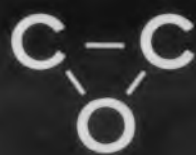
E-FORMS eliminate:

- Wasteful mixing of hardener and resin
- Dermatitis problems (completely non-toxic)
- Dixie cups and liquid metering machines
- The need for a trained chemist to supervise operation

"E-CASES" plus "E-FORM" pellets make mass production and automation techniques feasible since these combinations can be automatically fed, positioned and assembled with the use of standard available machinery.

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CIRCLE 8 ON READER-SERVICE CARD

ENGINEERING REVIEW

Education. Directed by Adjunct Professor Myron A. Coler, it will be concerned with the recognition and encouragement of scientific talent. Using an operational approach, they will seek to arrive at ways of dealing with creativity, to delineate creative research patterns, and to foster inter-science research projects. The subject of the first seminar, planned for early 1958, will be "The Role of Conjecture." Plans also are being made to publish the findings of the seminars.

Transistorized HF Power Boosts Fluorescent Lights

A transistorized high-frequency power source for lighting systems has been developed by Westinghouse Electric's lighting division. Prototypes already functioning in Westinghouse offices supply power at 1500 cycles to 64 standard 40-watt rapid start fluorescent lamps.

The frequency converter is a static device which accepts incoming three-phase ac power at normal distribution voltages and rectifies it by a diode bridge. The dc voltage is impressed across two groups of power transistors which conduct alternately and work with auxiliary circuits to provide a 150 volt alternating peak output. The final waveform, square or sinusoidal, is determined by the circuitry of the final stage. The use of semiconductors permits frequency stability to be maintained with high efficiency over a wide load and input voltage range. It is capable of continuous no load operation since its losses are less than fifty watts. By simple design modifications frequency output can be fixed anywhere in the audio range.

An advantage of high frequency power is that the efficiency of fluorescent lamps rises as frequency is increased. At high frequencies the bulk, weight, and losses of ballasts can be drastically reduced.

A high frequency system requires less power input, heat dissipated in the ballasts is reduced, and less overhead space is necessary to house and support the luminaires. This will free luminaire designers from mechanical and thermal problems that restrict luminaire design.

Besides the high reliability afforded by semiconductor devices, the frequency converter units can be installed very near the lighting load without long high-frequency distribution runs. Other advantages are negligible maintenance requirements, silent operation, and an ability to operate at more than 90 per cent efficiency over most of their load range.

Equipment Tests Airborne Radar in Flight

Test equipment that investigates the accuracy of a Navy interceptor's electronic gun-aiming system without actual firing—and does it in flight as well as on the ground in minutes instead of hours—has been developed by Westinghouse Electric Corp. A pilot will be able to perform these same tests while flying to his target if he has to become airborne in an emergency situation without the pre-flight checking of radar and computer equipment. This will eliminate the possibility of a plane flying into combat with its armament control system needing adjustment.

The six-step checkout process involves feeding artificial signals into the system under test to simulate combat conditions. The test equipment presents a realistic problem into the gun-aiming system. This is done in such a way that the pilot or technician can tell whether different components are working properly in interpreting signals that appear on the radar cathode-ray tube that is mounted in the cockpit. The equipment weighs 15 pounds.



The promising career of Thomas E. Melville Jr., 25, Assistant Editor of *ELECTRONIC DESIGN*, was cut short last month by his untimely death. His imaginative editorial talent and his winning personality was appreciated by all those with whom he worked.

He had been active in electronics industry and was well-known in the high-fidelity field. A native of Elmhurst, N. Y., he attended Rensselaer Polytechnic Institute, the R.C.A. Institute, and Fordham University. Formerly associated with the A.D.T. Company, he was a member of the M. G. Car Club and the Audio Engineering Society. He leaves many professional and personal friends at *ELECTRONIC DESIGN* and in the industry.

CLEVITE POWER TRANSISTORS



EXPANDED LINE OF POWER TRANSISTORS FOR AUDIO OUTPUT, POWER SUPPLY AND SWITCHING APPLICATIONS

Clevite Power Transistors, available in production quantities, offer:

- HIGH POWER RATINGS
- HIGH POWER GAIN
- LOW DISTORTION
- LOW THERMAL RESISTANCE
- RUGGED WELDED PACKAGE
- HERMETIC SEAL

Check the outline specifications for the type of performance you get from Clevite Power Transistors.

For on-the-job help with specific application problems, our engineers are available for consultation.

Data sheets B-211, B-214 and B-216 provide all the facts on Clevite Power Transistors. Write for your copies.



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TRANSISTOR PRODUCTS

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A Division of Clevite Corporation

Outline Specifications

Type	Military 2N297	CTP 1117	2N257	2N268	CTP 1109	CTP 1111	Units
Instantaneous Collector-to-base Voltage (absolute Maximum)	60	40	40	80	20	80	Volts
Junction Temperature (absolute Max.)	85	85	85	85	85	85	°C
Average Total Power Dissipation (with inf. heat sink @ 25°C)	25	30	25	25	25	25	Watts
Average Total Power Dissipation (with 36 sq. in. heat sink @ 25°C)	15	18	15	15	15	15	Watts
Typical Power Gain	a	33 ^b	33 ^c	31 ^c	30 ^d	26 ^c	db
Frequency Cutoff	5	6	7	6	6	4	Kc/s

a Large Signal D.C. Current Gain = 12 to 40 at $I_c = 2.0$ amps.
 b $V_{cc} = -14V$; $I_c = 750$ ma; $R_L = 17\Omega$ (choke coupled); $R_s = 10\Omega$;
 c $V_{cc} = -14V$; $I_c = 420$ ma; $R_L = 30\Omega$ (choke coupled); $R_s = 10\Omega$;
 d $V_{cc} = -7V$; $I_c = 420$ ma; $R_L = 15\Omega$ (choke coupled); $R_s = 10\Omega$.



Brush Electronics Co.



Cleveland Graphite Bronze Co.



Clevite Harris Products Inc.



Clevite Ltd.



Clevite Research Center

German Semiconductor Plant: Intermetall G.m.b.H.-Dusseldorf.

CIRCLE 9 ON READER-SERVICE CARD

Plain facts about... **BURROUGHS**

BEAM SWITCHING TUBES

CUSTOMERS

Over 750 manufacturers have purchased Beam Switching Tubes.

RELIABILITY

Shock	375 g
Temperature	-60° to +150°C
Vibration	to 20 g
Speed	to 20 mc
Life	to 50,000 hours
Power	min. input - useful output

COST

One Beam Switching Tube may replace as many as 4-6-10-20 or more tubes, transistors, and their associated components.

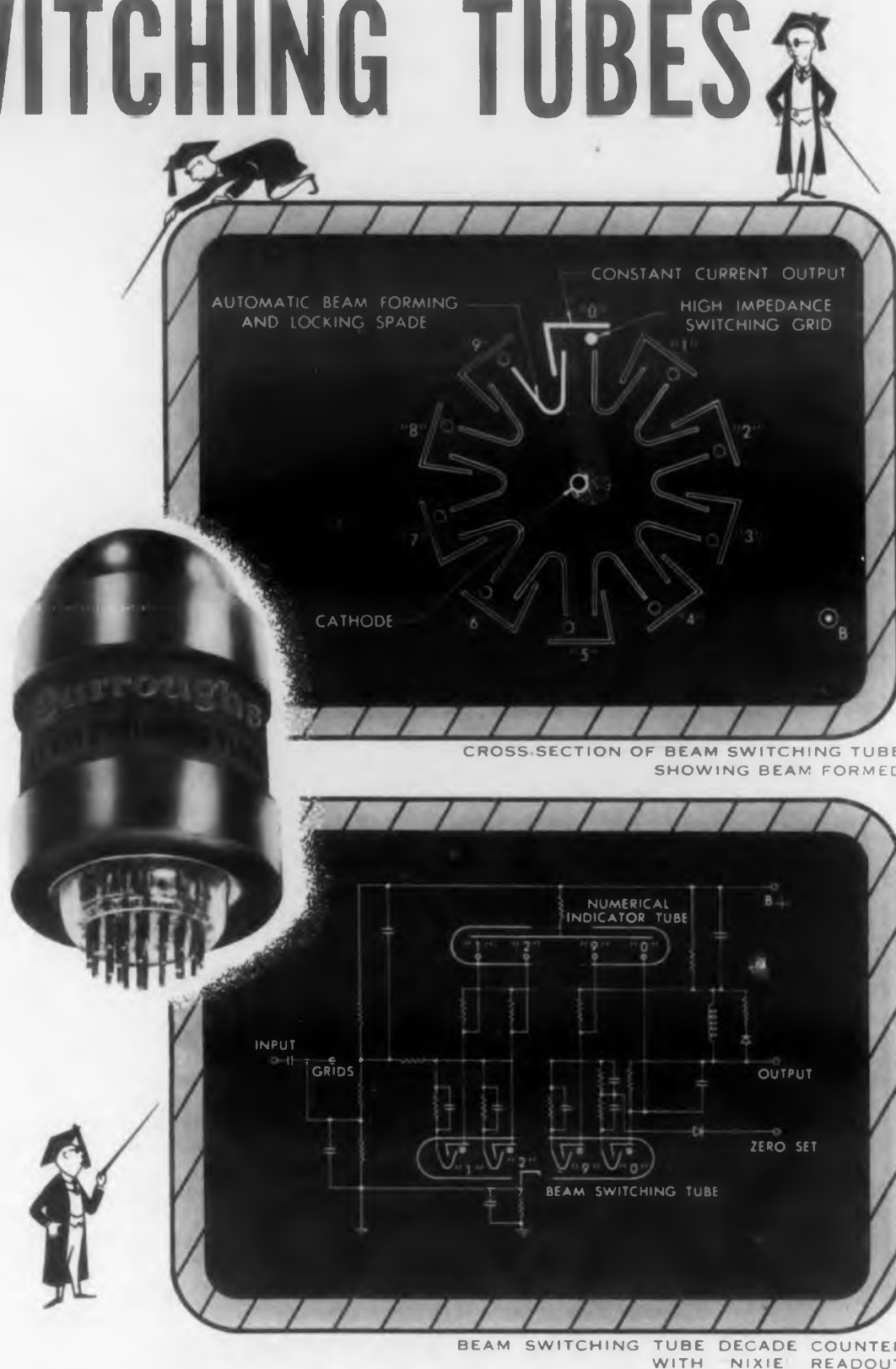
VERSATILITY

Compatible with tubes, transistors, cores, thyratrons, relays, Nixie numerical indicator 6844, and other devices.

APPLICATIONS

Wherever there is electronic distribution or switching - i.e.:
Counting, Telemetering, Frequency Dividing, Timing, Sampling, Coding, Matrixing, or Controlling

Tubes to
Mil - E - 1/1058
Available



Write for further information on all tube types.

ANOTHER ELECTRONIC CONTRIBUTION BY
Burroughs Corporation

ELECTRONIC TUBE DIVISION

Plainfield, New Jersey

ENGINEERING REVIEW

Automatic Indoor Lighting Control

In commercial buildings, this new lighting control system can save up to 80 per cent on lighting costs. Phototubes measure incoming daylight and turn artificial lighting on or off in proper amounts to maintain desired illumination in work areas. The system which can dim incandescent or fluorescent lights was developed by Minneapolis-Honeywell Regulator Co.

Microwave Eye Sees Ground Picture

A new electronic device which can "see the ground" and which may be the definite piece of equipment to permit fliers and navigators to make genuinely blind landings with aircraft, has been evolved in the "Eyatron," announced by the Diamond Antenna and Microwave Corp., Wakefield, Mass.

The unit researches by this firm slices through any kind of weather obstructions, such as fog or smoke, and comes up with a detailed picture of what's ahead. It gives a reproduction of the scene exactly as it would be viewed by the human eye under ideal conditions; not the pips of light with which radar outlines an object. The "Eyatron" could be the missing link of present-day radar systems, filling the short-range gap where radar functions imperfectly.

The device sees by means of microwave radio waves into visible light, so that the system can reproduce the vision of the human eye electronically. This translation of radio waves into visible light produces lifelike images of objects and scenes "illuminated" by microwave energy. It has the ability to view from zero range to many miles. The short-range feature of the device

◀ CIRCLE 10 ON READER-SERVICE CARD

one of its most important commercial aspects.

The device is not radar, nor is its purpose to replace radar, and it does not work on an infrared basis. The chief use of the device will be in supplying the missing line of present radar systems; the area where radar is useless at close proximities and where radar-type presentation requires skilled operators for interpretation.

By use of various frequencies, color identity could be realized, improving recognition of objects in its field of view. Red and green navigation lights on an aircraft, for instance, could be distinguished.


Stereoscopic effects to provide either natural or enhanced depth perception to the produced picture could be utilized. It can be employed in much larger installations as early warning systems and could transmit views through cables to stations hundreds of miles distant.

Self-Service Telegraph Office

If you happen to be in New York's West Side Air Terminal, you can send a telegram anywhere without talking to anyone and without cash. You write our your message and push a button on a facsimile machine. Transmission to a Western Union office is automatic, and charges are billed later to your home or business address. If you're rushing to catch a plane, you can send a telegram in seconds. There's no loss of time or searching for the right change.

Called the Autofax, the installation is the first "no coins needed" telegraph transmitter designed to make telegram-sending by the public easy, simple, automatic. Western Union hopes that the wire-now-pay-later feature of Autofax will meet with sufficient popularity (by honest people) to warrant installing machines in other public places.

CIRCLE 11 ON READER-SERVICE CARD ►



BURTON BROWNE ADVERTISING

EINSTEIN, INFINITY and the IONOSPHERE

Creative imagination took Einstein into a new widening concept of the nature of the physical universe.

At the National Co. creative imagination is continuing to broaden our mastery of the physical universe through the realization of such means of communication as Ionospheric Scatter systems.


The implications of these new means of communication are manifold and the applications multitudinous.

You, who enjoy such creative challenges to scientific and technical development, should talk to *National*.

National Co. *right now* affords engineers and physicists the opportunity to grow and establish prestige in such advanced fields as atomic frequency standards, multipath transmission, noise reduction and correlation techniques, Tropospheric scatter systems, Ionospheric scatter systems, molecular beam techniques for signal processing, and long range microwave transmission.

At National Co. in the heart of New England electronics, you can associate with a company in which creativity is required, recognized and rewarded.

Write or phone

tuned to tomorrow **National** 

The National Company, Inc.

Malden, Massachusetts

First From PHILCO

New Micro-Miniature Transistor Family

shown here actual size

★ High Voltage

★ High Beta

★ Excellent Switch

★ Low Saturation Voltage

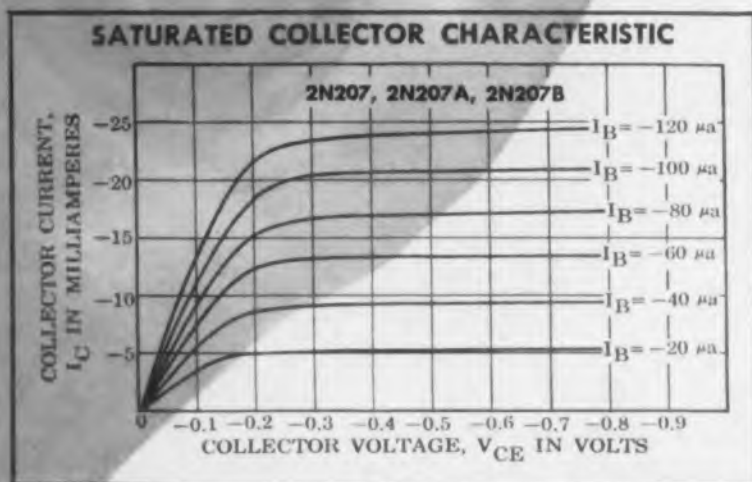
★ Outstanding Performance

Here is a completely new family of micro-miniature transistors, featuring proven reliability in industrial control systems, miniature hearing aid amplifiers, computers and business machines, direct-coupled amplifier and switching circuits, and audio output for miniature radios.

Among these six new transistors will be found the low-cost answer to a tremendous variety of important transistor problems. Our engineers will be happy to discuss specific applications with you.

Make Philco your prime source of information for all transistor applications.

Write to Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa., Dept. ED-158



MICRO-MINIATURE FAMILY APPLICATION DATA					
MAX. DISSIPATION = 50 MW.					
TYPE	MAX. RATING		TYPICAL PERFORMANCE		
	V_{CE} max.	I_C max.	f_{ab}	h_{fe}	NOISE FIGURE
2N207	12	20 ma		100	12 db
2N207A	12	20		100	9 db
2N207B	12	20		100	4 db
2N534	50	10		100	
2N535	20	20	2.0 mc	100	12 db
2N536	20	30	2.0 mc	$V_{BE} = 0.3v$ and $V_{CE} = .06v$ with $I_C = 10$ ma $I_B = 1$ ma	

PHILCO CORPORATION
 LANSDALE TUBE COMPANY DIVISION
 LANSDALE, PENNSYLVANIA



ENGINEERING REVIEW

Department Store Computer Eliminates Sales Books

A fully automated data processing system for department stores records a customer's transactions in as little as 10 sec. Daily totals are computed at the rate of 225 digits per second on this computer designed by the Clary Corp., San Gabriel, Calif. Although presently installed in department stores, the system also is applicable to retail control in other lines of business as well as industrial management through cost, production and inventory control.

A transactor writes customer's sales checks, eliminating sales books and hand-written receipts. Simultaneously, it prints by means of an electronic punch all sales information on "common language" tape which can be processed by a computer or punch cards. This tape, when fed through an electronic brain, provides the retail store with a complete picture of its daily business in hours rather than the days and even weeks it now requires.

Portable "TEW" Line

Sperry Gyroscope Co. of Great Neck, N. Y. has been awarded a contract to develop a new, highly portable, Tactical Early Warning system for the Marines. The new, long-range, search and height-finding radar system will detect close-in or distant high-speed enemy aircraft and missiles.

The AN/MPS-21 radar system, though only about one quarter the size and weight of conventional radar systems, has extended detection range and accuracy. By incorporating detection and height determination, the MPS-21 can replace two present radar systems.

The entire system can be transported by helicopter, cargo-type aircraft, truck, or amphibious vehicle, and can be brought into operation in two hours.

◀ CIRCLE 12 ON READER-SERVICE CARD

Signal Corps and Hams Hold on-The-Air Talks

The first U. S. Army Military Affiliate Radio System (MARS) Technical Net will officially begin operation early next January with the first of a series of technical symposiums for amateur radio operators. The net will operate on a single sideband on 4030 kilocycles each Monday evening at 9 p.m. (EST) beginning January 6, 1958.

The Army MARS network is a secondary means of communication for the Army in the event of a national emergency or disaster. Members are amateur radio operators from all parts of the United States as well as official Army Signal Corps stations.

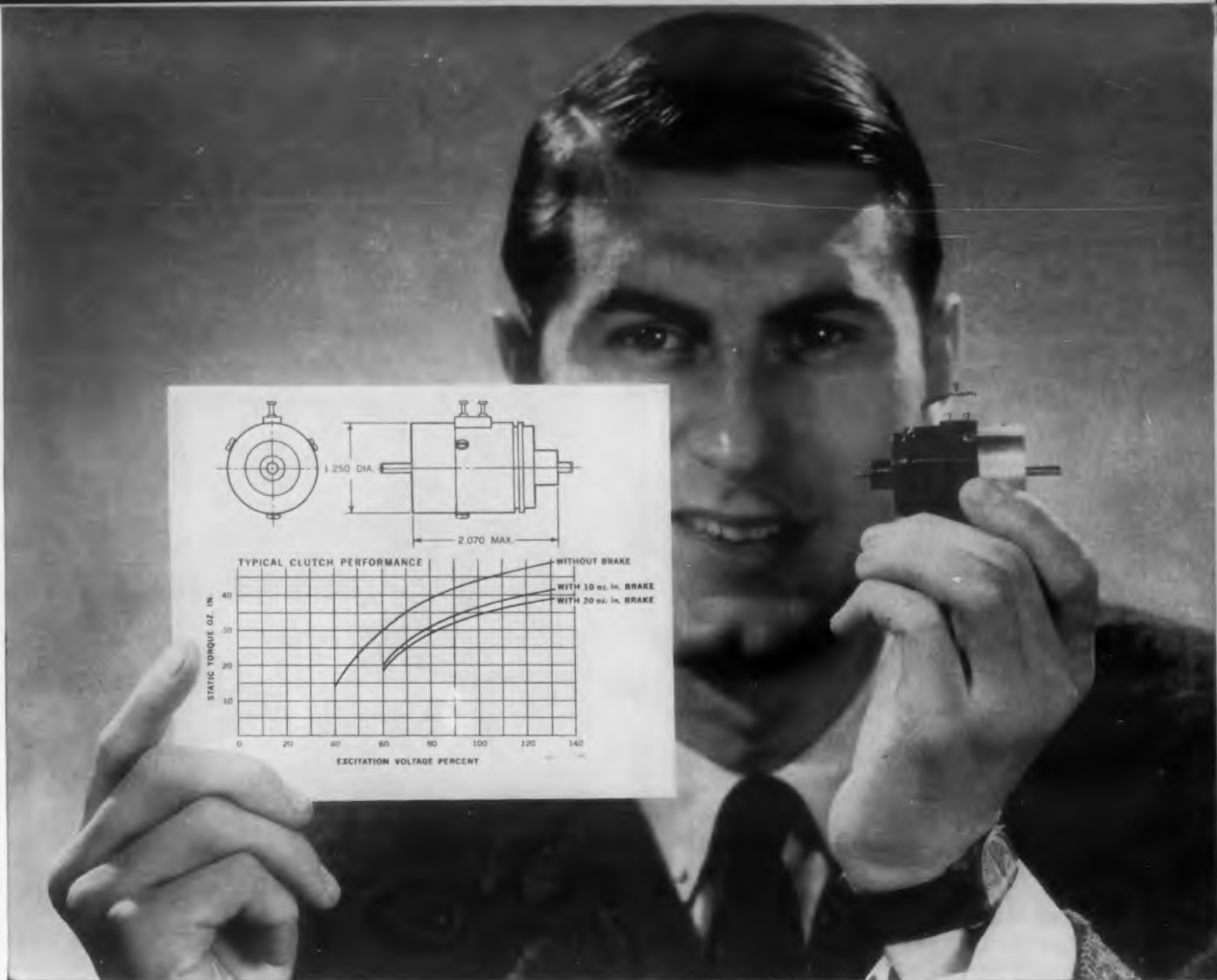
The technical symposiums will be conducted after members report into the net. After clearance of Army business, selected speakers will give talks each Monday, followed by a question and answer period. Orderly radiophone procedure will be used during this portion of the symposium.

Follow the Weather with a Portable Radar

Conversion of the AVQ-10 airborne weather radar to a compact, easily-operated commercial ground unit means almost anyone can be a weather expert. The new unit, developed by the Radio Corporation of America at Los Angeles, Calif., quickly and accurately displays weather conditions at distances up to 150 miles. The unit should prove particularly valuable in airport weather surveillance, in determining television and radio station transmission characteristics, and for construction projects and off-shore drilling operations.

The ground weather radar makes it possible to view and track storm fronts, thunderheads, squalls, heavy cloud formations, and other forms of precipitation and weather disturbances. The extent of rainfall and other characteristics can be determined from the information displayed on the viewing screen.

CIRCLE 13 ON READER-SERVICE CARD ➤



GLOBE MINIATURE CLUTCHES & CLUTCH-BRAKES RELIABLY HANDLE LOADS FASTER THAN 1ms

We can say with confidence that Globe clutches and clutch brakes are the best that money can buy. In 4 years of production we have deliberately refined and simplified the design. Result: reliability, maximum performance and design freedom.

Epoxy potted coil is moisture and vibration proof, stable to 125° C. Precision ABEC 5 ball bearings are standard.

PARAMETERS	ENGAGEMENT TIME	RELEASE TIME
Standard Clutches	14 ms.	2 ms.*
Special Clutches	4 ms.	2 ms.*
Standard Clutch Brakes	14 ms.	14 ms.
Special Clutch Brakes	5 ms.	5 ms.
Special units with built-in loads, such as a potentiometer	4 ms.	less than 1 ms.

*when application requires

In general, we can improve either engagement or release time, but not both together. Options include voltage choice, input-output shaft position choice. Because standard parts for Globe units are inventoried, and clutch design a specialty, you get prototypes within weeks! Inquire from the largest miniature motor manufacturer first. Globe Industries, Inc., 1784 Stanley Avenue, Dayton 4, Ohio. Telephone Baldwin 2-3741.



WASHINGTON REPORT

Congress Looks at Research

Rep. Wilbur Mills (D-Ark.) and his Subcommittee on Fiscal Policy are looking into the economic effects of Federal expenditures for research and development. This is their duty as part of the Joint Economic Committee of Congress as dictated in the Employment Act of 1946.

A distinguished panel of experts presented their views to them recently. They concluded that R & D induces obsolescence. It also creates, at the same time, new or improved products and increases efficiency. However, according to E. Finley Carter, Director of the Stanford Research Institute, "we need to recognize that science is a key factor in our country's welfare and security . . . we need to establish at the highest level of the Federal Government a permanent mechanism to insure consistent, continuous, and long-term attention to all aspects of science."

All of the panel members recommended more money for research and continuity of programming. Here are some of the specific comments and suggestions made by several.

Former Assistant Secretary of Defense (R & E) Frank Newbury called on his experience in the Department to marshal up an attack on the present system.

According to his calculations, more than \$9 billion is spent on R & D annually in the United States, but less than \$300 million is spent on basic research for purely scientific ends. A large portion of that money comes from the Department of Defense. But, in Newbury's opinion, "ten years' experience has demonstrated the futility of expecting effective and economic control of expenditures through virtually voluntary coordination by the three military departments. Formal review and approval of R & D programs and projects by Coordinating Committee on which military departments have the major representation has been ineffective. (They) sit as judge and jury in the review of their own programs and projects."

F. G. Hill and M. H. Baker of the University of Buffalo approached the problem from a broad aspect. They proposed "A National Science Act should be passed creating a Council of Scientific Advisers in the Office of the President, a Joint Committee on Science Policy in the Congress, and a President's Advisory Committee on Science."

The proposed Council would "make an annual appraisal and report concerning the trends, prob-

CLASS A FILMS

Formvar
Nyform
Sodereze®
Enamel
Bondex®
Grip-eze*

CLASS H

Daglas®-Silicone
Class "H" film wires
Film-Daglas®-Silicone
combinations.

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FILMS

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Other Polyesters

FABRICS

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Film-Daglas®
combinations.

Consult Phelps Dodge for

MAGNET WIRES THAT SUGGEST IMPROVED INSULATION SYSTEM DESIGNS !

Here are basic magnet
wires with proven experi-
ence in a wide variety of
applications and unlimited
potential for the future.

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

PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 14 ON READER-SERVICE CARD

lems, long-run needs, and desirable policy changes in Federal research activities. This report and the President's recommendations could then be considered by the Joint Committee, which could suggest general legislative changes for the attention of the appropriate committees.

"The greatest liaison should be maintained with the Bureau of the Budget, which exercises budgetary and administrative review over the Federal research programs, and with the National Science Foundation, which makes detailed surveys of research progress and needs in the various scientific fields."

R. E. Burgess of the American Cynamid Company told the Committee that he believes we are now in a research crisis.

"We must realize that our supply of creative genius is at present fully utilized. To accomplish more basic research we must, therefore, reallocate this scarce resource and, in the absence of coercion or voluntary action taken for patriotic reasons, this shift will have to be accomplished through competitive bidding for research time. It will probably mean rising research costs for Government since achieving offsetting economies in Federal non-defense research programs would seem to be at least questionable. . . . If increased research spending creates a budgetary problem, the required additional funds should be made up out of savings in domestic, non-research, non-defense spending."

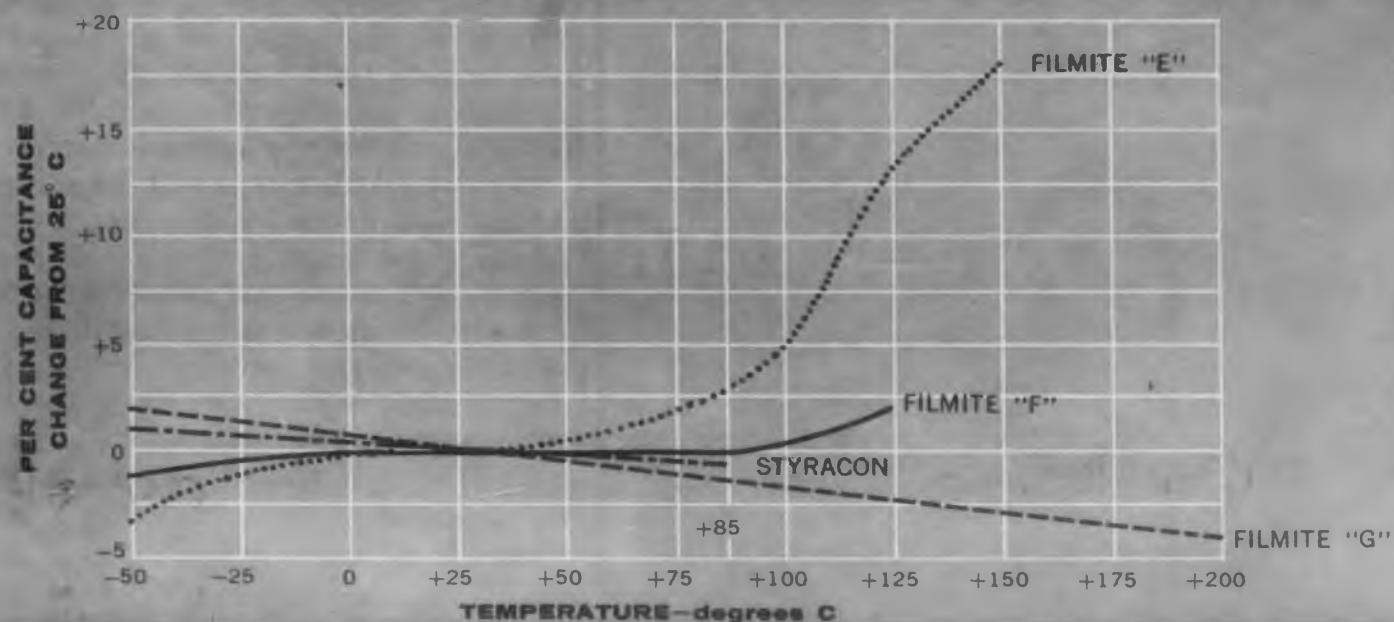
FM Reallocation Rumors Squelched

The Federal Communications Commission makes note that it has received numerous inquiries and protests on the possible reallocation of the FM Broadcast band to other services. These protests have apparently come from both the general public and from members of Congress.

The FCC believes the flood of inquiries it received was prompted by the announcement of an investigative fact finding hearing. This was instituted by the Commission's own motion for the purpose of obtaining the views of the public regarding allocation of frequencies between 25 mc and 890 mc and the possible need for changes in the allocation of such spectrum space.

Many comments have been received by the Commission in this matter. Hearings have been held and statements have been filed. In fact, the period for filing had been extended from June to November 25, 1957. However, no decision has been reached as to how these frequencies shall be allocated. In a later action, the Commission ordered the splitting of channels in the 42.0 to 46.51 and 47.0 to 49.51 mc bands. But this has little bearing on the overall issue of who is to use the higher frequencies and in what manner.

TYPICAL CAPACITANCE vs TEMPERATURE CHARACTERISTICS at 1000~



	STYRACON (85° C)	FILMITE "E" (150° C)	FILMITE "F" (125° C)	FILMITE "G" (200° C)
RATINGS	.001 to 1.00 μ F 50 to 600 WVDC	.001 to 1.00 μ F 200 to 2500 WVDC	.001 to 1.00 μ F 200 to 600 WVDC	.001 to 1.00 μ F 200 to 600 WVDC
STYLES	tubular metal cases screw-neck cases drawn metal cases	tubular metal cases screw-neck cases	tubular metal cases screw-neck cases "bathtub" cases	tubular metal cases screw-neck cases drawn oval cases
WRITE FOR TECHNICAL DATA	Engineering Bulletin No. 2510	Engineering Bulletin No. 2410	Engineering Bulletin No. 2560	Engineering Bulletin No. 2610

4 kinds of film dielectric capacitors for specialized applications

Here are four plastic-film dielectric capacitors now in regular production at Sprague:

STYRACON CAPACITORS find wide application in laboratory equipment and in industrial controls where their low dielectric hysteresis (low "soak"), high insulation resistance, high "Q", low and linear temperature coefficient of capacitance are of great value.

FILMITE "E" CAPACITORS are general-purpose capacitors for use up to 150°C where capacitance stability with temperature is of secondary importance. They are also used at lower temperatures where very high insulation resistance is a prime requirement.

FILMITE "F" CAPACITORS are intended for use in circuits where

the absolute minimum in capacitance change with temperature is a must and relatively large capacitance values are used. These capacitors typically will be within .05% of their 25°C value from -10°C to +85°C. They may be used up to 125°C where greater capacitance excursion is tolerable.

FILMITE "G" CAPACITORS have the highest temperature rating of any organic dielectric. They may be used up to 200°C! All units are nickel-plated to withstand high temperature corrosion. They also have the highest insulation resistance, the lowest dielectric hysteresis, and the lowest dissipation factor of any capacitor made so that they are often used at lower temperatures which are above the 85°C limit of the lower-cost Styracon Capacitors.

CAPACITANCE VS. TEMPERATURE CHARACTERISTICS of all four types of film capacitors are compared in the chart above for the benefit of the circuit designer.

ALL SPRAGUE FILM CAPACITORS are designed to have positive electrical contact between leads and electrodes, even at low operating voltages.

WRITE FOR ENGINEERING BULLETINS on the Sprague plastic-film capacitors in which you're interested. Address your letter to Sprague Electric Co., Technical Literature Section, 347 Marshall Street, North Adams, Mass.

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CIRCLE 16 ON READER-SERVICE CARD

MEETINGS

Jan. 27-28: Sixth Scintillation Counter Symposium

Hotel Shoreham, Washington, D.C. Sponsored by the IRE, AIEE, AEC, and NBS. There will be four half-day sessions covering Phosphor and Crenkov Scintillators; Photomultipliers; Energy and Time Resolution; and Scintillation Counter Applications. Papers on components, equipments and applications will be read. Write IRE, 1 E. 79th St., New York 21, N.Y., for information.

Jan. 27-Mar. 10: Monday Evening Lecture Series on Modern Circuit Theory from an Elementary Point of View

Western Union Bldg., 160 W. Broadway, New York City. Jointly sponsored by the IRE Professional Group on Circuit Theory and the AIEE Basic Science Division. Starting with Jan. 27 and ending with Mar. 10 there will be a lecture every Monday evening at 7:00 p.m. Registration must be made in advance. Tickets will not be sold at the door.

Jan. 28-31: Fourteenth Annual National Technical Conference of the Society of Plastics Engineers

Sheraton-Cadillac Hotel, Detroit, Mich. The theme of the conference will be "Progress Through Plastics Engineering." Its sessions will deal with radiation and plastics, epoxy resins and embedment, extrusion, injection molding, education, packaging, plastic tooling, mold design, new materials, test methods, reinforced plastics, color and finishing, foams, compression molding, sheet forming, and research. For further details write to Lewis A. Bernhard, Society of Plastics Engineers, Inc., Suite 116-18, 34 E. Putnam Ave., Greenwich, Conn.

Feb. 2-7: AIEE Winter General Meeting

Hotel Sheraton McAlpin, New York, N.Y. The meeting will feature the largest technical program in the history of the Institute. Sessions of special interest to the electronic design engineer are listed below.

Mon. a.m., Feb. 3

ELECTRONIC TRANSFORMERS

Papers are on computer design; reliability of transformers; and high temperature electronic transformers.

MAGNETIC AMPLIFIERS

A magnetic saturable core timing device; core reset functions; magnetometers; and fast response magnetic amplifiers are topics.

Tues. a.m., Feb. 4

ELECTRON TUBE DEVELOPMENTS

Papers on low-mu triodes; high temperature ceramic voltage regulators; ceramic hydrogen thyratrons; and a reliable X-band beacon magnetron.

Tues. p.m., Feb. 4

ELECTRON TUBE EVALUATION PROGRAM

Various specific programs will be discussed.

MAGNETIC AMPLIFIERS

Among others, there will be papers on transactors; a self-saturating transformer; and applications of non-linear magnetics.

Wed. a.m., Feb. 5

LINEAR TRANSISTOR APPLICATIONS

Includes temperature stabilization; an analog frequency measuring circuit; a transistor phase locked oscillator; active filters; and transistor bias design.

Wed. p.m., Feb. 5

COMMUNICATION THEORY

Topics of papers are: entering the machine domain; recent progress in applying information theory to digital transmission systems, binary communication feedback systems; binary symmetric decision feedback systems; and an experimental study of a binary code.

THEORY AND DESIGN OF SWITCHING CIRCUITS

Papers will cover circuit simplification; transients; and calculating response time from characteristic curves. Specific circuits discussed are multivibrator pulse generators; hook transistor configurations; and transistor linear delay circuits.

SYMPOSIUM ON RADIATION EFFECTS ON MATERIALS

Subjects are radiation damage to insulators; radiation effects on electronic components; the Argonne high level gamma irradiation facility; and the effect of in-pile radiation on a ceramic triode.

Thurs. a.m., Feb. 6

FEEDBACK CONTROL SYSTEMS, COMPUTING DEVICES

Topics are a statistical design theory for digital controlled continuous systems; the use of a sine-wave encoder; accuracy limitations of a geared

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Accuracies not exceeding 7 minutes max. of error are guaranteed.

A full line of size 8 rotary components is available including AC and DC motors, linear transformers and motor generators.

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TYPICAL SYSTEM MEASUREMENTS

	Input		Output		Sensitivity (MV/deg)	IMPEDANCE		Phase Shift (deg)	Remarks
	Voltage (Volts)	Current (Amps)	Power (Watts)	Voltage (Volts)		Input	Output		
Transmitter - Control Transformer	26	111	28	22.5	100	58 (279)	405 (223)	18	High impedance load on CT
Transmitter - Control Transformer	26	111	27	21.8	110	55 (275)		18	50 load on CT
Transmitter - Distrib. Transformer	26	110	80	28.2	110	64 (221)		17	1" load on CT
Transmitter - Differential - CT	26	108	1.08	19.3	140		140 (364)	40	Output to High Impedance
Electrical Receiver - Electrical Receiver	11.8	115		1	100			50	Input to Motor
Electrical Receiver - Electrical Receiver	26			25	100			53	Input to Motor

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HIGH STABILITY
FOR -55°C to $+85^{\circ}\text{C}$ OPERATION
HIGH CAPACITANCE
SUBMINIATURE SIZES
LONG SHELF LIFE

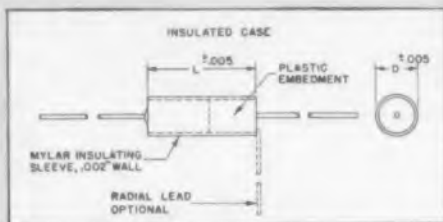
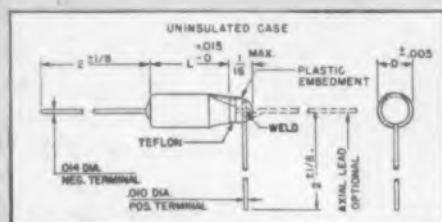


SERIES TW WIRE-TYPE TANTALUM CAPACITORS

These new subminiature, wire-type units feature greater capacitance per unit volume, lower leakage current and power factor, and small capacitance drop at extremely low temperatures as compared to other types of electrolytics. Ultrasmall for low-voltage DC transistorized electronic equipment, these new tantalum capacitors have *high stability, high capacitance, long shelf life, and excellent performance* under temperature extremes of -55°C to $+85^{\circ}\text{C}$. Available in eight subminiature sizes; 0.1 to 80 mfd. over-all capacitance range.

SIZE	UNINSULATED		INSULATED	
	D (Inches)	L (Inches)	D	L
*T	.075 ($\frac{3}{64}$)	.156 ($\frac{5}{32}$)	.082	.203
*S	.075 ($\frac{3}{64}$)	.187 ($\frac{3}{16}$)	.082	.234
*M	.095 ($\frac{3}{32}$)	.172 ($\frac{11}{64}$)	.100	.218
*A	.095 ($\frac{3}{32}$)	.250 ($\frac{1}{4}$)	.100	.312
*B	.125 ($\frac{1}{8}$)	.312 ($\frac{5}{16}$)	.134	.375
C	.125 ($\frac{1}{8}$)	.500 ($\frac{1}{2}$)	.134	.562
D	.125 ($\frac{1}{8}$)	.625 ($\frac{5}{8}$)	.134	.687
E	.125 ($\frac{1}{8}$)	.750 ($\frac{3}{4}$)	.134	.812

Smallest size is .075 ($\frac{3}{64}$) x .156 ($\frac{5}{32}$) inches; the largest is .125 ($\frac{1}{8}$) x .750 ($\frac{3}{4}$) inches. Five stock sizes (*) are available in a wide range of capacitances and voltages. Units insulated with a tough Mylar® plastic sleeve can be furnished. Write on company letterhead for Bulletin 148B.



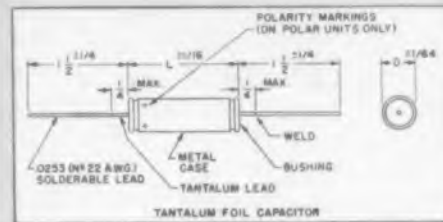
SERIES TF FOIL-TYPE

These capacitors are tantalum foil, electrolytic units designed for low voltage AC and DC applications where small size, top performance, and stability of electrical characteristics are required. Units feature unusually long shelf and operating life.

CASE SIZE	D*	L*
J	$\frac{3}{16}$ "	$1\frac{1}{16}$ "
K	$\frac{1}{8}$ "	$\frac{7}{8}$ "
L	$\frac{3}{8}$ "	$1\frac{7}{16}$ "

*Add $\frac{1}{16}$ " to L and $\frac{1}{32}$ " to D when insulating sleeve is used.

Three sizes now available; .25 to 140 mfd. over-all capacitance range. Standard tolerance is $\pm 20\%$. Working voltage up to 150 volts. Polar and nonpolar units are available. Bulletin 152. Design and construction meet military specification MIL-C-3965, paragraph 3.3.



MEETINGS

up encoder; the effect of quantization in sampled-feedback systems; and the stability of finite pulsed feedback systems.

RADIATION EFFECTS ON DIELECTRICS

The session will cover the effects of gamma radiation on silicone dielectrics; a method for the evaluation of radiation damage to the mechanical properties of plastics; the effects of gamma radiation at high temperatures on the engineering properties of elastomer materials; and conductivity induced in insulating materials during gamma irradiation.

Thurs. p.m., Feb. 6

TRANSISTORS IN FEEDBACK CONTROL SYSTEMS

To be discussed are stability considerations in the design of large feedback junction transistor amplifiers; transistor performance in choppers; switching transistors and saturable reactors in a high-performance servo; and compensating saturation in feedback control systems by excess error storage.

THINKING MACHINES OF THE FUTURE

Among other papers, there will be one of the future matching of man and machine.

Fri. a.m., Feb. 7

SEMICONDUCTORS

Topics will be thermoelectric heat pumping; thermoelectric power generation; and a 1-watt solar power plant.

Fri. p.m., Feb. 7

FEEDBACK CONTROL SYSTEMS

There will be papers on the sensitivity of the poles of a linear, closed-loop system; limiting values of driving point impedances and transfer functions due to component variations; gain variations in an output rate stabilized servomechanism; a time-varying analysis of a guidance system; and the use of phase space in transient stability studies.

COMPUTERS IN DESIGN

Papers will cover applying digital computers to engineering problems; applying digital computers to the design of electrical apparatus; and a computer procedure for the design of optimum systems.

For more information, write the AIEE, 33 W. 39th St., New York 18, N.Y.

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CIRCLE 18 ON READER-SERVICE CARD

Feb. 3-4: Flight Control—Panel Integration Symposium

Biltmore Hotel, Dayton, Ohio. Sponsored by the USAF, Flight Control Lab., WADC. Philosophy of flight instrumentation, system integration, and many other topics will be covered. For reservations and program information write to John H. Kearns, Box 942, Dayton, Ohio.

Feb. 3-4: Instrument Society of America National Conference on Progress and Trends in Chemical and Petroleum Instrumentation

Wilmington, Del. For information and advance programs write to H. S. Kindler, Director of Technical Programs, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

Feb. 4-6: Thirteenth Annual Technical and Management Conference of the Reinforced Plastics Div. of the Society of the Plastics Industry, Inc.

Edgewater Beach Hotel, Chicago, Ill. The basic theme for the 18-session program will be the new and improved in materials, test results, quality controls and processing techniques. There will be papers in reinforced plastics tooling, industrial design, speed-temperature-radiation behavior of reinforced plastics, the development of reinforced plastic motors, filament winding, quality control of electrical applications, and other subjects. For information, write George L. Smead, Manager, Reinforced Sales, L-O-F Glass Fiber Co., 1810 Madison Ave., Toledo, Ohio.

Feb. 14-15: 5th Annual Cleveland Electronics Conference

Masonic Auditorium, Cleveland, Ohio. Sponsored by the Cleveland chapters of the IRE, AIEE, ISA, and Cleveland Physics Society, in cooperation with Case Institute of Technology and Western Reserve University. For details write C. T. Greenleaf, Conference Chairman, Cleveland Electronics Conference, 14700 Detroit Ave., Cleveland 7, Ohio.

Feb. 18: Fourteenth Annual Quality Control Clinic

War Memorial, Rochester, N. Y. Sponsored by the Rochester Society for Quality Control. The 20 technical papers to be read will cover all phases of quality control and industrial statistics. Exhibits of the latest equipment for data processing and electronic and mechanical gaging and measuring will be demonstrated throughout the clinic. For full details write to Edward F. Wintekorn, Eastman Kodak Co., Navy Ordnance Div., 50 Main St. W., Rochester 14, N. Y.

Extended Life and High Stability at 125°C

Please note extra performance features

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616G - 617G - SUBMINIATURE MYLAR* Dielectric CAPACITORS

NEW

This ruggedly designed capacitor is a standout for stability after thousands of hours at 125°C... field tested under the severest military conditions.

NEW

A superior capacitor element rated for accelerated life testing twice that applied to conventional metal enclosed tubulars.

NEW

Formed Mylar insulators prevent leakage to the case and contribute to the high IR which characterizes these designs. *DuPont's trademark for polyester film.



SPECIFICATIONS

Long Term Stability—Extensive testing indicates capacitance change is less than 1% after 5000 hours operation at rated voltage and 125°C

Life Test—500 hours at 125°C and 125% of rated voltage

Insulation Resistance—See curve below for typical performance

Temperature Immersion—Meet requirements of MIL-C-25A for 125°C (Characteristic K)

Mechanical Properties—Meet all requirements of MIL-C-25A

Capacitance Change with Temp.—See curve below for typical performance

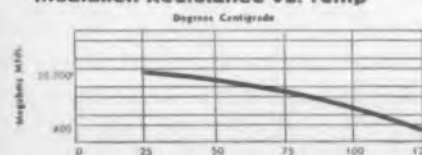
616-G (One Lead Grounded to Case)

Cap. In. Mfd.	50V	150V	400V
.001	.173 x 1/8	.173 x 1/8	.193 x 1/8
.0047	.173 x 1/8	.193 x 1/8	.233 x 1/8
.01	.193 x 1/8	.233 x 1/8	.312 x 1/8
.047	.312 x 1/8	.400 x 1/8	.562 x 1/8
.1	.400 x 1/8	.562 x 1/8	.800 x 1/8

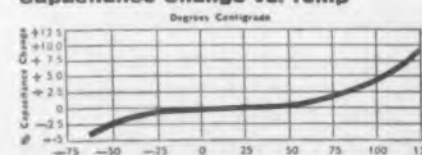
617-G (Both Leads Insulated From Case)

Cap. In. Mfd.	50V	150V	400V
.001	.173 x 3/16	.173 x 3/16	.193 x 3/16
.0047	.173 x 3/16	.193 x 3/16	.233 x 3/16
.01	.193 x 3/16	.233 x 3/16	.312 x 3/16
.047	.312 x 3/16	.400 x 3/16	.562 x 3/16
.1	.400 x 3/16	.562 x 3/16	.800 x 3/16

Insulation Resistance vs. Temp



Capacitance Change vs. Temp



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CIRCLE 19 ON READER-SERVICE CARD

J. Caroline of Bell Telephone Labs with PW board used for determining current-carrying capacity.



Current-Carrying Capacity

of

Printed Wiring

J. Caroline

Bell Telephone Laboratories, Inc.

THE SIZE of a printed conductor on a printed circuit board has usually been determined by picking a cross-sectional area equivalent to that of a conventional insulated wire, and then "making it a little wider." A more rigorous approach to design was desired. The factors involved are delineated herein, test procedures are described, and conclusions are drawn from the results obtained.

Conventional Wiring vs Printed Wiring

The insulated wire in a conventionally wired chassis is usually terminated between two soldering posts as terminals. The ultimate temperature of the wire caused by current through it is a function of its cross-sectional area, length, ambient temperature, and the thermal conductivity characteristic is determined by the insulation and the change in resistivity. In a printed wiring assembly the conductor is firmly cemented to a thermosetting-laminate or ceramic base. The temperature rise of the conductor caused by the current is a function of its cross-sectional area, length, ambient temperature and the thermal characteristics of the base material. The limiting temperature is determined by the difference in thermal expansion of the materials, the thermal properties of the adhesive or bonding agent, the thermal properties of the base material, change in resistivity and the buckling temperature. Buckling occurs when the conductor expands faster

than the base and this breaks loose from the surface. When a ceramic base is used, the problem is usually confined to that of thermal expansion and resistivity. However, with plastics and laminates the problem is more acute.

Thermal Expansion Effects

Thermal expansion differs considerably for the various materials currently used for printed circuits. The adhesion between the conductor and the base material generally decreases with rising temperatures; the heat dissipation properties of the various base materials differ; and the physical properties of common base materials change with temperature more appreciably than for ceramics or metals and at lower ambients. Based on these characteristics, two sets of values should be established: 1. a safe current based on a fixed rise in conductor temperature, and 2. the maximum permissible current, based on the buckling temperature. Tests were made on various base materials to determine characteristics for rise-in-temperature versus conductor current for various thicknesses and widths of conductors.

Test Procedure

A test procedure was established for measuring the above-ambient temperature rise of printed-conductor test specimens for various fixed currents. The test specimens were constructed as shown in Fig. 1. The four conductors,

Relative current-carrying capacities of five PW base materials for a 10 C tested rise:

Material	Current Carrying Capacity for 10 C Rise Above Ambient
G-10	100%
XXXXP	95%
Teflon Glass	88%
XXX	87%
N-1	86%
XXXXP	82%

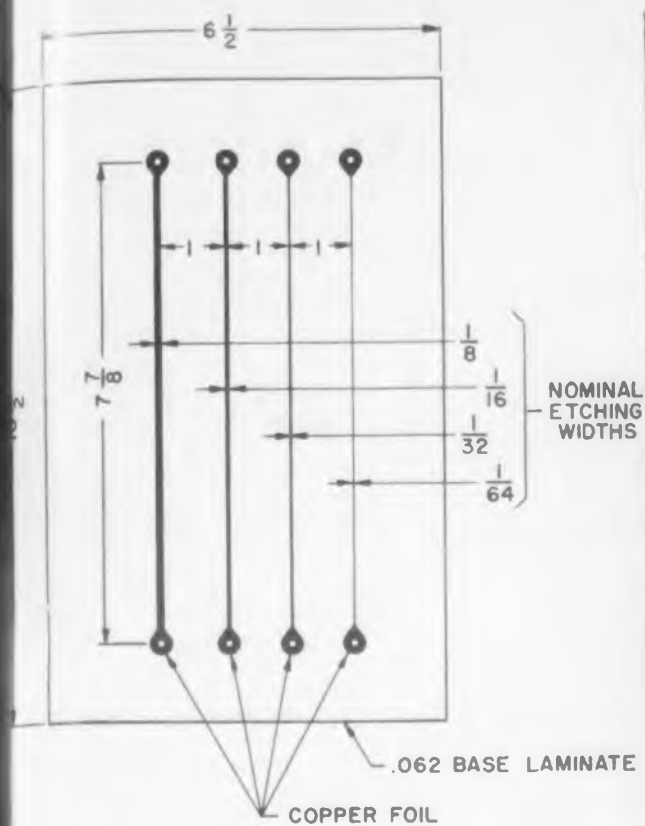


Fig. 1. Test board used in determining PW current-carrying capacity for a given temperature rise of base laminate.

of different widths, were located on one side of the board only. The test specimens were prepared from standard copper-clad laminates obtained from four suppliers—XXX paper base phenolic, XXXP hot-and-cold punching paper-base phenolic, N-1 nylon phenolic, G-10 epoxy glass, and Teflon glass. The ferric chloride etched foil method was used. Three samples were cut from each 36 x 42 in. sheet, one from each end and one from the center. Four weights of copper, 1, 2, 3, and 5 oz per sq ft, were used in combination with the various base materials.

The test circuit is shown in Fig. 2. The specimens were secured on a flat ceramic plate, and the printed conductors were connected to the circuit with screw-type terminals. Each conductor was tested individually starting with the narrowest one. A 6 v dc potential was impressed on the circuit, and the current was controlled with a slide wire resistor. The ultimate temperature of the conductor for various currents was measured by means of a thermocouple bridge and two copper-constantan thermocouples which were closely spaced at the center of the printed conductor under test. The potential drop across a 6 in. length of conductor was measured in each case and compared with calculated nominal values based on the dimensions in Fig. 1. Upon completion of the electrical test, the conductors were stripped from the insulating base and measured for thickness and width uniformity. This



Type F: Miniature 12-position, 30-60° throw, can be mounted in 1-5/16" circle; phenolic, Mycalex or steatite.



Type H: Standard 12-position; 1-7/8" diameter; 15-30-60° throw; phenolic, Mycalex or steatite.



Types J, K, N: 1-17/32" diameter; provides for flexibility of layout; interchangeable sections, phenolic or steatite.



Type L or DL: Using dual eyelet fastening; 18-position; mounts in 2-9/32" circle, phenolic, Mycalex.

Special Switches



Multiple Shafts combined to operate snap switches and potentiometers; many different section types.



Type MF: 24-position switch may be mounted in 2-5/16" circle; in phenolic insulation.



Series 20: Simple switch for tone controls, band switching, and talk-listen circuits.



For Printed Circuits: Special lug design for insertion into printed circuit boards.

an INFINITE VARIETY
from standard parts



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CHOPPERS
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WRITE FOR your copy of the OAK Switch Catalog which covers the most popular of OAK's standard switches.

Type 160 Rotary Slider: 7/8" height allows shallow chassis; leads are readily accessible.



Type 122: New type operated version of the standard OAK rotary switches.



Type 130 Pushbutton: Available with from one to 24 buttons, 32 contacts each button.



Type 80 Pushbutton: Very adaptable. Used in communication equipment; economical for less complex applications.

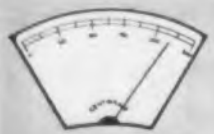


CIRCLE 20 ON READER-SERVICE CARD



Dipped in MOLTEN SOLDER... yet retains 100% reliability!

Most requirements for DALOHM RH and PH wire wound resistors will not be as severe as the molten solder dip shown above. But, here are the tough parameters RH and PH types will meet.



HI-TEMPERATURE
- 65° C to + 275° C



HI-PRECISION
± 0.05% to ± 3%



HI-WATTAGE
10 to 250 WATTS



HI-RESISTANCE
0.1 Ohm to 100K Ohms

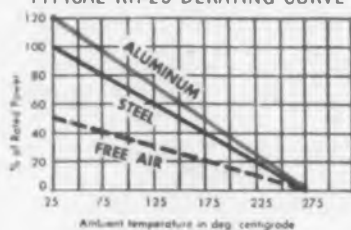
- Operating temperature range: - 65° C. to 275° C.
- Precision tolerance range: ± 0.05%, ± 0.1%, ± 0.25%, ± 0.5%, ± 1% and ± 3%.
- Powered at 10, 25, 50, 100 and 250 watts.
- Resistance range from 0.1 ohm to 100,000 ohms.
- Surpasses requirements of MIL-R-18546B
- Temperature coefficient: 0.00002/degree C.
- Complete protection from vibration, moisture and salt spray.
- Insulation breakdown: 1000 V AC or DC

DALOHM RH and PH resistors are advanced design wire wound precision power resistors for applications under severe operating conditions, coupled with tight space requirements. These miniature powerhouse resistors offer complete protection from mechanical shock, vibration, moisture and salt spray. DALOHM four point "ruggedized" construction provides 100% reliability with:

1. Precision wire wound resistor element.
2. All welded construction from terminal to terminal.
3. Suspension in special shock absorbing compound.
4. Insertion and sealing in radiator finned, anodized aluminum housing for maximum heat dissipation on panel mounting.

Careful advanced production techniques, backed by years of experience, and total progressive inspection assure reliability in all DALOHM resistors.

TYPICAL RH 25 DERATING CURVE



RH-TYPE

Lugs provided for horizontal mounting. Four wattages and sizes—RH 10, 10 watts; RH 25, 25 watts; RH 50, 50 watts; RH 250, 250 watts.



PH-TYPE

New hole mounted resistor. Two wattages and sizes—PH-25, 25 watts; PH 100, 100 watts.

JUST ASK US

DALOHM line includes a complete selection of precision wire wound, power and precision deposited carbon resistors. Also trimmer potentiometers, precision wire wound and deposited carbon; and collet fitting knobs. Write for free catalog.

If none of DALOHM standard line meets with your need, our engineering department is ready to help solve your problem in the realm of development, engineering, design and production. Just outline your specific situation.

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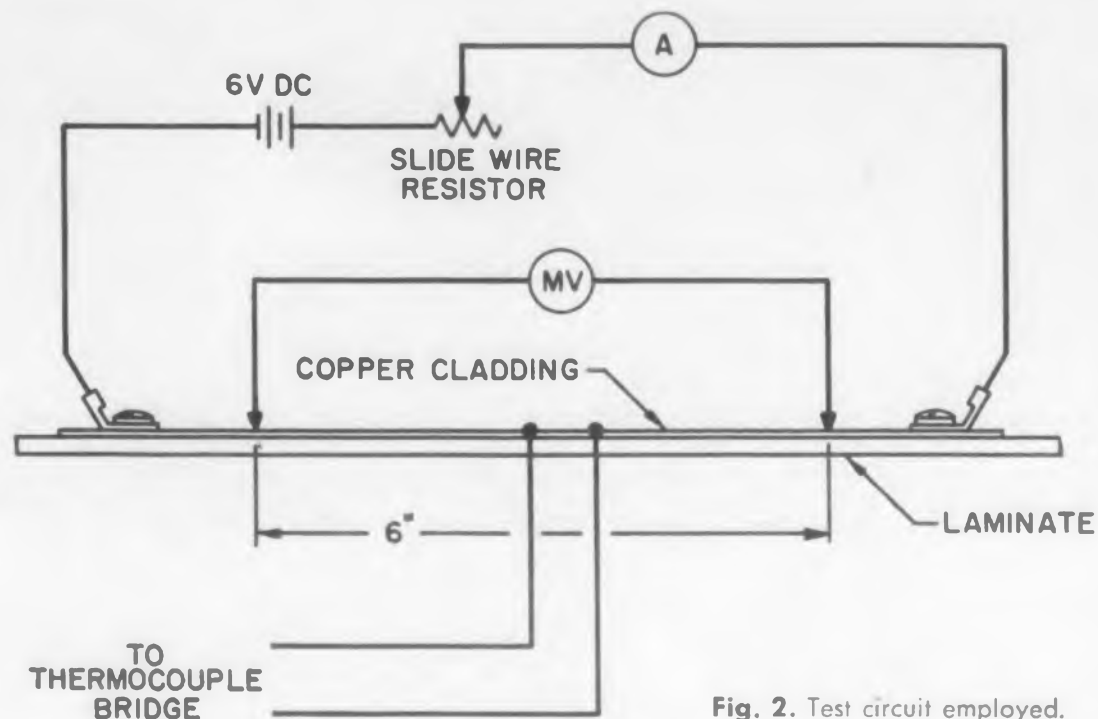


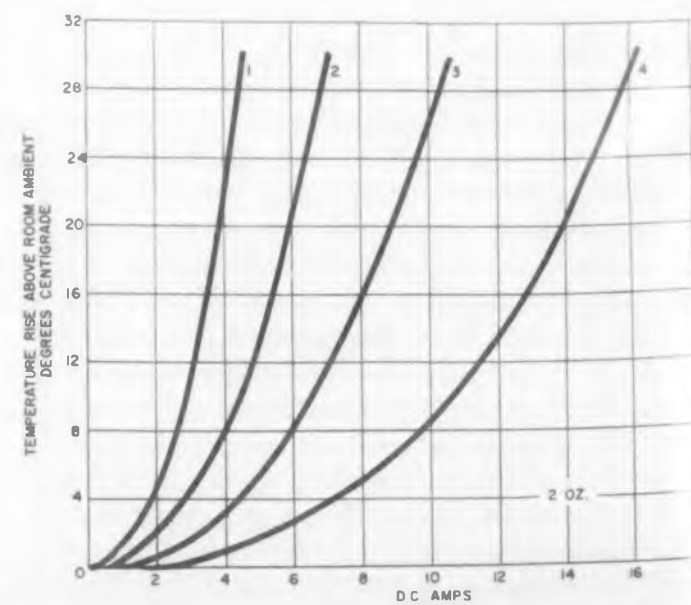
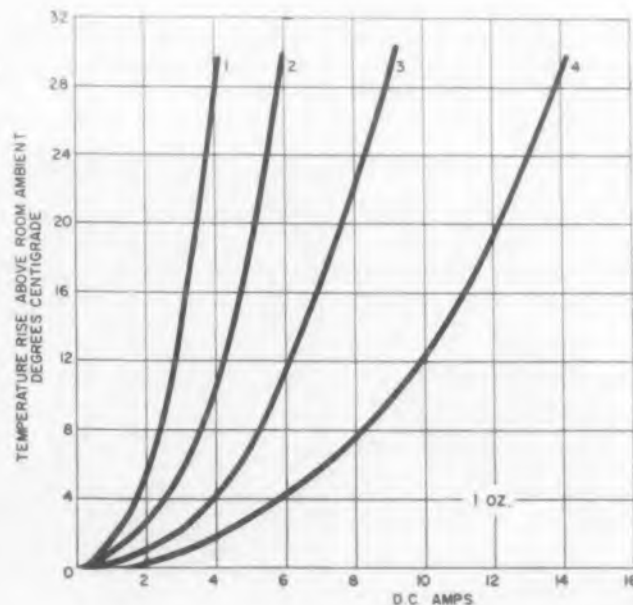
Fig. 2. Test circuit employed.

study was limited to 1/16 in. copper-clad laminates with 1, 2, 3 and 5 oz per sq ft nominal weight copper because it was the only material commercially available at the time. The copper facing of the base material was foil in all cases. It was electrolytically deposited and then stripped from a revolving lead drum in a continuous manufacturing process. Rolled foil is now becoming commercially available. The nominal thickness of the copper foil was 0.0014 in. for 1 oz, 0.0028 in. for 2 oz, 0.0043 in. for 3 oz, and 0.0067 in. for 5 oz per sq ft.

Findings

Curves were prepared as shown in the sample (Fig. 3). From these curves it was determined that current-carrying capacities of printed conductors could exceed values which are normally called safe limits for conventional insulated wire

of the same conductor area. This is primarily due to the large heat conduction surface of the printed conductor and the heat dissipation characteristics of the insulator. This could be better illustrated by comparing the various materials with respect to current-carrying capacity of the printed conductor. If the materials are compared at 10 C above ambient, using the cross-sectional area of the conductors as a parameter in computing the current densities, the insulator is seen to be a factor in establishing safe limits on current. For example: The conductor with the highest average current density (0.0591 amp per sq mil) was on the epoxy-glass laminate. If the same geometry is used with nylon phenolic as the base material, the average current density will be 0.0511 amp per sq mil. Thus the various materials could be compared qualitatively by assuming epoxy-glass laminate to have the optimum meas-



ured value of current density. Then the relative current-carrying capacity for a given rise in temperature in the conductor could be computed from the single relationship:

$$\frac{\text{Average Current Density for Laminate "X"}}{\text{Average Current Density for Epoxy-Glass}} \times 100\%$$

For nylon phenolic, this could be:

$$\frac{0.0511 \text{ amp / sq mil}}{0.0591 \text{ amp / sq mil}} \times 100\% = 86\%$$

Therefore, the heat dissipation of the N-1 base laminate as a function of current-carrying capacity, as found by actual test, is 86 per cent of that of epoxy-glass.

Calculations were also made at 20 C over room temperature. The results were within 1 per cent of the 10 C readings. The relative current-carrying capacities of the various laminates for a 10 C rise over room temperature are as shown in the accompanying table.

Design Procedure

The designer has great flexibility in the combination of materials and conductor sizes for maximum ambient operating temperatures. For proper selection, however, he must establish the current characteristics of the circuit. With this information, a base material is first selected which will meet the physical requirements under the environmental conditions anticipated. Then a weight of copper is selected and the minimum width of conductor determined which will limit the temperature rise in the printed conductor to a safe value compatible with the resistivity tolerance requirements on the circuit. Most of the materials will take a 10 C rise without appreciably affecting the bond when the operating temperatures are below 85 C. This allowable rise varies somewhat with the material, and with some silicones it can be raised considerably.

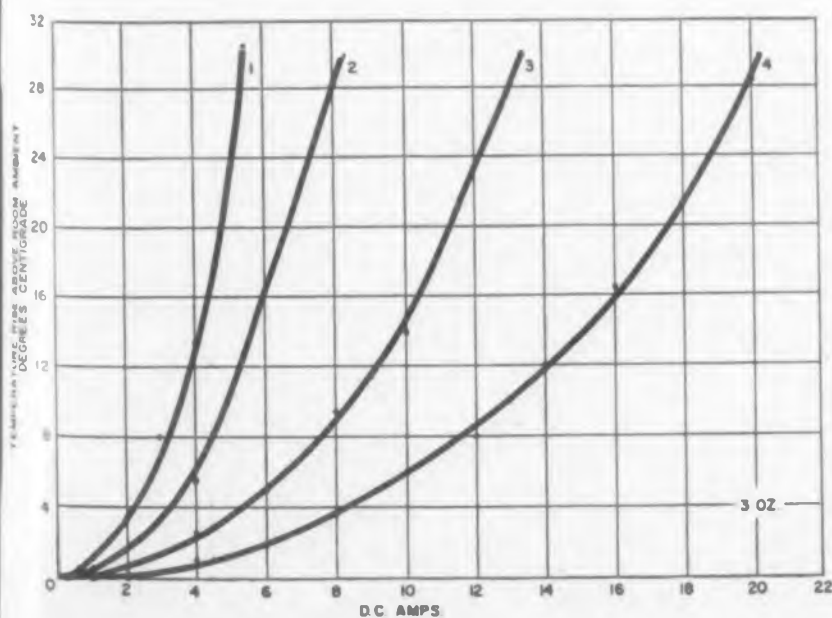


Fig. 3. Characteristics of base-laminate temperature rise versus PW conductor current for 1, 2, and 3 oz (per sq ft) copper-foil conductors, respectively. Laminate tested was 0.062 in.-thick paper-base type. Conductors for curve 1 were nominally 0.016 in. wide; curve 2, 0.031 in.; curve 3, 0.061 in.; and for curve 4, 0.123 in.

FREQUENCY DETECTOR

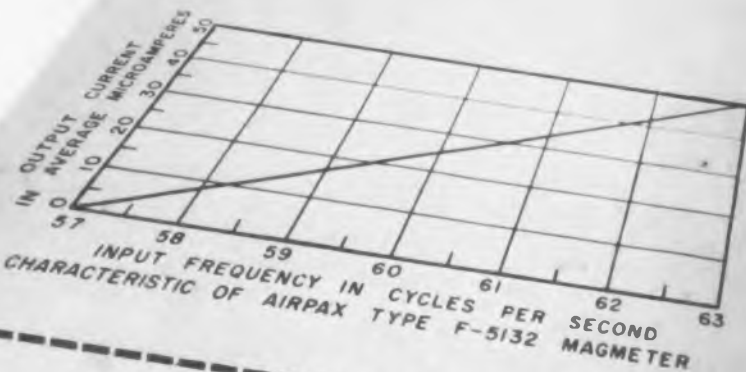
is used for direct frequency indications or for servo frequency control. Because of its stability, the Magmeter detector simplifies telemetering equipment and automatic generator controllers. It is excellent for constant-speed servos. It requires no reference.

Measure Frequency of 60-CPS Power Accurately

Output current of Airpax Magmeter detector Type F-5132 is directly proportional to frequency deviation.

Response is rapid. Detector can be used—

- (1) to display frequency directly on a panel meter,
- (2) to record frequency on a chart recorder, or
- (3) to control generator through follow-up loop.



DETECTOR CHARACTERISTICS

Airpax Type F-5132 Magmeter detector operates entirely from the input signal.

RANGE: 60 ± 3 CPS (other ranges on special order)

ACCURACY: Linear within ± ¼% of mid-scale frequency
Reproducible to ± ¼% of mid-scale

INPUT: Approx. 1 W of signal power

OUTPUT: 50 µa at 63 CPS (0 at 57 CPS) into load of 2200 ohms maximum

ENCLOSURE: Hermetically sealed rectangular can 1¼" x 2¼" x 3" with four 6-32 bolt-down studs and 7-pin solder hook header



Airpax Products Company, Seminole Division, Fort Lauderdale, Florida

Military Environmental Requirements for Electronic Parts

Environmental Requirements Chart for Military Electronic Parts										
Environmental characteristics	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII	Group IX	Group X
Temperature: Operating Storage	-55° + 55°C -65° + 71°C	-65° + 85°C -65° + 71°C	-65° + 125°C -65° + 71°C	-65° + 125°C -65° + 71°C	-65° + 125°C -65° + 71°C	-65° + 200°C -65° + 71°C	-65° + 200°C -65° + 71°C	-65° + 350°C -65° + 71°C	-65° + 500°C -65° + 71°C	-65° + 1,000°C -65° + 71°C
Pressure: Operating Altitude (ft) Nonoperating Altitude (ft)	20.58" Hg 10,000 3.4" Hg 50,000	1.32" Hg 70,000 NA [*]	20.58" Hg 10,000 3.4" Hg 50,000	20.58" Hg 10,000 3.4" Hg 50,000	1.32" Hg 70,000 NA	0.315" Hg 100,000 NA	0.04" Hg 150,000 NA	0.315" Hg 100,000 NA	0.04" Hg 180,000 NA	0.04" Hg 150,000 NA
Moisture (100% relative humidity)	10 c	10 c	10 c	10 c	10 c	10 c	10 c	10 c	10 c	10 c
Vibration: Cycles per second Acceleration (g)	10 - 55 NA	10 - 2,000 10	10 - 55 NA	10 - 55 NA	10 - 2,000 10	10 - 2,000 15	10 - 2,000 15	10 - 2,000 20	10 - 3,000 40	10 - 3,000 40
Shock: Acceleration (g) Time in milliseconds	50 6	50 11 ± 1	50 11 ± 1	50 11 ± 1	50 11 ± 1	50 11 ± 1	50 11 ± 1	50 30 ± 1	50 11 ± 1	50 11 ± 1
Air-induced vibration: Cycles per second Db above 2 x 10 ⁻⁴ dynes/ sq cm	NA NA	NA NA	NA NA	NA NA	150 - 9,600 160	150 - 9,600 160	150 - 9,600 160	150 - 9,600 160	150 - 9,600 165	150 - 19,200 165
Acceleration: (Constant) g Time in seconds	NA NA	50 5	50 10	50 10	50 10	50 10	50 10	50 10	50 10	50 10
Explosive atmosphere	NA	NA	NA	NA	I	II	I	NA	NA	NA
Nuclear radiation: Neutron flux level (fast) Neutron/cm ² -sec Time in hours Gamma photon flux level Photon/cm ² -sec Time in hours Thermal neutrons				10 ⁵ 40,000		NA NA	10 ⁹ 1,000	NA NA	10 ¹¹ 1,000	10 ¹³ 1,000
Sand and dust	NA	NA	NA	NA	I	NA	I	I	I	I
Salt atmosphere per MIL-STD-202 (hr)	96	96	96	96	96	96	96	96	96	96
Flammability	See paragraph 3.2.13 for Groups I through VII.							NA	NA	NA
Fungus resistance	Non-nutrient in all ten groups.									
Life (hrs) Operating Storage	30 K 30 K	30 K 30 K	30 K 30 K	40 K 40 K	2 K 30 K	20 K 30 K	2 K 30 K	2 K 30 K	10 K 50 K	10 K 50 K

NOTES: ^{*}Not applicable.
[†]The part is to be tested in accordance with Procedure I of specification MIL-E-5272.
^{**}Thermal neutrons are not listed as a requirement, but, since all neutron fluxes have some thermal component, this component should be measured and reported with all tests.

The accompanying chart with associated explanation is reproduced from a newly released report of the Advisory Group on Electronic Parts of the Office of The Assistant Secretary of Defense For Research and Engineering. Copies of the complete report are available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. Environmental test procedures are outlined in the full report.

ELECTRONIC parts such as capacitors, resistors, switches, relays, transformers, crystals, wave guides, etc. must be capable of sustained operations not only under the conditions required of the prime equipments to which they are applied, but also in their environment within those equipments. The accompanying chart establishes a guide for research and development requirements for environmental design, to be used in present and future electronics planning.

Environmental Groups

The environmental groups shown in the chart contain characteristics designed to meet the various environmental requirements of the three Military Departments. They are defined as:

Group I. Required to fulfill the needs for electronic hardware items handled by military.

Group II. Covers those items requiring highly stabilized components for general usage.

Group III. Covers general usage of shipboard and ground components.

Group IV. Includes nuclear radiation for general usage on shipboard and ground.

Group V. Includes requirements for high-performance aircraft and surface-to-air and air-to-air missiles.

Group VI. Includes high-performance aircraft and specialized shipboard requirements.

Group VII. Includes requirements for nuclear-powered aircraft and ballistic missiles.

Group VIII. Pertains primarily to shipboard missile requirements.

Groups IX and X. Pertain to nuclear-powered weapons requirements.

Applicable Publications

The following publications are applicable:

Military Specifications. MIL-S-4456(USAF) "Shock, Variable Duration, Method and Apparatus for"; MIL-E-5272 "Environmental Testing, Aeronautical and Associated Equipment, General Specifications for."

Military Standards. MIL-STD-202 "Test Methods for Electronic and Electronic Component Parts"; MIL-STD-210 "Climatic Extremes for Military Equipment."

Technical Note. WADC Technical Note 56-190 "Standard Instrumentation Techniques for Nuclear-Environmental Testing," 20 April 1956.

For a reprint of this article circle 23 on the Reader-Service card.

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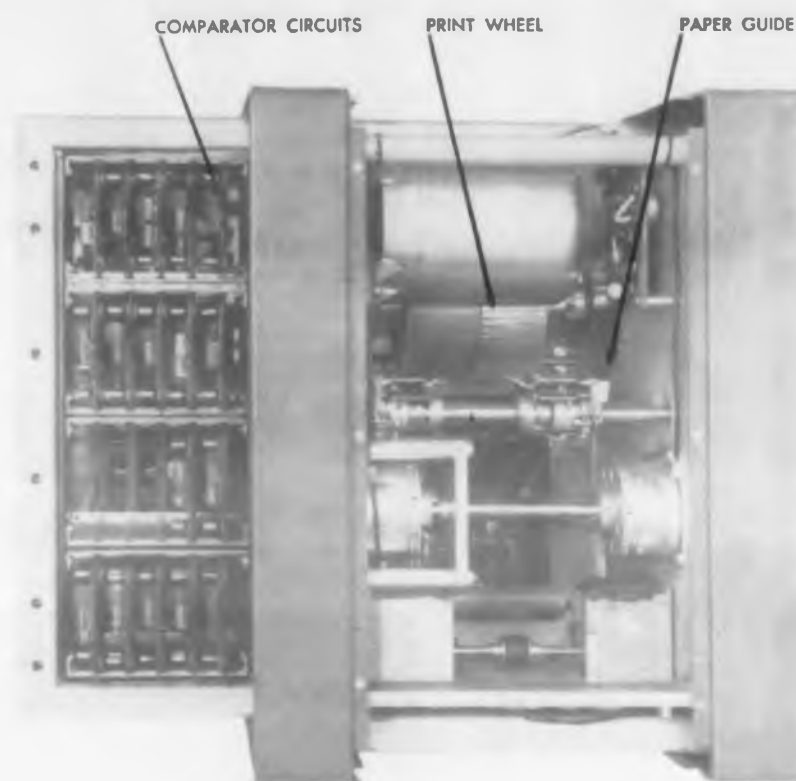
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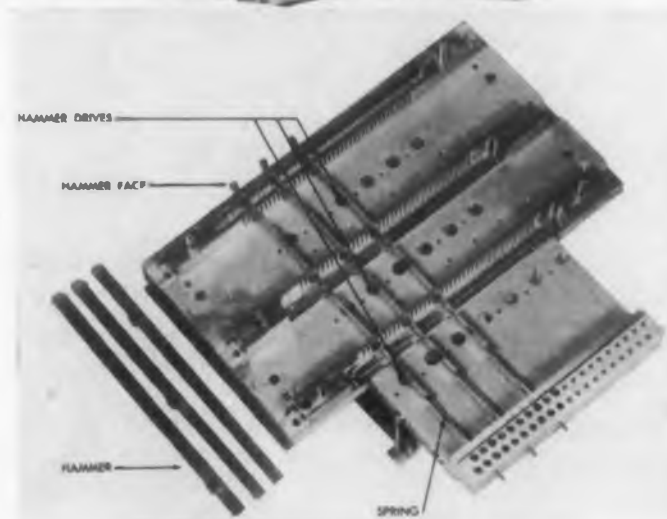
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This high speed printer doesn't take up much more room than a typical desk top "Out" box. The paper drive clutch (left) and brake are seen just below the adjustable paper guides. Below the paper drive, the ribbon drive may be seen. Hammer assembly (not shown) is below print wheel.

Desk Top High Speed Printer

—Uses Simple Mechanical Design



To conserve space, the solenoids are mounted on opposite halves of the hammer plate assembly. Further space economy results from the hammers being driven from one of three positions.

IF ONE wanted to stop and think about it, one could no doubt come up with a really fancy name for this remarkably small, high speed printer. Potter Instrument Company, Inc. of Plainview, New York, has chosen to designate it, simply, the Model 3260 Alphanumeric Printer. Off the record, those who've been working with it like to call it the "baby printer."

This very high speed digital printer is reliable, compact, and versatile. A compact package, integral with the printing mechanism, houses the completely transistorized circuit modules which consume only 65 w. With an overall size of only 19 in. wide by 15 in. high by 16 in. deep, the entire printer fits comfortably on the corner of a desk, or on a standard 19 in. relay rack. It weighs about 100 lb.

Like many other printers, this one is useful for data logging and presenting binary information in decimal or alphanumeric form. It can decode from magnetic or perforated tape input and can be used as a high speed, "on the line" printer. Data from any digital source can be printed if an external register provides a four bit code for numeric or a six bit code for alphanumeric printing.

The "3260" prints up to 28 lines of numbers per second or 10 lines of alphanumerics. With up to 40 columns of numbers available, it has a maxi-

imum printing rate of 1120 numbers per second.

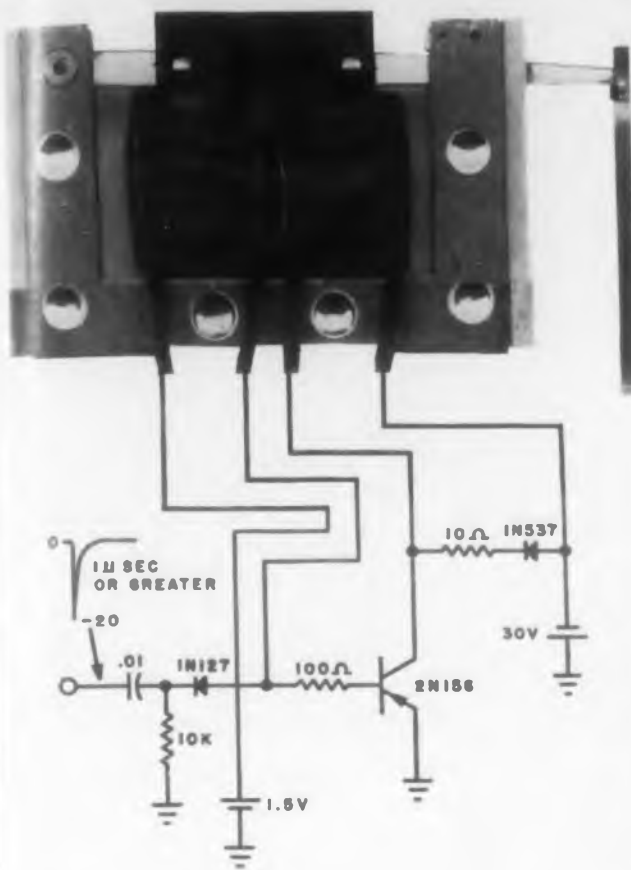
The character well exemplifies the flexibility embodied in the machine. It takes the form of a grooved drum. Up to 63 different character slugs can be inserted around the drum periphery. This character wheel rotates at only 300 rpm. It can be seen in the photograph of the printer.

How It Works

When we saw the specifications on the "3260," we were naturally impressed, especially when we realized that this printer could sit on that unused corner of the desk.

We were quite surprised, on inspecting the printer, to find none of the usual complex mechanical linkages, usually associated with printers. This one is definitely not an electrical adding machine.

A profusion of clever devices illustrates the design care that went into the machine. As an example, for the actual printout, a lightweight hammer (about 1/3 oz) strikes the paper against the character on the rotating drum. In most printers, a thyatron driven solenoid drives the hammer home. But in the thyatron types, it is difficult to control the current waveform through the solenoid without changing the total energy driving the hammer.



The hammer drive solenoid is an integral part of a blocking oscillator circuit.

In the "3260" the total hammer travel is about .070 in. A transistor driven solenoid kicks the hammer about .030 in. and kinetic energy carries it the rest of the way. The hammer bounces back to position after it strikes the resilient stellite character.

The solenoid is an integral part of a blocking oscillator. The advantage inherent in a blocking oscillator is that the current stays high till the solenoid gap closes, so the hammer is driven throughout the initial part of its travel. In the circuit diagram, a negative pulse from the comparator (at least 1 μ s wide) injects current into the transistor base. The diode, shown in the schematic, isolates the blocking oscillator from the trigger source, while the 100 ohm resistor biases the transistor.

Collector current flows through one coil of the solenoid, coupling energy to the other coil, which drives more current into the base, till the transistor saturates, and drives the hammer home. After saturation, the field can no longer change, so it collapses and the hammer bounces back. The diode in the collector circuit protects the collector from swinging more negative than the 30 v power supply.

For more information about this printer turn to the Reader's Service Card and circle 25.



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The silicon unijunction transistor extends the transistor equivalents of the vacuum tube. It performs the same functions as the grid-controlled thyatron, increasing the number of circuits that can be efficiently transistorized. In sawtooth, pulse, and multivibrator oscillators, it reduces design requirements by eliminating half the transistors required and their adjunctive components.

more circuits transistorized with the

Silicon Unijunction Transistor

S. R. Brown T. P. Sylvan

General Electric Co.
Semiconductor Products Dept.
Syracuse, N.Y.

Part II

THE SILICON unijunction transistor is a three-terminal semiconductor device which exhibits open-circuit stable negative resistance characteristics. It is primarily useful in switching and oscillator applications. It can be operated in a number of different circuit configurations such that any of the three terminals can serve as a signal input or a load output.

When supplied from different emitter supply circuits as shown in Figure 1a, the unijunction transistor will operate in a bistable (1) monostable (2), or astable (3) fashion depending on how the static load lines intersect the emitter characteristics as shown in Figure 1b. In the bistable circuit configuration the unijunction transistor may be triggered from the low emitter current state to the high emitter current state by either raising the emitter voltage or lowering the base-two or base-one voltage. Similarly it may be triggered from the high emitter current state to the low emitter current state by lowering the emitter voltage or by raising the base-one voltage.

The relationship between the interbase current, I_{B2} , and the interbase voltage, V_{BB} , are also of considerable interest to the circuit designer. The representative circuit of Figure 2 could be used to explain the interbase characteristics if a suitable curve showing the variation of R_{B2} could be drawn. Since R_{B2} is a function of several

variables this becomes quite involved and the circuit of Figure 2 will be used instead.

With reference to Figure 2, if $S1$ is open (I_E zero) and $S2$ is in position 1, a curve as shown in Figure 3, curve *a*, would be traced out if the interbase voltage, V_{BB} , was steadily raised from zero.

The curvature at the low voltage end of curve *a* is primarily due to the increase of the resistivity of the bar with temperature and applied power. Increased power input to the bar at the high voltage end of the curve raises the temperature high enough so that the additional hole-electron pairs caused by thermal excitation decreases the resistance and accounts for most of the curvature noticed in this region. Curve *d* of Figure 3 is produced when $S1$ is closed and the emitter is driven with the maximum rated emitter current and the emitter voltage is raised from zero as before. This curve is explained by the following actions. Zero interbase voltage implies that a short circuit exists or can be placed from base-two to base-one (i.e. as if $S2$ is in position 2). Since base-one is the return for the emitter current, base-two is also an equivalent return at zero interbase voltage. Therefore a portion of the emitter current flows from the emitter to base-two as well as to base-one. This gives rise to a negative value of I_{B2} for $V_{BB}=0$

as shown in Figure 3, curve *d*. If $S2$ is returned to position 1 and V_{BB} is increased slightly from zero, I_{B2} will rise very rapidly since the entire region between base-two and base-one is filled with injected holes and "neutralizing" electrons. As the interbase voltage further increases and I_{B2} goes positive a field will be built up in the emitter to base-two region such as to oppose the diffusion field set up by the injected holes. During this action, however, the total charge concentration in the bar is high and slight increase of interbase voltage causes large increases of interbase current, primarily because of electron conduction from base-one to base-two. As the interbase voltage is further increased a field is established near base-two which sweeps this region free of the injected holes. This region of the bar is thus returned to its high resistivity state and the major portion of the interbase voltage then appears across this region between base-two and the emitter. From this point on the interbase characteristics follow the general behavior of curve *a*.

It is extremely important to note that almost all the power being supplied by the interbase power supply is being dissipated in a narrow region near base-two. Thus if the power available from this supply is not limited in an appropriate fashion, a local "hot spot" can develop

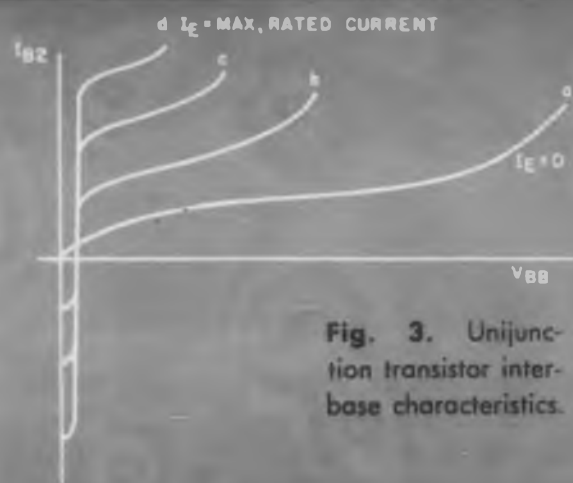
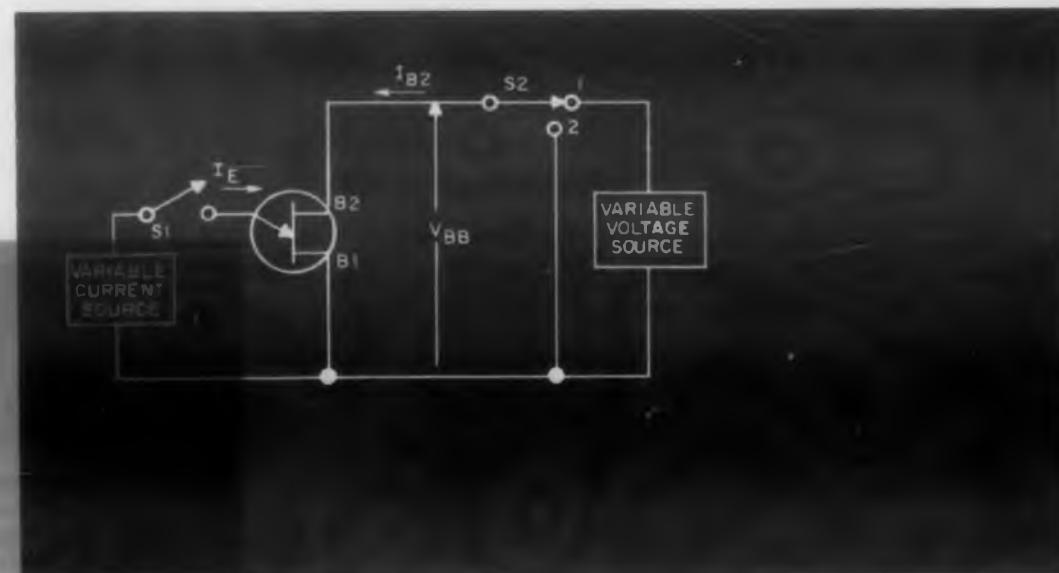
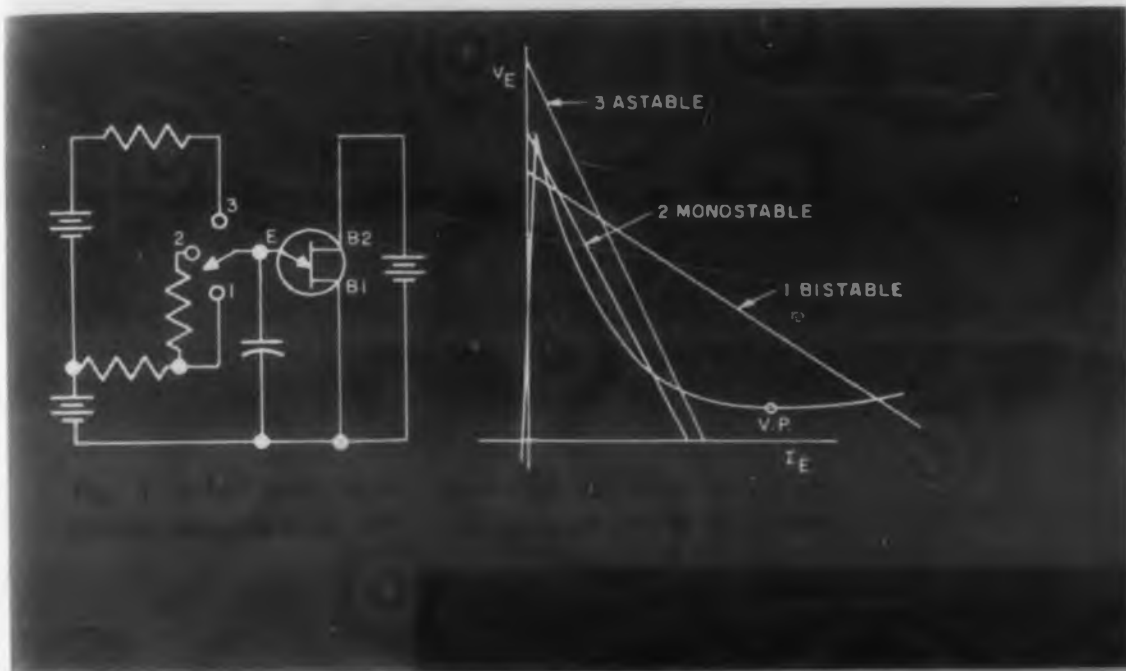


Fig. 3. Unijunction transistor interbase characteristics.

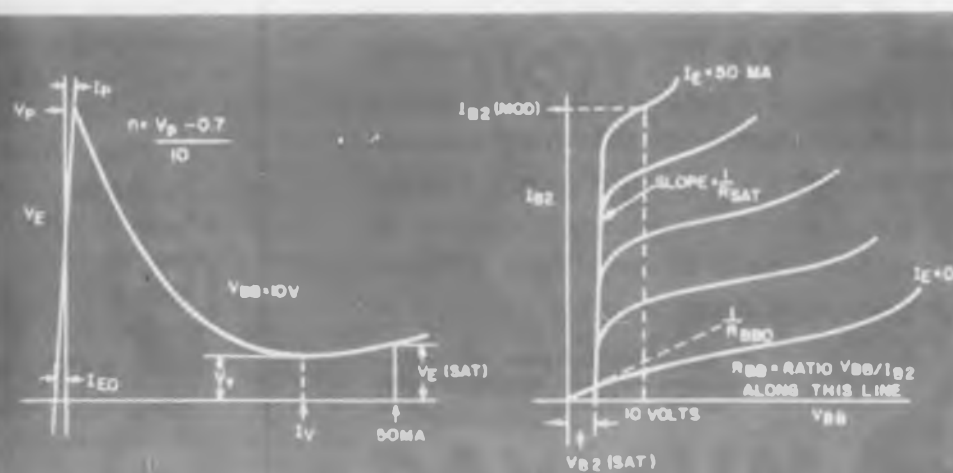
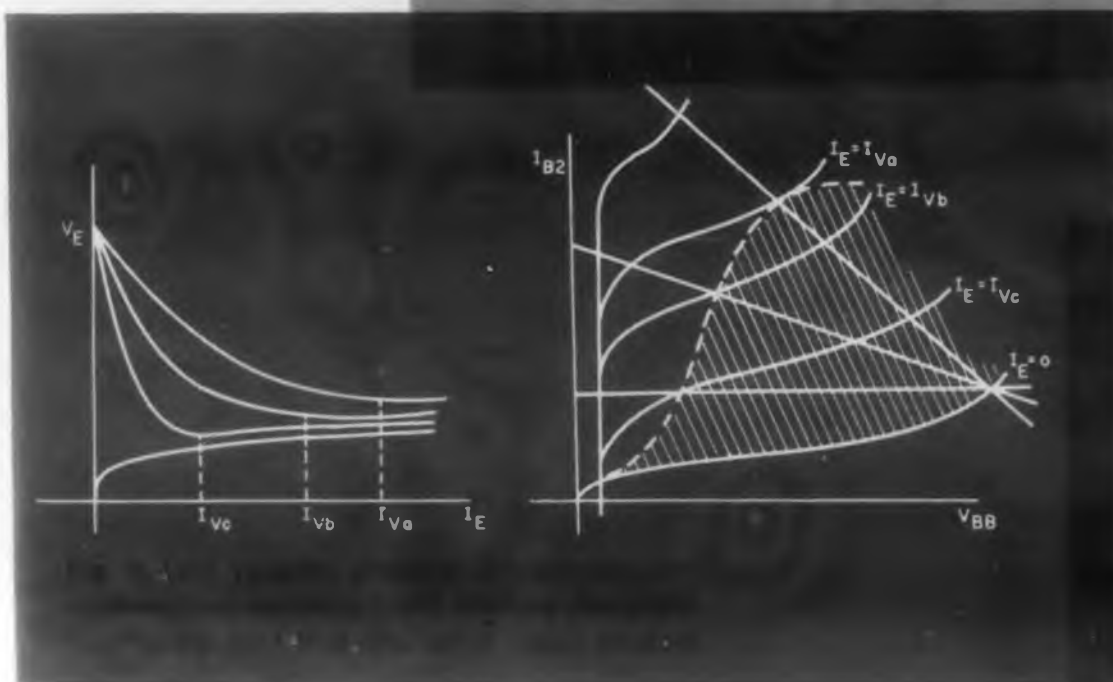


Fig. 5. (left) Unijunction transistor characteristics showing parameters of interest; (right) Unijunction transistor interbase characteristics showing parameters of interest

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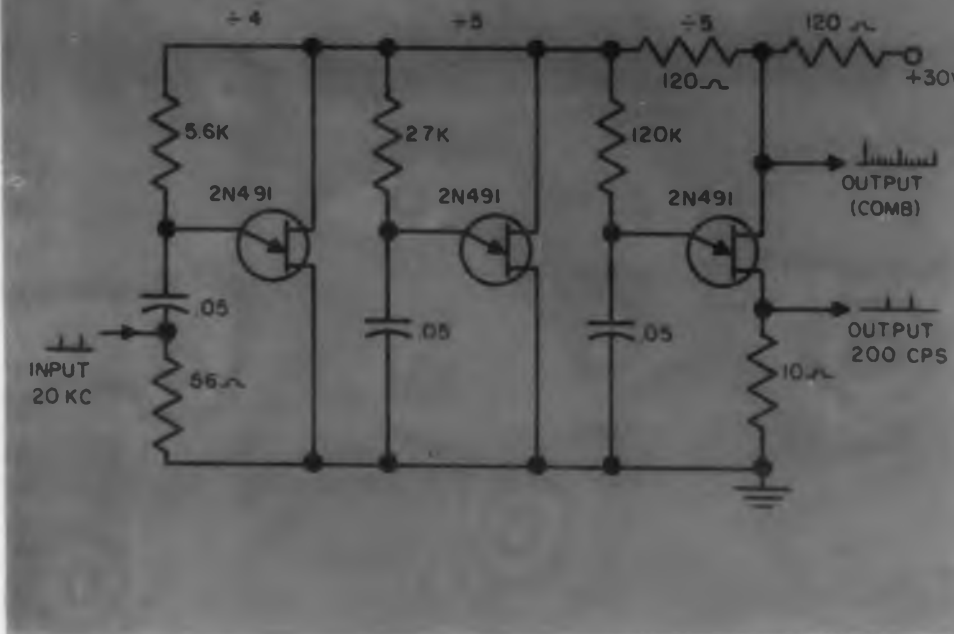


Fig. 6. Fre-
quency divider
circuit (100:1).

in this region and the device may run away thermally, resulting in burn-out. This is the only way that the unijunction transistor can run away in normal circuit applications and if adequate safeguards (e.g. a suitable value of resistance in the base-two circuit) are taken they may be severely abused in other respects without damage.

There are certain interactions between the emitter characteristics and the interbase characteristics which are important to note. Figure 4 shows the effect of the interbase load resistance on the emitter characteristics. Assume that the interbase characteristics are as shown in Figure 4b and that three interbase load lines are being considered, namely a, b, and c.

All of these load lines were chosen so as to cross the $I_E=0$ curve at the same point, therefore the peak voltage of the emitter curves for each load line will be the same because the interbase voltage at $I_E=0$ is the same. For any emitter current other than zero, however, the interbase voltage appearing with load line a will be greater than that of load line b or c. The emitter voltage drop is due to the sum of I_E and I_{B2} flowing through R_{B1} . Since R_{B1} depends on I_E only, this implies that the larger interbase voltage along load line a will cause a higher emitter voltage at any given emitter current than if the other load lines were used. Assume that curve a, Figure 4a represents the emitter characteristics under these conditions. If load line a represents the maximum allowable power dissipation load line, curve a, Figure 4a would represent the upper limit of all possible emitter curves having the same peak point. The absolute lower limit of emitter characteristics is specified by the emitter to base-one diode characteristics, curve d, Figure 4a.

In a like manner load line c, being a constant-current load line, would represent the lower

limit of the family of emitter characteristic curves having the same peak point. This is represented by curve c, Figure 4a.

It will be noted that the valley point currents $I_{V_{a1}}$, $I_{V_{b1}}$, and $I_{V_{c1}}$ for each of the emitter characteristics shown in Figure 4a are not the same. This indicates that the active, or negative resistance region of emitter current is determined to a large extent by the interbase circuitry. The active region on the emitter characteristic plot can be transferred to the interbase characteristic curves by marking the intersection points of each load line with the corresponding valley point current. These points are indicated by the points x in Figure 4. The active region on the interbase characteristic curves is outlined by the dotted line joining the x's and the $I_E=0$ curve. For the maximum speed of operation in bistable circuits it is desirable to operate between points located near the boundaries of the active regions in both the emitter and interbase characteristics.

The preceding discussion has explained the behavior of the unijunction transistor and defined some of the terms important in specifying this device. Figures 5a and 5b summarize the important definitions.

$I_{B2}(MOD)$ in Figure 5b refers to the quantity called the modulated interbase current. This current is measured under the same bias conditions as $V_E(SAT)$ and serves as an indication of the capabilities of the unijunction transistor to switch currents in the interbase circuit.

Presently available specifications on the unijunction transistor (2N489-2N494) list nominal, minimum and maximum values on almost all of the parameters discussed above. These specifications also include additional data and information on the response time, temperature derating, maximum power and current ratings.

(This is the second of a two-part article. Part I appeared in the Jan. 8 issue of ELECTRONIC DESIGN.)

Fig. 7. Matrix switching circuit. This circuit permits switching an ac signal from a single input to any one of a number of outputs. If switching signal is applied simultaneously to A_1 and B_1 , the ac signal will appear at output X' only.

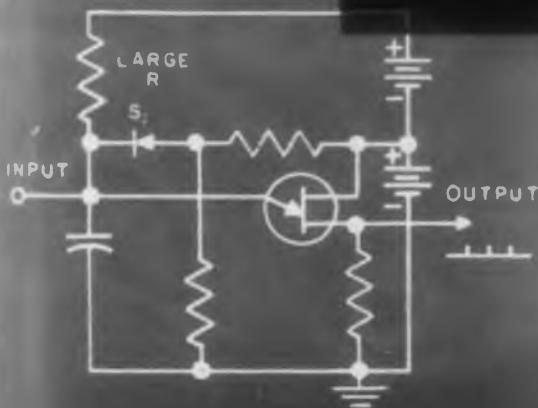
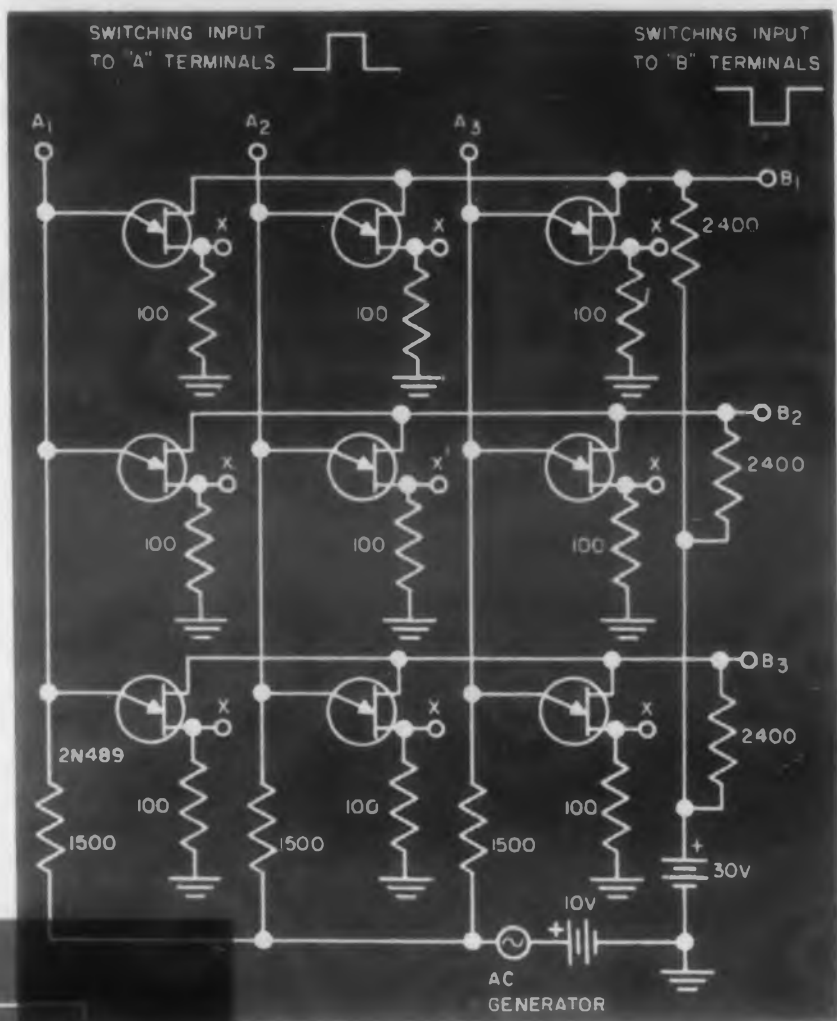


Fig. 8. Low level dc current sensing circuit. The pulse frequency at the output will be constant for zero input current and will increase as the input current increases. With suitable values of components input currents of 10^{-7} amperes will change the frequency by 5—10 per cent. Reliable readings are possible to 10^{-8} amperes.

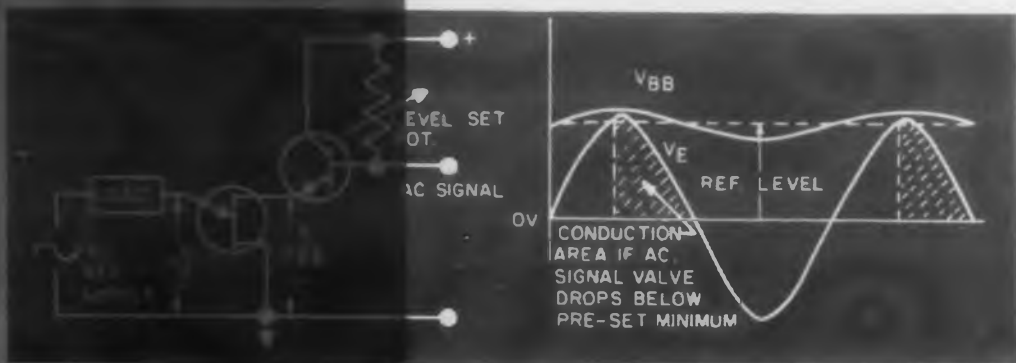


Fig. 9. Phase and/or amplitude sensitive switch. Waveforms shown are for circuit which will fire if signal drops below a given minimum. 180° phase reversal of reference will yield a circuit which fires on excess signal. Both types of circuits will fire with phase shift in proper direction.



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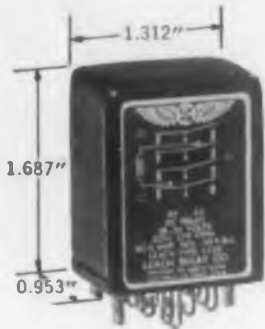
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Normal operating voltages—6-115 vdc, 115 vac (400 cycle), 4 PDT.

Contact ratings @ 28 vdc or 115 vac single-phase

Resistive — 3 amp @ 120°C
— 5 amp @ 85°C (dc only)

Inductive — 1.5 amp @ 85°-120°C

Motor Load — 1.5 amp @ 85°-120°C

Rated duty — continuous

Minimum operating cycles — 100,000

Weight — 0.25 to 0.30 lbs.

Shock — 50 G's

Vibration — 10 G's, 0-500 cps

Applicable specifications — MIL-R-6106B,
MIL-R-5757C

Also available in units to meet the minimum current requirements of MIL-R-6106C

We invite other special requirements such as microamp switching, high vibration and special mountings.

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Principal Cities of U. S. and Canada

CIRCLE 29 ON READER-SERVICE CARD

Wide Load DC Differential Amplifier

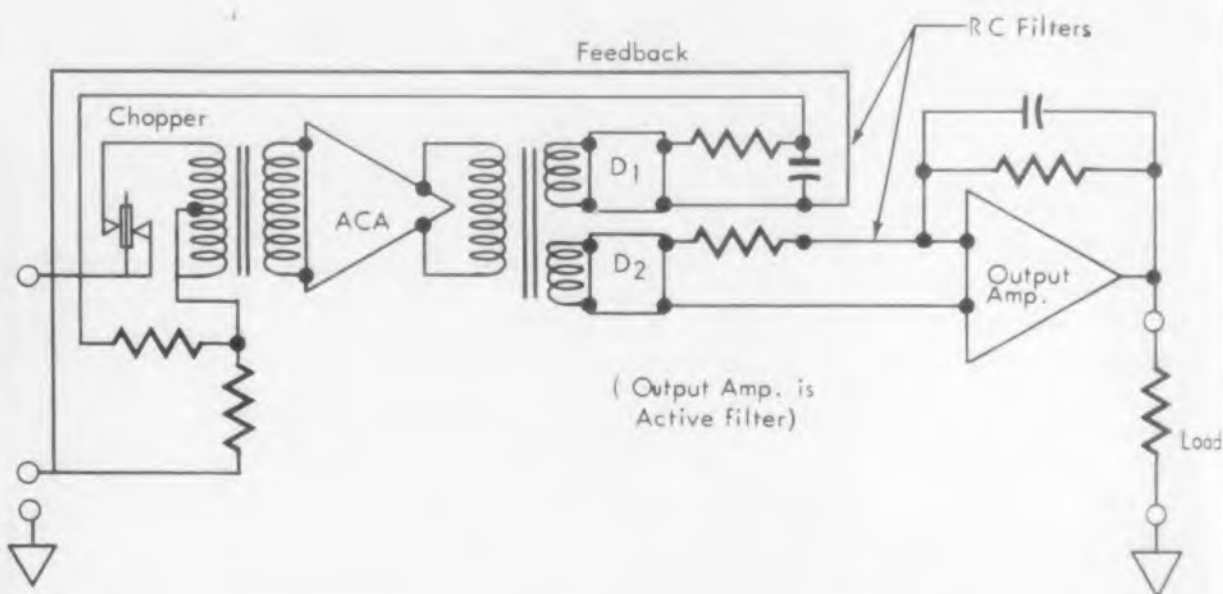


Fig. 1. Emitter-follower output amplifier provides low output impedance, good isolation of demodulator D_2 . In this way the balanced feedback signal provided by D_1 is a realistic replica of the output signal, which changes very little with a change in load.

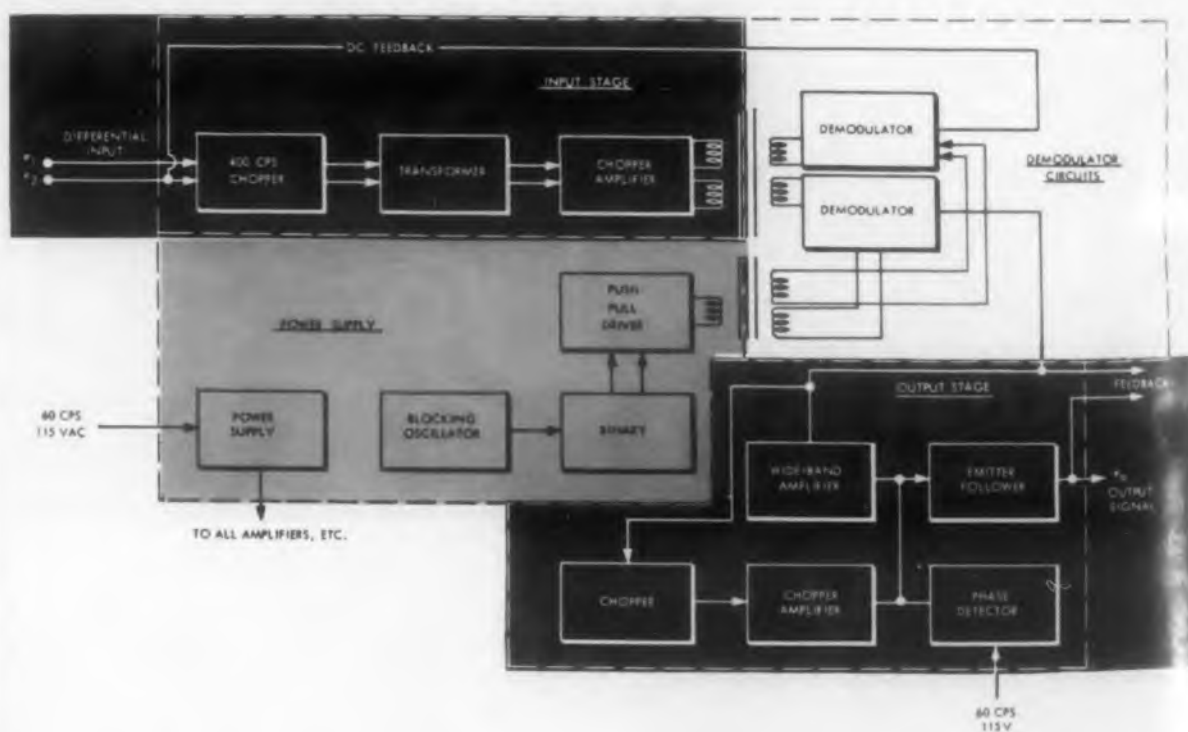


Fig. 2. Block diagram of the differential amplifier. Self-contained power supply and plug-in modules (denoted by color blocks) prevent the disabling of a number of channels by power supply failure and provide easy replacement of the unit.

NEW HIGH RELIABILITY



IN ELECTROLYTIC CAPACITORS!

These new dry electrolytic capacitors are especially built for applications that require an extremely high level of reliability over long periods of time.

Sangamo Type TR capacitors are designed to operate in a temperature range from -20°C to $+85^{\circ}\text{C}$.

The Type TR is well suited for use in communication systems; in all types of electronic industrial controls, laboratory test instruments, computer equipments, and in many other similar applications. Type TR capacitors are available in ratings from 3 to 450 volts D.C.

Sangamo Type TR

TWIST-TAB ELECTROLYTICS

have a life expectancy of at least 10 years when operated within their ratings

These high reliability dry electrolytics are designed with safety factors to pass high ripple currents. The use of high purity aluminum foil assures lower leakage current, and a highly effective end seal gives these capacitors unusually long operating life provided they are operated within their ratings.

Engineering Bulletin TSC 119 gives full information.

SANGAMO
Electric Company
SPRINGFIELD, ILLINOIS

SC38-1
CIRCLE 31 ON READER-SERVICE CARD



SENSITIVITY to wide output load variation and good common mode rejection are the principal virtues of this new dc differential amplifier. Designed to accept and amplify small signals from remote transducers, the amplifier can be used with multiplexing gear without loss of accuracy from one output load to another. With the vernier gain set at the X1 position, accuracy is rated at 1 per cent, stability 0.1 per cent, over an output load variation down to 100 ohms.

An output amplifier stage isolates the demodulator from the load. As shown in Fig. 1, this presents a very constant load from demodulator 2. In this way the feedback—necessary to accuracy and stability—provided by D_1 is a realistic replica of the output signal, and is not betrayed by changes in loading.

With a transistor emitter-follower output stage, the output impedance is less than an ohm; a 20 ohm load may be connected and change the equipment accuracy only to 5 per cent.

Produced by Kin Tel, 5725 Kearny Villa Road, San Diego, Cal, the single-ended device puts out 10 v peak at 10 ma peak for use with converters; 5 v is standard for telemetering. Common mode rejection from dc to 60 cps is 120 db.

Bandwidth of the amplifier, a block diagram of which is shown in Fig. 2, is dc to 15 cps. Ten to 1000 gain is provided in steps, with a vernier control between steps. Gain switching varies the amount of feedback around the ACA. To compensate for these changes the ACA gain is also switched internally; filter response is maintained at a constant level. The variable gain control, a wire wound unit with good linearity and resolution, is connected at the input to the amplifier.

Transient response is rated to be 40 msec rise time with a 3 per cent maximum overshoot and 0.2 sec overload recovery. Input impedance is 100 K \pm 5 per cent, terminal to terminal while the isolation from ground of either terminal is 100 meg.

Rated over 24 hr period, drift of the amplifier is $\pm 5 \mu\text{v}$ equivalent input at gains of 100 or more; $\pm 5 \mu\text{v}$ at a gain of 10, with ambient temperatures ranging between 20 and -55°C . Minimum load recommended for the instrument is 20 ohms or maximum external capacity of 0.5 μf .

Transistor demodulators are used in the Model 114A to take advantage of their low power requirements. The increased control combined with the use of the demodulator filters with similar characteristics provides the low overshoot mentioned above. Extensive use of transistors—only two vacuum tubes are used—keeps the power consumption of the unit to 10 w.

A balance control at the input of the amplifier introduces offset to overcome any system imbalance, and has a range of 50 mv.

For further information on this dc differential amplifier, circle 30 on the Reader Service Card.

NOW! Immediate delivery on low-cost ultrasonic cleaning equipment you can afford!

Prices start at only \$175⁰⁰— with a full two-year warranty



Series 600
\$350

narda SONBLASTER

Now, thanks to Narda's mass production techniques, you can get top ultrasonic cleaning equipment with a full two year guarantee, at the lowest prices in the industry! What's more, Narda's SonBlasters are available now — off-the-shelf — for immediate delivery! Here's your opportunity to start saving immediately on labor, chemicals and floor space — not to mention improved cleaning with fewer rejects.

Simply plug this new Narda SonBlaster into any 115 V-AC outlet — fill the tank with the cleaning solution of your choice and flip the switch. In seconds, you are cleaning everything from hot lab apparatus to medical instruments, optical and technical glassware to clocks and timing mechanisms, electronic components and semiconductors to motors, relays and bearings. In short, you will clean most any mechanical, electrical, electronic or horological part or assembly you can think of—and clean it faster, better and cheaper. In addition, Narda SonBlasters are ideal for brightening, polishing, decontaminating, sterilizing, pickling, and plating; emulsifying, mixing, impregnating, degassing, and other chemical process applications.

Write for more details now, and we'll include a free questionnaire to help determine the precise model you need.

Narda SonBlasters — a complete line of production-size units with the quality, power, performance, capacity and appearance of cleaners selling up to three times the price. From \$175 to \$1200.

Fill out and mail for full information—

SPECIFICATIONS

Inside tank dimensions: (Model NT-602) 9¼" l, 6" h, 5" w; one gallon capacity; stainless steel.
Generator: 10" l, 8½" h, 9½" w; 115 V-AC; Selector switch for alternating between two tanks.
Complete unit is portable and compact.

NARDA ULTRASONICS CORP.
Herricks Road, Mineola, L. I., N. Y.
Dept. ED-2

Please send me more information about Series 600 SonBlasters.

Name _____
Organization _____
Address _____
City _____ Zone _____ State _____

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Subsidiary of The Narda Microwave Corporation

CIRCLE 32 ON READER-SERVICE CARD

Design Forum

Disc Magnetic Memory

Floats on Air

AIR is used to keep an accurate head-to-disc magnetic gap and to support the memory unit of a new computer. The memory, a flat disc, revolves below fixed recording and reproducing heads, and rides on an air bearing—an unusual application of a principle established in railroad journal bearings in 1885.

Designed by Autonetics Division of North American Aviation, Inc., 9150 East Imperial Highway, Downey, California for installation in the Recomp II, a portable general purpose digital computer, the air bearing uses no compressed air. The functioning of the bearing involves a boundary layer property, and the forces developed are actually opposite in sense to those indicated by a simple application of aerodynamic principles. The force of separation is a function of the viscous shear of the medium in the gap.

As in Fig. 1—which shows the operation of an oil journal bearing but which illustrates the viscous shear principle—when the bearing has no velocity, the shaft rests at the bottom of the bearing in contact with the surface. When the shaft begins to rotate it climbs uphill and finally, at speed, the position shifts as in the last sketch. This floating position is due to the viscous shear of the material.

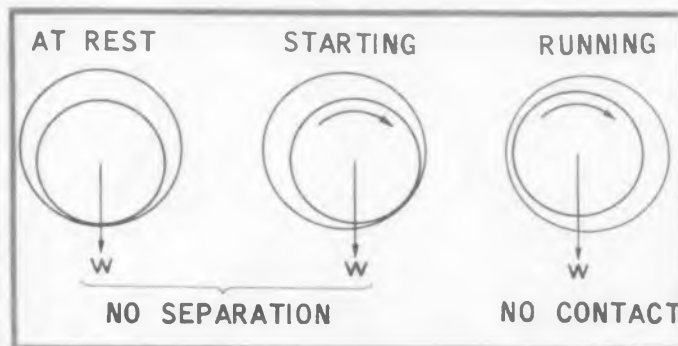


Fig. 1. Hydrodynamic journal bearing. As the rotating shaft comes up to speed it is held away from the bearing walls by force due to viscous shear. In the same way, air, as the viscous shear material in the magnetic memory holds a constant gap between rotating disc and head plate.

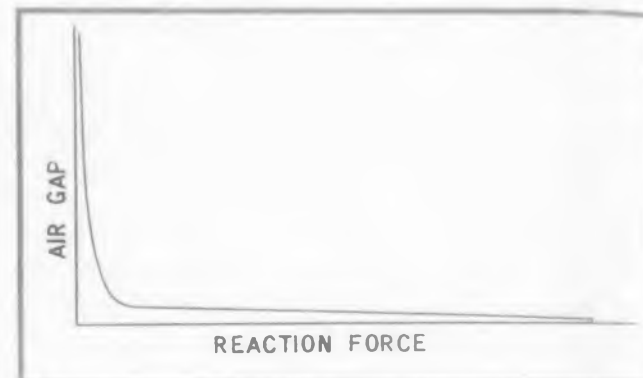


Fig. 2. Properties of an air bearing. Pounds per microinch of deflection can be obtained, to hold a very constant magnetic gap.

In the floating disc air is used as the viscous material. A dimensionless curve of approximate air-bearing properties is shown in Fig. 2. It is clear that operation of the bearing in the region where the curve is almost flat results in a very constant gap width, even under large variable loads. Spring constants of the order of pounds per microinch of deflection and ultimate strengths of the order of hundreds of pounds are not uncommon.

A disc was used for the memory instead of a drum for reasons of ease of production. A flat surface requires forming only to shape, where a cylinder requires meeting tolerances in both shape and dimension. The discs shown in Fig. 3 are attached to the shaft by means of very thin diaphragms. The diaphragm provides stiff coupling between the disc and the shaft about the rotational axis, and loose coupling in orthogonal directions.

This loose compliance is of the order of pounds per mil and is used in the design for these reasons: 1. the spring—diaphragm—sets the preload on the disc, 2. If there is any misalignment of the headplate with respect to the shaft axis, the diaphragm flexes to maintain the disc parallel to the plate, and 3. the diaphragm flexes so the force of the air bearing can offset exterior forces operating orthogonal to the surface of the bearing.



Air bearing was ideal for this time-sequenced, recirculating, processing, and storing memory. Air maintains proper head-to-magnetic disc gap.

Because there is no support force at low speeds, the surfaces must be separated to prevent scoring the bearing surfaces. This is done by a solenoid actuator. The solenoid's travel is the separation distance from disc to air bearing, and the additional distance necessary to cock the diaphragm to the preload force.

Open recording and reproducing heads are used in the memory unit, since they can be better shielded against crosstalk. The disc is constructed of a magnetic-oxide coated ferromagnetic material. Units using 32 bit loops with densities of 180 cells per in. are operated with magnetic crosstalk less than 2 per cent,

readout modulation less than 5 per cent, and a base distortion less than 5 per cent.

Write currents range from 4 to 20 ma. One unit, containing 85,000 cells on 40 tracks, is 8-3/4 in. diam and 6 in. high. In the Recomp II the memory unit capacity is 4096 words of 40 bits length, including 16 words in high-speed memory loops. Access time in the main memory is an average of 17.42 ms; in the high speed loops it is 1.82 ms.

For further information on this air-floating disc magnetic memory unit design or the Recomp II portable digital computer turn to the Reader-Service Card and circle 33.

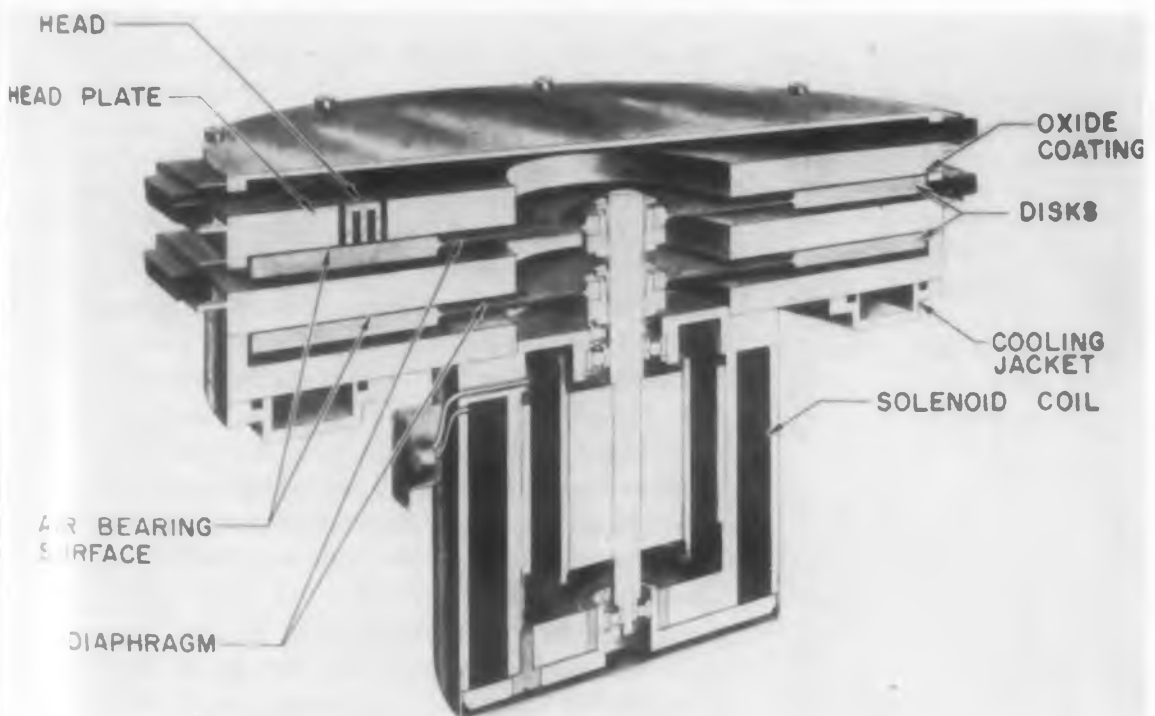
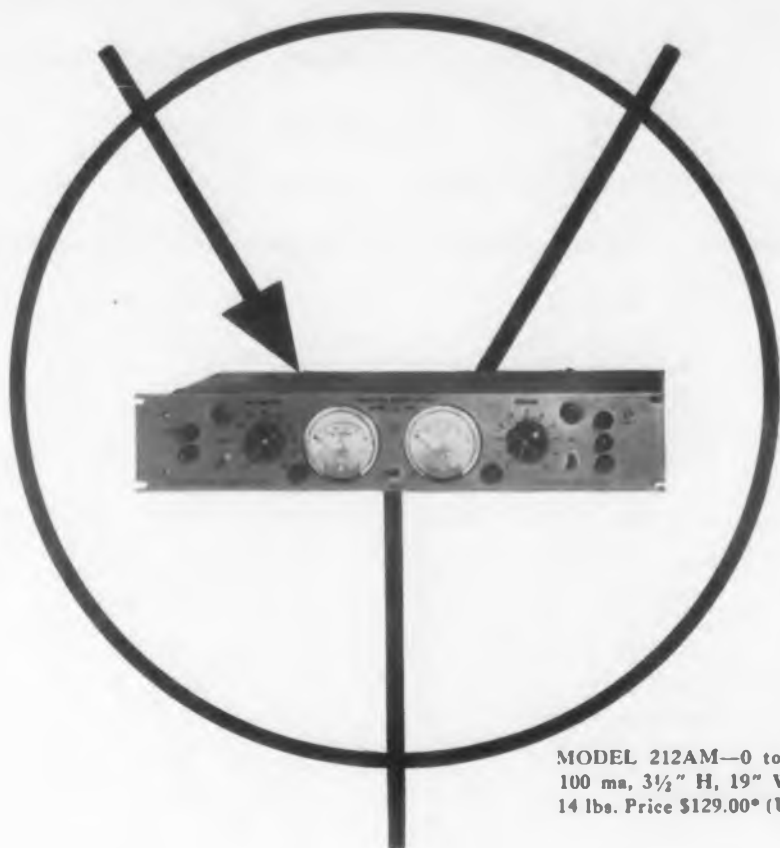


Fig. 3. Cutaway view of the magnetic disc memory. Two discs are shown mounted on the rotating shaft. The thin diaphragm provides extremely rigid coupling to the shaft, but permits flexure in an up-and-down direction. Need for difficult production tolerance and dimensional specs is reduced.



MODEL 212AM—0 to 100V dc;
100 ma, 3½" H, 19" W, 9¼" D;
14 lbs. Price \$129.00* (Unmetered)

Transistor Application Starts With ® REGATRON Power Packs

Over 96% of the applications of Regatron super-regulated Transistor Power Packs are for prototype development of transistorized equipment and for high-speed automatic transistor testing. That's because Regatron Transistor Power Packs are specifically designed to furnish transistor power.

They deliver full rated current over the entire voltage range . . . without loss of regulation or stability. They can be programmed from a remote location by means of an ordinary resistor, delivering one volt for each 1000 ohms of programming resistance.

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Model 212AM shown above has less than .0005 volt hum; regulation is within 0.1% or 0.02 volt over entire range of load and input voltage; output impedance is less than 1.0 ohm at 40 KC cycles, dropping off to less than 0.01 ohm at low audio frequencies. A modulation input is provided.

Other models available covering higher current and voltage ranges. Constant current models also available. Write for data file. Dept. 300.



MODEL 213AM—0 to 50V dc; 1 amp; 7" H, 19" W, 11" D; 35 lbs. Price \$345.00* (Unmetered)

*Metered units slightly more.



Leader in Power for Semiconductors

ELECTRONIC MEASUREMENTS CO., Inc.

Eatontown • New Jersey

CIRCLE 34 ON READER-SERVICE CARD

New Junction Transistors

Type	Class	Maximum Ratings					Characteristics				
		Max. Tem. (C)	W_c (mw)	mw/C	V_{cb} (volts)	I_c (ma)	β	$f_{\alpha b}$	NF (db)	C_{ob} ($\mu\mu f$)	I_{co} (μa)
OC73	p-n-p-a ge	60j	35	2.50	30	10	45	500K	10		3.5
TR77	p-n-p-a ge	50a	35		25	15	55	700K	7	40	10
TR105	p-n-p-a ge	50a	35		25	15	55	750K	8	17	5.0
TR269	p-n-p-a ge	71a	35	1.56	25	100		4000K		20	4.0
TR139	p-n-p-a ge	70a	35		16	15	45	4500K	5	9.5	6.0
TR218	p-n-p-a ge	70a	35		16	15	45	4500K	5	9.5	6.0
TR34	p-n-p ge	75j	50	1.00	40	50	40	600K	18	15	5.0
TRM34	p-n-p ge	75j	50	1.00	40	50	40	600K	18	15	5.0
2N306	n-p-n-a ge	75j	50	1.00	20		24	750K			200
TR35	p-n-p ge	75j	50	1.00	40	50	40	800K	16	18	5.0
2N229	n-p-n ge	75a	50		10	40	24	1600K			200
2N482	p-n-p-f ge	85j	50		12*	20		3000K		12	3.0
TR194	n-p-n-a ge	75j	50	1.00	15*	50	8	3000K	20	10	
TR216	n-p-a-a ge	75j	50	1.00	15*		8	3000K		11	
TR193	n-p-n-a-b ge	75j	50	1.00	15*	50	6	3500K		11	
TR211	n-p-n ge	75j	50	1.00	10*	50	30	3500K		10	
2N481	p-n-p-f ge	85j	50		12*	20		4000K		12	3.0
2N483	p-n-p-f ge	85j	50		12*	20		5000K		12	3.0
2N485	p-n-p-f ge	85j	50		12*	20		5000K		12	3.0
TR760	p-n-p-a ge	75	50		15		40	5000K		14	1.0
TR212	n-p-n-a ge	75j	50	1.00	10*	50	10	6000K	20	10	
2N484	p-n-p-f ge	85j	50		10*	20		9000K		12	3.0
2N486	p-n-p-f ge	85j	50		10*	20		9000K		12	3.0
2T71	n-p-n-g ge	65j	50	1.25	25	10	49	20M		1.0	12
2T72	n-p-n-g ge	65j	50	1.25	25	10	32	20M		1.0	12
TR763	p-n-p-a ge	75j	50		6.0		200	30M		14	1.0
2N213	n-p-n-a ge	75j	50		25*	100	150				200
2N233A	n-p-n-a ge	75j	50	1.00	10	50	5				150
2N398	p-n-p-a ge	85s	50		105	100	60				14
TR109	p-n-p-a ge	50a	50		25	70	70				10
TR217	p-n-p-a ge	50a	50		25	70	70				10
TR213	n-p-n-g ge	85j	65	1.10	15	20	25	5000K		2.4	.50
TR167	n-p-n ge	85s	65	1.10	30	75	25	8000K		4.0	.80
TR18	p-n-p ge	85	70		25		45	700K	12		15
TR87	p-n-p ge	85j	70	2.00	25		28	1000K	17	50	15
TR12	p-n-p-b ge	85j	70		25		15		12		15
TR13	p-n-p ge	85	70		25		28		12		15
TR14	p-n-p ge	85	70		25		45				15
TR81	p-n-p ge	85	70		25		65		12		15
TR88	p-n-p ge	85	70		25		65		12		15
TRM13	p-n-p ge	85	70		25		28		12		15
TRM14	p-n-p ge	85	70		25		45				15
TRM81	p-n-p ge	85	70		25		65		12		15
2N409	p-n-p-a ge	71a	80		12	15	48	14M	5		10
2N410		Flexible Lead Version 2N409									
2N411	p-n-p-a ge	71a	80		12	15	75	16.5M			10
2N412		Flexible Lead Version 2N411									
2N274	p-n-p ge	71a	80		35	10	60	30M	8	1.7	16
2N370	p-n-p-a ge	71a	80		20	10	60	132M			20
2N371	p-n-p-a ge	71a	80		20	10		132M			20
2N372	p-n-p-a ge	71a	80		20	10	60	132M			20
TR801	p-n-p-a ge	75s	90		12	100	25	2500K			6.0
GT948R	n-p-n ge	75s	90	1.80	10*			3500K		14	6.0
TR802	p-n-p-a ge	75s	90		10	100	40	5000K			6.0
GT792R	n-p-n ge	75s	90	1.80	10*			6000K		14	6.0
TR803	p-n-p-a ge	75s	90		10	100	70	11M			6.0
TR804	p-n-p-a ge	75s	90		6.0	100	120	17M			6.0

Legend: a-alloy, d-diffused, f-fused, g-grown, ma-microalloy, s-surface barrier, b-symmetrical or bi-directional, p-matched pair, 4-tetrode. Temperature; s-storage, a-ambient, [-]junction, *- V_{es} .

Transistor Data Supplement

BECAUSE of the general interest in the rapidly moving transistor field, there is distinct need for a mid-year supplement to ELECTRONIC DESIGN's annual July Transistor Issue. This supplementary compilation of transistors which is extracted from the October transistor list of Derivation and Tabulation Associates, Inc., includes all types introduced from August to October of 1957. The 196 new types in this listing, including those of a new American manufacture, make up about a 30 per cent increase over the total number of transistors which were being produced in October by 23 American and 14 foreign manufacturers.

For ease of reference the technical data sections of this compilation are presented by electrical characteristics. Junction transistors are listed in order of maximum collector dissipation, $f_{\alpha b}$, and type number. Power transistors are given in order of decreasing maximum thermal resistance or maximum collector dissipation, and type number. Following the technical data section is a cross index listing the transistors in order of type number and indicating all manufacturers.

Although these new transistors comprise but a minor portion of the total, the worldwide coverage evidenced here gives a sense of direction in the growth of the transistor field. It also emphasizes the rapid changes that can occur over a short period. Progress in the manufacture of transistors has altered the thinking and progress in design engineering and has created an additional need for current information in the field.

For those readers interested in complete and current transistor data in a similar format, subscriptions to D. A. T. A.'s quarterly Transistor

New Junction Transistors (cont.)

A complete survey of new transistor types available since July, 1957 (see ELECTRONIC DESIGN'S Transistor Data Chart, July 15, 1957).

Type	Class	Maximum Ratings					Characteristics				
		Max. Tem. (C)	W _c (mw)	mw/C	V _{cb} (volts)	I _c (ma)	β	f _{ab}	NF (db)	C _{ob} (μmf)	I _{co} (μa)
GT210H	p-n-p-a ge	75s	90		12	50	120				25
GT905R	n-p-n-p ge	75s	90	1.80	18*		40		14		6.0
GT949R	n-p-n ge	75s	90	1.80	12*		120		14		6.0
TR758A	p-n-p ge	85s	100		20	200	15	500K	16		5.0
2N130A	p-n-p-f ge	85j	100	1.70	40*	100	22	600K	15		6.0
TR63	p-n-p-f ge	85j	100	1.70	22*	150	22	600K	15		6.0
TR09	n-p-n-a ge	85s	100		30	200	30	700K			25
2N131A	p-n-p-f ge	85j	100	1.70	30*	100	45	800K	13		6.0
2N133A	p-n-p-f ge	85j	100	1.70	15*	100	50	800K	5		6.0
TR64	p-n-p-f ge	85j	100	1.70	15	150	45	800K	13		6.0
2N132A	p-n-p-f ge	85j	100	1.70	20*	100	90	1200K	11		6.0
CK754	p-n-p-f ge	85j	100	1.70	10*	100		1200K			5.0
TR65	p-n-p-f ge	85j	100	1.70	12	150	90	1200K	11		6.0
GTSMPA	p ge	85s	100	2.00	15		18	2500K	14	14	5.0
GTSMPB	p ge	85s	100	2.00	15		23	3000K	14	14	5.0
TR759	p-n-p-a ge	75j	100		15	100	25	3000K	16		
GTSMP C	p ge	85s	100	2.00	15		28	3500K	14	14	5.0
2N438	n-p-n-a ge	75j	100		25		25	3750K		10	10
TR182	n-p-n-a-b ge	75	100	2.00	25		25	3800K		10	3.0
GTSMPD	p ge	85s	100	2.00	15		33	4000K	14	14	5.0
TR04	n-p-n-a ge	75s	100		20	200	30	4000K			25
TR08	n-p-n-a ge	85s	100		20	200	30	4000K			20
GTSMP E	p ge	85s	100	2.00	15		38	4500K	14	14	5.0
TR792	p-n-p-a ge	85s	100		20	100	100	4800K			6.0
2N439	n-p-n-a ge	75j	100		25		40	7500K		10	10
TR183	n-p-n-a-b ge	75	100	2.00	25		40	7500K		10	3.0
TR123	p-n-p-a ge	85s	100	1.67	20	125	49	8000K		15	2.0
2N440	n-p-n-a ge	75j	100		25		50	15M		10	10
TR184	n-p-n-a-b ge	75	100	2.00	25		60	15M		10	3.0
TR764	p-n-p-a ge	85s	100		20	200	200	25M	16		5.0
TR03	n-p-n-a ge	85s	100		20	200	53				25
TR05	n-p-n-a ge	85s	100		20	200	30				25
TR07	n-p-n-a ge	85s	100		15	200	40				25
TR20	p-n-p-a ge	85s	100		30	200	20				5.0
2N404	p-n-p ge	71a	120		25	100		4000K			5.0
2N384	p-n-p-a ge	85a	120		30	10	60	100M		1.3	16
OC76	p-n-p-a ge	75j	125	2.50	32	125	45	350K	15		4.5
OC77	p-n-p-a ge	75j	125	2.50	60	125	45	350K	15		4.5
TR214	n-p-n-a ge	85j	125	2.50	10*		70	800K		15	200
TR19	p-n-p-a ge	85j	125	2.50	25		100	2000K	16	50	5.0
TR11	p-n-p-a ge	85s	125		100	100	18				450
TR15	p-n-p-a ge	85s	125		25	100	75		12		6.0
TR16	p-n-p-a ge	85s	125		25	100	150		12		6.0
TR17	p-n-p-a ge	85s	125		25	100	150		16		6.0
TR21	p-n-p-a ge	85j	125		12	100	20		30		6.0
TRM15	p-n-p-a ge	85s	125		25	100	75		12		6.0
TRM16	p-n-p-a ge	85s	125		25	100	150		12		6.0
TRM17	p-n-p ge	85s	125		25	100	150		16		6.0
TRM21	p-n-p-a ge	85j	125		12	100	20		30		6.0
TR762	p-n-p-f ge	85j	130	2.50	30	200	75	20M		12	1.0
TR761	p-n-p-f ge	85j	130	2.50	30	200					

List can be purchased by contacting Derivation and Tabulation Associates, Inc., 67 Lawrence Ave., West Orange, N.J.

New Power Transistors

Type	Class	Maximum Ratings				
		Tem. (C)	°C/W	I _c (amp.)	V _{cb} (volts)	I _{co} (ma)
2N326	n-p-n-a ge	85j		2.00	35	.50
2N325	p-n-p-a ge	85j		2.00	35	.50
2N296	p-n-p-a ge	85j		2.00	60	2.0
CTP1112	p-n-p ge	85j		3.00	80	
CTP1117	p-n-p ge	85j		3.00	40	
2N424	n-p-n-d si	150s		2.00	60	10
TF77	p-n-p-a ge	75j	13	.60	16	.020
TF77/30	p-n-p-a ge	75j	13	.60	32	.020
TF80/30	p-n-p-a ge	75j	4.0	2.5	32	.10
2N459	p-n-p-a ge	85s	3.0	3.00	105	.50
2N234	p-n-p ge	90j	2.0	3.00	30	
2N234A		same as 2N234				
2N236	p-n-p ge	95j	2.0	3.00	40	.33
2N236A		same as 2N236				
2N285A		same as 2N285				
2N399	p-n-p ge	90j	2.0	3.00	40	
2N400	p-n-p ge	95j	2.0	3.00	40	
2N401	p-n-p ge	95j	2.0	3.00	40	
2N421		same as 2N420				
2N418	p-n-p ge	95j	1.5	3.00	40	1.0
2N419	p-n-p ge	95j	1.5	3.00	50	2.0
2N451	n-p-n-d si	150j	1.5	5.00	65	20
2N441	p-n-p ge	95j	1.2	13	40	10
2N442	p-n-p ge	95j	1.2	13	50	10
2N443	p-n-p ge	95j	1.2	13	60	10
OC16	p-n-p-a ge	75j	1.2	1.5	32	.10
DT100	p-n-p ge	95j	1.0	13	100	10
H200E	p-n-p-a4 ge	95j	1.0	10	60	2.0

Legend: a-alloy, d-diffused, f-fused, g-grown, ma-microalloy, s-surface barrier, b-symmetrical or bi-directional, p-matched pair, 4-tetrode. Temperature; s-storage, a-ambient, j-junction, *-V_{ce}.

REX K-F WIRES

OFFER A NEW STANDARD OF
QUALITY IN HOOK-UP WIRES
FOR 1,000 VOLT SERVICE AT
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FROM -65°C to 175°C .

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Insulated with Kel-F*

MECHANICAL CHARACTERISTICS

- Good abrasion resistance
- Excellent resistance to cold flow
- Extremely flexible
- Smaller O.D. than wires of comparable values

ELECTRICAL PROPERTIES

- Dielectric constant between 2.5 and 3.0
- Good arc resistance
- Zero moisture absorption
- Resists wetting and high humidity

Available from stock in 17 solid colors — AWG sizes 10 through 30, also in 1, 2 or 3 stripes in any combination of 10 colors for almost unlimited color coding. Can also be supplied with braided shielding for special requirements.

Complete facilities for twisting single, insulated conductors in pairs, triplex or quads, cabling 808 conductors into a single core, and, for layer or sector type cabling are available. Application of braided shielding or spiral tape shielding over the core before jacketing a specialty. Jacketing done in polyethylene, vinyl, nylon, or Kel-F.

EFFECTS OF HEAT AGING ON WIRE INSULATED WITH "KEL-F" 500 RESIN

TEMPERATURE AND PERIOD	RMS VOLTAGE BREAKDOWN
Initial Value	13,500
150°C (302°F)	
1 Week	13,000
2 Weeks	14,600
5 Months	12,100
175°C (347°F)	
1 Week	13,500
2 Weeks	14,500
5 Months	5,200
190°C (374°F)	
2 Weeks	9,600

REX - K F

Operating Temperature	175°C to -65°C
Continuous Operating Voltage	1000 volts RMS
Spark Test	7500 volts RMS
Dielectric Strength	5000 volts RMS
Power Factor	.001-.011
Dielectric Constant	2.4-2.8
Insulation Resistance	< 5000meg./1000'
Moisture Absorption	Nil
Flammability	Non flammable
Solvent Resistance	Impervious to corrosive chemicals

Send for complete technical data

*T.M. M. W. Kellogg Co.

ELECTRONICS DIVISION



THE REX CORPORATION

210 Hayward Road
West Acton, Massachusetts

CIRCLE 35 ON READER-SERVICE CARD

New Junction Transistors (cont.)

Type	Class	Max. Tem. (C)	Maximum Ratings				Characteristics				
			W_c (mw)	mw/C	V_{cb} (volts)	I_c (ma)	β	f_{ab}	NF (db)	C_{ob} (μmf)	f_{α} (mc)
TR104	p-n-p-a ge	70a	150	2.50	30	50	44	700K	7	40	10
TR215	p-n-p-a ge	70a	150	2.50	30	50	44	700K	7	40	10
2N422	p-n-p-f ge	85j	150	2.50	20*	100	50	800K	5		6.0
TR43	p-n-p-f ge	100	150	2.00	45	50	50	1000K	22	40	10
TR43A	p-n-p-f ge	100	150	2.00	45	50	43	1000K	10	40	5.0
TR44	p-n-p-f ge	100	150	2.00	45	50	22	1000K	22	40	10
TR45	p-n-p-f ge	100	150	2.00	45	50	12	1000K	22	40	10
2N413	p-n-p-f ge	85j	150	2.50	18*	200	25	3000K		12	2.0
2N425	p-n-p-f ge	85j	150	2.50	20*	400	30	4000K		12	2.0
2N377	n-p-n-a ge	100j	150	2.00	25	200	40	5000K		15	6.0
2N414	p-n-p-f ge	85j	150	2.50	15*	200	30	5000K		12	2.0
2N385	n-p-n-a ge	100j	150	2.00	25	200	60	6000K			6.0
2N426	p-n-p-f ge	85j	150	2.50	18*	400	40	6000K		12	2.0
2N388	n-p-n-a ge	100j	150	2.00	25	200	80	8000K			6.0
2N416	p-n-p-f ge	85j	150	2.50	12*	200	80	10M		12	2.0
2N427	p-n-p-f ge	85j	150	2.50	15*	400	55	11M		12	2.0
2N428	p-n-p-f ge	85j	150	2.50	12*	400	80	17M		12	2.0
2N417	p-n-p-f ge	85j	150	2.50	10*	200	110	20M		12	2.0
2N405	p-n-p-a ge	71a	150		12	35	35				14
2N406											
2N407	p-n-p-a ge	71a	150		20	70	65				14
2N408											
2N413A	p-n-p-f ge	85j	150	2.50	18*	50				12	2.0
2N414A	p-n-p-f ge	85j	150	2.50	15*	50				12	2.0
2N415	p-n-p-f ge	85j	150	2.50	12*	50				12	2.0
2N415A	p-n-p-f ge	85j	150	2.50	12*	50				12	2.0
TR10	p-n-p-a ge	85j	150		50	100	18		16		25
2N464	p-n-p-f ge	85j	168	2.80	40*	400	22	600K	12		6.0
2N465	p-n-p-f ge	85j	168	2.80	30*	400	45	800K	12		6.0
2N359	p-n-p-f ge	85j	168	2.80	20*	400	150	1200K			10
2N360	p-n-p-f ge	85j	168	2.80	20*	400	100	1200K			10
2N361	p-n-p-f ge	85j	168	2.80	30*	400	70	1200K			10
2N362	p-n-p-f ge	85j	168	2.80	20*	400	120	1200K			10
2N363	p-n-p-f ge	85j	168	2.80	40*	400	50	1200K			10
2N466	p-n-p-f ge	85j	168	2.80	20*	400	90	1200K	12		6.0
2N467	p-n-p-f ge	85j	168	2.80	15*	400	180	1200K	12		
2T85	n-p-n-a ge	65j	200	4.00	25	100	45	1000K	5	30	
2N460	p-n-p-a ge	100j	200		45	400	24	1200K	9	50	15
2N461	p-n-p-a ge	100j	200		45	400	49	1200K	9	50	15
ST10	n-p-n si	175a	200		15		16	8000K	22	7.0	.02
ST30	n-p-n si	175a	200		30		16	8000K		7.0	.02
ST40	n-p-n si	175a	200		45		16	8000K	22	7.0	.02
ST11	n-p-n si	175a	200		15		30	11M	20	7.0	.02
ST12	n-p-n si	175a	200		15		60	11M	19	7.0	.02
ST31	n-p-n si	175a	200		30		30	11M	20	7.0	.02
ST32	n-p-n si	175a	200		30		60	11M	19	7.0	.02
ST41	n-p-n si	175a	200		45		30	11M	20	7.0	.02
ST42	n-p-n si	175a	200		45		60	11M	19	7.0	.02
ST13	n-p-n si	175a	200		15		45	17M	19	8.0	.02
ST33	n-p-n si	175a	200		30		45	17M	19	8.0	.02
HA5021	n-p-n-a ge	60a	300	6.70	20	200	49	5000K		15	10
HA5016	n-p-n-a ge	60a	400		30	200	50	1000K			5.0
HA7501	p-n-p-a si	150j	500	4.00	60	200		500K			.10
HA7502	p-n-p-f si	150j	500	4.00	60		16	900K			.10

Legend: a-alloy, d-diffused, f-fused, g-grown, ma-microalloy, s-surface barrier, b-symmetrical or bi-directional, p-matched pair, 4-tetrode. Temperature: s-storage, a-ambient, j-junction, *- V_{ces} .

CROSS INDEX

BAC	Bendix Aviation Corp.	MULB	Mullard Ltd.
CLE	Clevite Transistor Products, Inc.	RAYN	Raytheon Mfg. Co.
DEL	Delco Radio Div., General Motors Corp.	RCAS	Radio Corp. of America, Semiconductor Div.
GES	General Electric Co., Electronics Div.	SIHG	Siemens & Halske
GTC	General Transistor Corp.	SYLN	Sylvania Electric Products, Inc.
HAC	Hughes Aircraft Co.	TEC	Transitron Electronic Corp.
HYT	CBS-Hytron	TII	Texas Instruments, Inc.
ITC	Industro Transistor Corp.	TSE	Tung-Sol Electric, Inc.
MIN	Minneapolis-Honeywell Regulator Co., Transistor Div.	TTKJ	Tokyo Tsushin Kogyo, Ltd.

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<p>2N130A RAYN 2N131A RAYN 2N132A RAYN 2N133A RAYN 2N213 SYLN 2N229 SYLN 2N233A SYLN 2N234 BACE 2N234A BACE 2N236 BACE 2N236A BACE 2N274 RCAS 2N285A BACE 2N296 SYLN 2N306 SYLN 2N325 SYLN 2N326 SYLN 2N359 RAYN 2N360 RAYN 2N361 RAYN 2N362 RAYN 2N363 RAYN 2N370 RCAS 2N371 RCAS 2N372 RCAS 2N377 SYLN 2N384 RCAS 2N385 SYLN 2N388 SYLN 2N398 RCAS 2N399 BACE 2N400 BACE 2N401 BACE 2N404 RCAS 2N405 RCAS 2N406 RCAS 2N407 RCAS 2N408 RCAS 2N409 RCAS 2N410 RCAS 2N411 RCAS 2N412 RCAS 2N413 RCAS 2N414 RAYN ITC TSE 2N415 A RAYN ITC TSE 2N416 RAYN ITC TSE 2N417 RAYN ITC 2N418 BACE 2N419 BACE 2N421 BACE 2N422 RAYN 2N424 TII 2N425 RAYN ITC TSE 2N426 RAYN ITC TSE 2N427 RAYN ITC TSE 2N428 RAYN ITC TSE 2N438 HYT 2N439 HYT 2N440 HYT 2N441 DEL 2N442 DEL 2N443 DEL 2N451 GESY 2N459 TSE 2N460 TSE 2N461 TSE 2N464 RAYN 2N465 RAYN 2N466 RAYN 2N467 RAYN 2N481 RAYN 2N482 RAYN 2N483 RAYN 2N484 RAYN 2N485 RAYN 2N486 RAYN 2T71 TTKJ 2T72 TTKJ 2T85 TTKJ CK754 RAYN CTP1112 CLE CTP1117 CLE DT100 DEL GT210H GTC GT792R GTC GT905R GTC GT948R GTC GT949R GTC GTSMPA GTC GTSMPB GTC GTSMPD GTC GTSMPD GTC GTSMPD GTC</p>	<p>2N416 RAYN ITC 2N417 RAYN ITC 2N418 BACE 2N419 BACE 2N421 BACE 2N422 RAYN 2N424 TII 2N425 RAYN ITC TSE 2N426 RAYN ITC TSE 2N427 RAYN ITC TSE 2N428 RAYN ITC TSE 2N438 HYT 2N439 HYT 2N440 HYT 2N441 DEL 2N442 DEL 2N443 DEL 2N451 GESY 2N459 TSE 2N460 TSE 2N461 TSE 2N464 RAYN 2N465 RAYN 2N466 RAYN 2N467 RAYN 2N481 RAYN 2N482 RAYN 2N483 RAYN 2N484 RAYN 2N485 RAYN 2N486 RAYN 2T71 TTKJ 2T72 TTKJ 2T85 TTKJ CK754 RAYN CTP1112 CLE CTP1117 CLE DT100 DEL GT210H GTC GT792R GTC GT905R GTC GT948R GTC GT949R GTC GTSMPA GTC GTSMPB GTC GTSMPD GTC GTSMPD GTC GTSMPD GTC</p>	<p>H200E MIN HA5016 HAC HA5021 HAC HA7501 HAC HA7502 HAC OC16 MULB OC73 MULB OC76 MULB OC77 MULB ST10 TEC ST11 TEC ST12 TEC ST13 TEC ST30 TEC ST31 TEC ST32 TEC ST33 TEC ST40 TEC ST41 TEC ST42 TEC TF77 SIHG TF77/30 SIHG TF80/30 SIHG TR03 ITC TR04 ITC TR05 ITC TR07 ITC TR08 ITC TR09 ITC TR10 ITC TR11 ITC TR12 ITC TR13 ITC TR14 ITC TR15 ITC TR16 ITC TR17 ITC TR18 ITC TR19 ITC TR20 ITC TR21 ITC TR34 ITC TR35 ITC TR43 ITC TR43A ITC TR44 ITC TR45 ITC</p>	<p>TR63 ITC TR64 ITC TR65 ITC TR77 ITC TR81 ITC TR87 ITC TR88 ITC TR104 ITC TR105 ITC TR109 ITC TR123 ITC TR139 ITC TR167 ITC TR182 ITC TR183 ITC TR184 ITC TR193 ITC TR194 ITC TR211 ITC TR212 ITC TR213 ITC TR214 ITC TR215 ITC TR216 ITC TR217 ITC TR218 ITC TR269 ITC TR758A ITC TR759 ITC TR760 ITC TR761 ITC TR762 ITC TR763 ITC TR764 ITC TR792 ITC TR801 ITC TR802 ITC TR803 ITC TR804 ITC TRM13 ITC TRM14 ITC TRM15 ITC TRM16 ITC TRM17 ITC TRM21 ITC TRM81 ITC</p>
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FARLITE

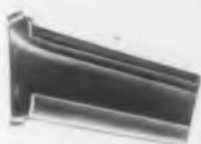


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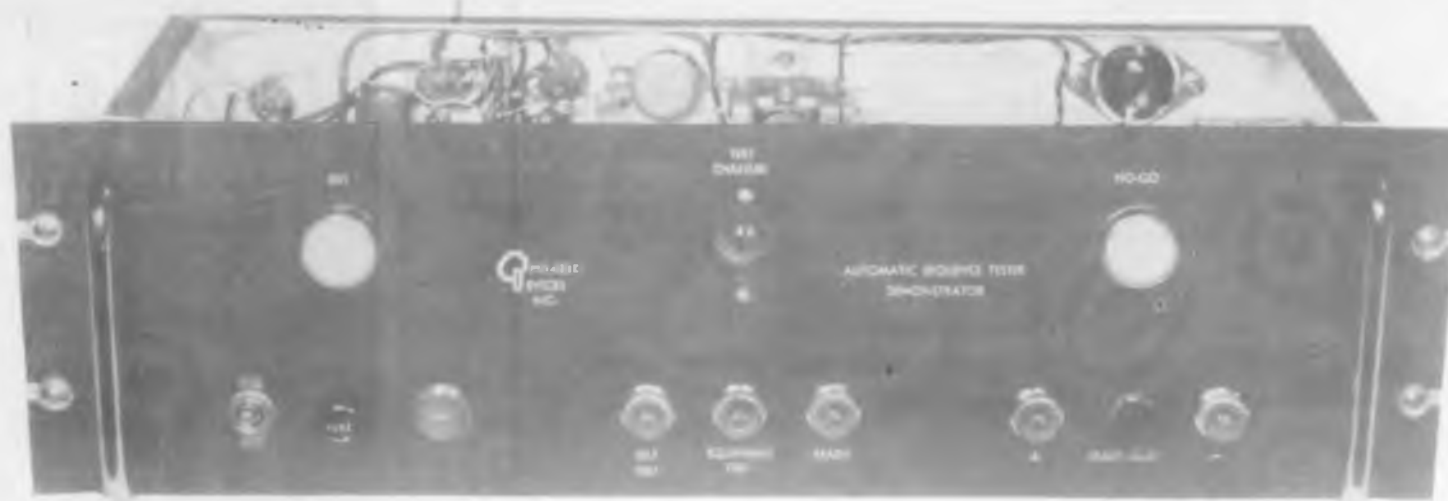


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CIRCUIT
STOCK



PLASTICS DIVISION
FARLEY & LOETSCHER MFG. CO.
DUBUQUE, IOWA

CIRCLE 36 ON READER-SERVICE CARD



The Standard Auto-test Set is designed for standard 19 in. rack mounting and has a 5-1/4 in. high panel.

save time and trouble with Automatic Sequence Tester

COMPLEX electronic equipment often requires a somewhat time consuming and complex checkout procedure to assure that it is functioning properly and ready for operation. Described here is an automatic go, no-go sequence tester for checking out a large number of preset characteristics of a system and to provide indication that the equipment is ready for operation.

The Autotest, developed and manufactured by Optimized Devices, Inc., P.O. Box 38, Gedney Station, White Plains, New York, programs and performs any number of pre-operational go, no-go tests and then initiates the operation only upon the successful completion of the test sequence. Any no-go indication halts the test sequence at the offending channel and shows where to look for trouble.

Before performing the necessary tests, the Autotest checks out its own circuits to be sure

it is performing properly. Designed to be built into custom installations, its function prevents energizing of any circuit which tests in excess of pre-established tolerances. It is readily adapted to all forms of measurements by proper selection of transducers to convert the physical or electrical phenomena to proper values for use in the test set.

Examples of Use

As an example of how this equipment performs, the Autotest was used to check out a radar computer which needed to be warmed up for three minutes and then have six separate voltages checked before operation. Voltage checks were as follows: 1000 v dc ± 20 per cent, 500 v dc ± 2 per cent, 300 v dc ± 2 per cent, -300 v dc ± 2 per cent, +24 v dc ± 20 per cent, and 115 v ac ± 10 per cent. The Autotest programmed the warmup, then automatically performed the en-

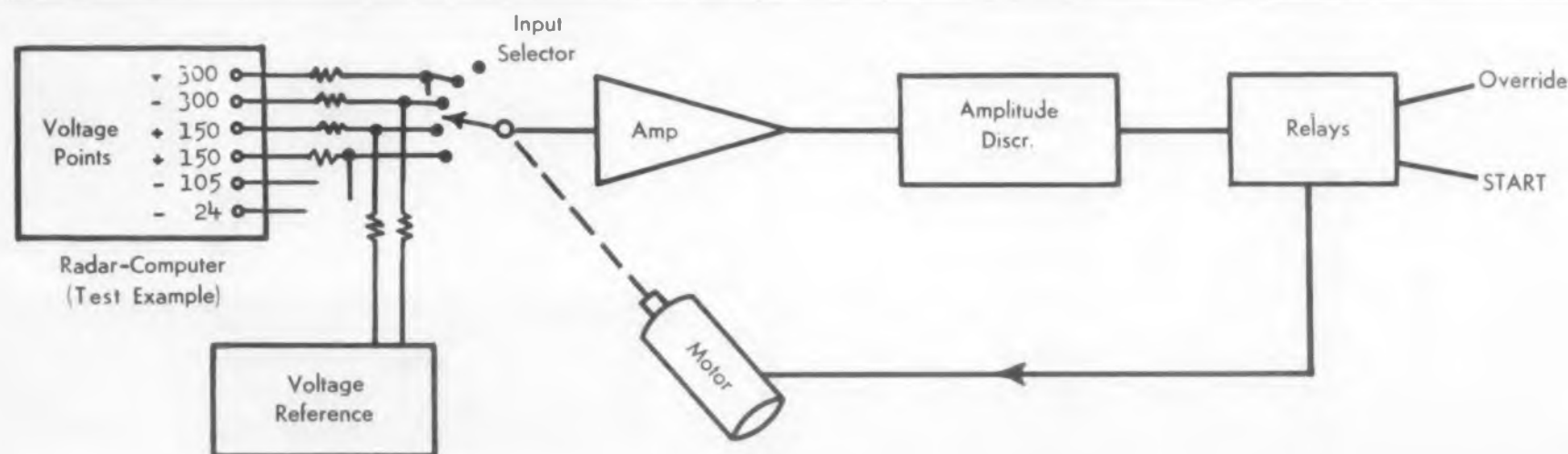
tire check out in a total of 3 sec. Another example is its use with a power supply where the Autotest checks power consumption, voltage output, current output, output impedance, and noise level. It checks itself and then performs the entire test procedure in 2 sec.

How It Works

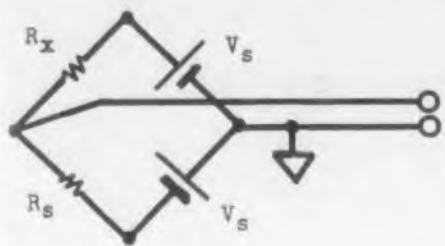
The designer orders the equipment to perform a specific series of tests. It follows the following sequence: (for block diagram and basic circuits see illustrations)

1. *Self check.* Four separate tests consisting of positive and negative, over-and-under limits, are performed near the threshold level to insure accuracy. Any indication of calibration drift or malfunction will stop the sequence before the system tests.

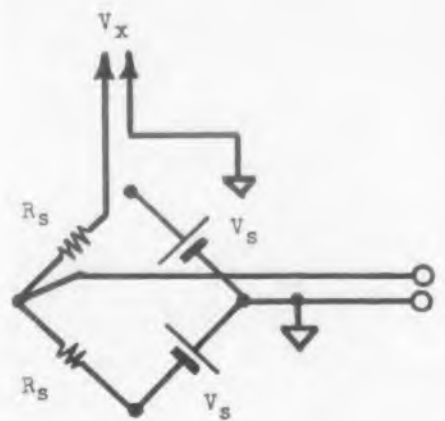
2. *System Check.* The Autotest follows a preset program of tests and performs a go, no-go



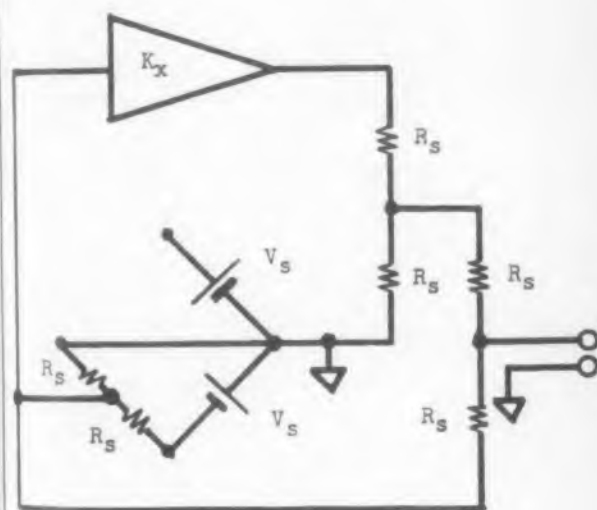
Basic equipment employed in the Autotest.



For Voltage



For Resistance



For Gain

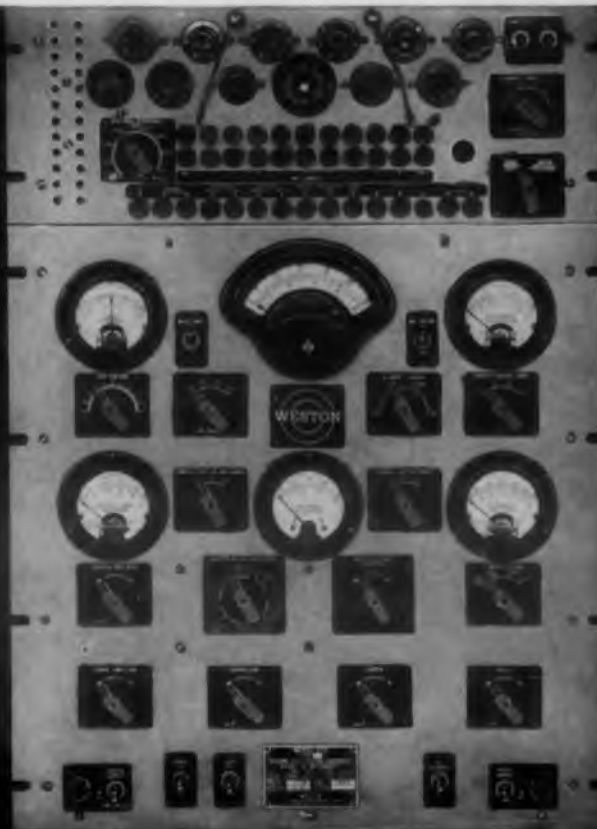
Bridge measuring circuits employed. The unknown has an x subscript in each case.

check on each test. Any no-go indication halts the testing, with neon displays indicating the faulty channel and the nature of the defect. The sequence of testing resumes immediately upon fault correction. Normal test speed is 4 channels per second.

3. *Ready Light.* Upon the successful completion of the test sequence, the ready light energizes and locks. The Autotest goes on standby, and further operations can be initiated.

For more information, turn to the Reader Service Card and circle 37.

ELECTRONIC DESIGN • January 22, 1953



LABORATORY MODEL (686)

A true mutual conductance analyzer that tests tubes under actual circuit operating potentials. Overall GM accuracy is 3% or better.

Transconductance is measured directly without need for null adjustments or corrections, providing GM readings on all receiving type tubes.

Circuit is mathematically calibrated and requires no calibrated tubes for GM circuit standardization.

A real laboratory for electron tubes. Model 686 is entirely self-contained, with a filtered d.c. power source, special circuitry to keep meter loading effects negligible, and a well regulated grid bias supply.

Tube Analyzers
by **WESTON**

PORTABLE MODEL (981)

- Filtered d.c. potentials provide better GM accuracy
- Voltage divider network for better grid bias settings
- Four signal levels provided protect against excessive grid current surges.
- Provision for tube interelectrode leakage measurements as high as 10 megohms.

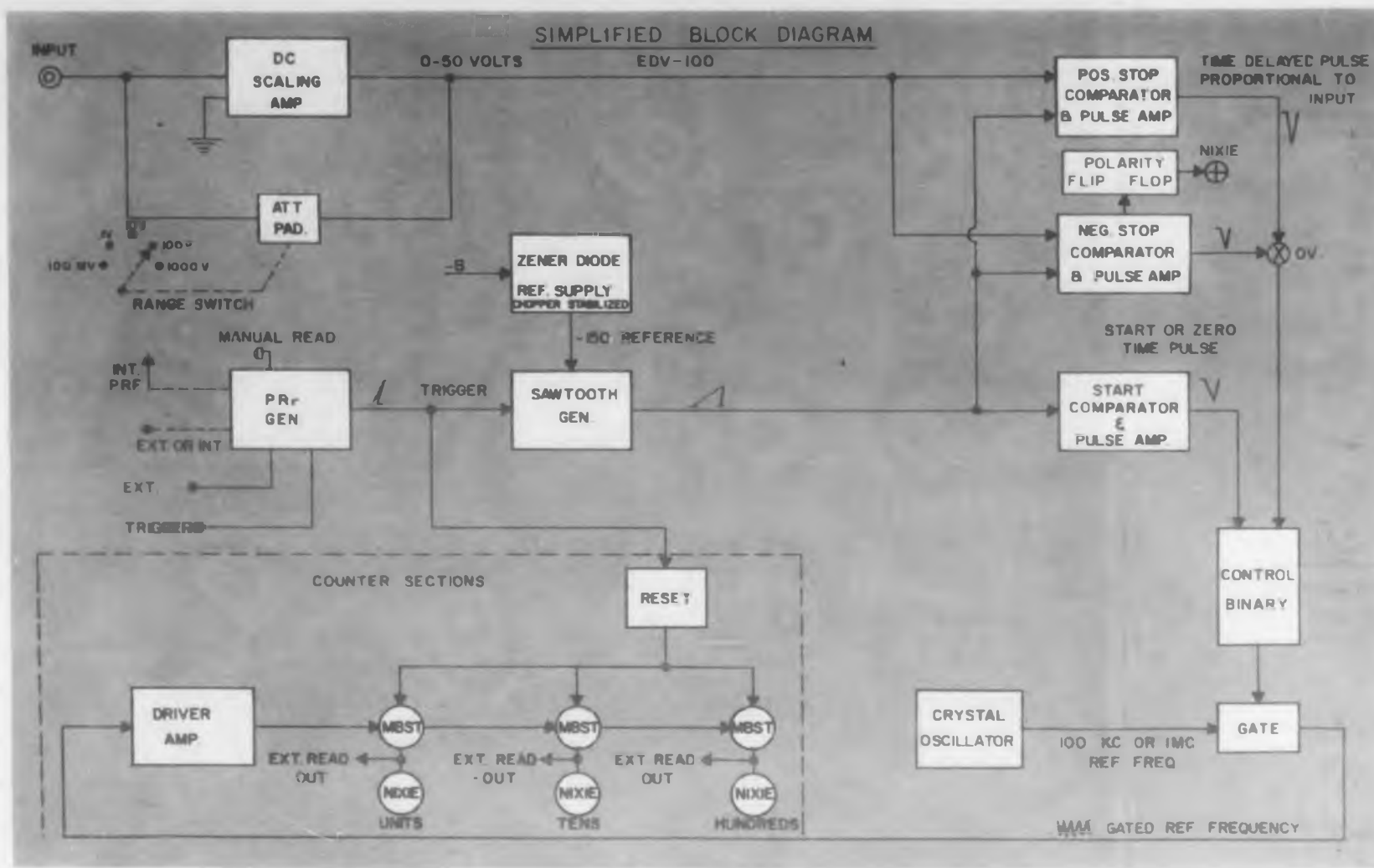


WESTON
TEST EQUIPMENT



CIRCLE 38 ON READER-SERVICE CARD

Whether for production quality control . . . laboratory analysis of tube characteristics . . . or quick accurate servicing of electronic equipment, WESTON tubecheckers are acknowledged leaders for accuracy, time-saving facility, and long term dependability. These and other Weston test instruments are available through leading distributors. Bulletin available by writing WESTON INSTRUMENTS, Division of DAYSTROM, INC., 614 Frelinghuysen Avenue, Newark 12, New Jersey.



Snappy Digital Voltmeter Reads Fast—Reads Right

WE GET to see many digital voltmeters. But when one comes along that can make 980 readings per second with an accuracy of 0.05 per cent full scale, we stop and take notice. When one can read the instrument at 40 feet and at angles up to 45 degrees, we become interested; and when the instrument boasts a full scale balance time of no more than 1 millisecond, we really want to know what makes it tick.

We spoke to Alexander Long who supervised the design for Servonics, Inc., 822 N. Henry St., Alexandria, Va. Here's what we found out.

The important elements of the instrument are:

- Three comparator circuits; a start comparator, and a separate stop comparator for positive and negative voltages.
- A sawtooth generator whose slope is linear to better than one part in 10,000.
- A crystal oscillator, with long term accuracy

to 10 parts per million.

- Magnetron beam switching tubes which boast a 50,000 hour life. They drive
- Nixie digital readout tubes.

Of course, even the best components don't make an instrument. It's how they're put together.

Time modulation provides the reliable counting. This simply means that pulses from a precise crystal oscillator are counted during an interval proportional to the input voltage. Here's how the Servonics Electronic Digital Voltmeter goes about it.

A diode circuit compares the input voltage with the very accurate sawtooth. Comparison begins shortly after the sawtooth starts. This eliminates zero set errors due to base line drift. A sync pulse, which initiates the comparison also triggers the beam switching tubes to start count-

ing pulses from the crystal reference frequency. When the sawtooth voltage reaches the level of the input voltage, a pulse is generated to stop the counters. The count on the Nixie readout tubes is then equal to the input voltage.

Basically, that's how the instrument works. Naturally, that's not all there is to it. There are a few sophisticated tricks. The comparator for negative voltages uses a summing network. In this case, the stop pulse is generated, not when the sawtooth equals the input voltage, but when their sum equals zero. The negative comparator also fires a flip-flop to operate the readout polarity indicator.

The pulses from both the start and stop comparators are differentiated and amplified to a rise time of 100 v per μ sec. These pulses trigger a control binary which gates the crystal oscillator output to the counter.



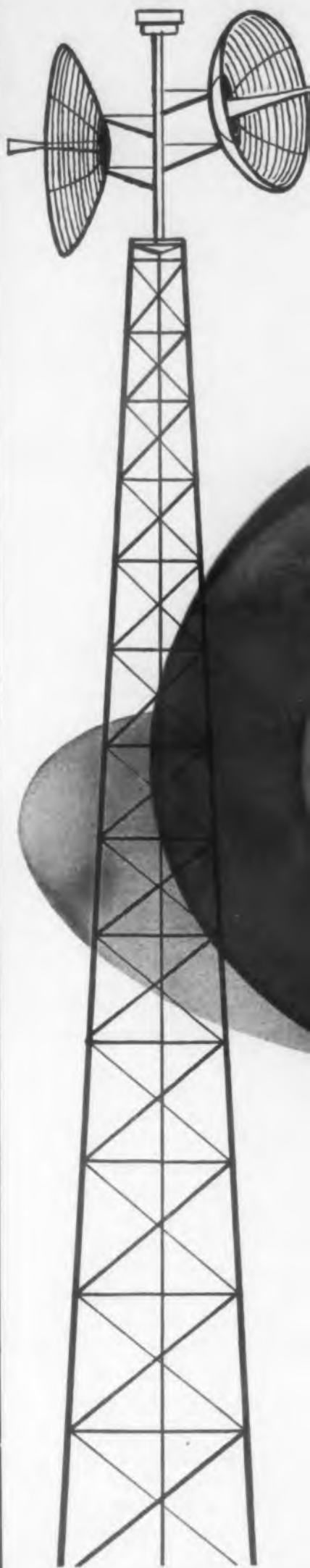
The beauty of the instrument lies not only in its accuracy, speed and flexibility, but also in its reliability. Accuracy depends on the proper functioning of only three components in a Miller integrator—a resistor, a capacitor, and a Zener diode. This diode can be replaced by an external reference voltage. All three are stabilized in an oven, controlled to within 1/2 deg. F. The diodes in the comparator circuits are stabilized in the same oven.

Various models of these electronic encoders are available. All have ranges from 100 mv to 1000 v full scale. An external amplifier is available to extend full scale sensitivity to 1 mv. All provide internal or external synchronization, automatic polarity indication and decimal point positioning.

In automatic testing, these meters can provide "go" or "no go" and proportional measurements. In addition to the visual output, outputs are available for use with counters and printers. These can include a staircase voltage for each decade, a 1-2-4-8 binary coded decimal, or a 1-2-4-2 binary.

Models are available to provide 3 or 4 digit readings, 0.05 or 0.01 per cent accuracy, and 98 or 980 readings per second, with the rate adjustable down to one per second.

More information is available if you turn to the Reader's Service Card and circle 39.



⇒ New polyclad insulation eliminates core taping



(Left) New Polyclad resin provides complete insulation, eliminates taping required for former uncoated core (shown above).

This excellent insulation, added to the unique properties of Hipersil® cores—highest permeability with lowest loss, 100% flux carrying activity, lowest volume and weight—means a better foundation for better transformers . . . smaller, lighter, more efficient, and at a lower unit cost.

Positive protection against the effects of humidity and high-voltage stress, new Westinghouse Polyclad resin coating eliminates the need for taping the core or encasing it in a plastic or aluminum box—*insulation costs are reduced 15%*. The resin forms a smooth, continuous coating; rounded corners prevent shorting wire to core, allow winding directly on core. Strains induced into the magnetic core are much less than with ordinary insulation—magnetic values stay constant.

For more information about Polyclad insulated Hipersil cores—and other Hipersil cores, as well as the complete line of Hipermag® and Hiperthin® cores—call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 231, Greenville, Pennsylvania.

J-70820

YOU CAN BE SURE...IF IT'S Westinghouse



CIRCLE 40 ON READER-SERVICE CARD

NEW PRODUCTS

To provide a complete coverage of ALL new products generally specified when designing electronic original equipment, the New Product section has been extended. To include the larger number of items, products which are best suited to a brief description have been noted at the end of the section.



CIRCLE 41 ON READER-SERVICE CARD

HIGH SPEED PRINTER

A Printing Speed of 4680 Lines Per Min is made possible by the combination of a Charactron shaped beam tube and a Xerox Copyflo printer manufactured by the Haloid Co. Designated the S-C 5000, the unit can be used in both the on-line method of receiving data direct from a computer and the off-line method of receiving data from magnetic tape.

Basically, the operation consists of translating a computer input into a display of numbers, letters, and symbols by means of the Charactron shaped beam tube. Inside this tube, small shaped openings form an electron beam into characters. These characters are projected by an optical system into the xerographic process, sensitizing the surface of a selenium drum. The latent images thus produced are developed with dry powder electrostatically and then printed on continuous rolls of paper.

Stromberg-Carlson Co., Dept. ED, 1895 Hancock St., San Diego 12, Calif.

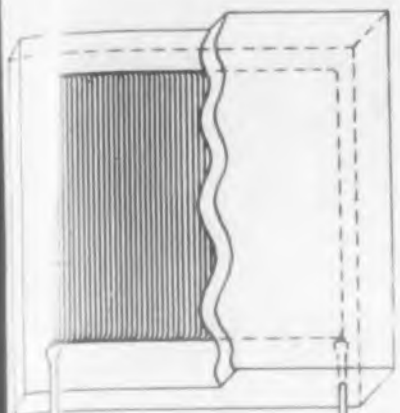


AC TO AC CONVERTER

Providing 400 CPS ± 0.01 Per Cent from a 400 cps ± 5 per cent source, model 2261 frequency changer has a unity power factor load of 60 va. Composed of 3 assemblies with a total weight of 5-1/2 lb., the design of the unit allows unusual versatility. For example, if only a single phase output is required, the phase splitting network be deleted; if a 28 v ac unit is available, the power supply section can be eliminated. Normal input is 115 to 208 v ac, with an output of 115 v ac regulated to 5 per cent.

Varo Mfg. Co., Inc., Dept. ED, 2201 Walnut St., Garland, Texas.

CIRCLE 42 ON READER-SERVICE CARD



WIREWOUND RESISTORS

No Bobbin or Winding Form in these resistors makes possible smaller size and a high stability. The winding process permits resistance elements and contacts to be firmly embedded in epoxy resin. Stability is stated as a permanent change in resistance of less than 0.2 per cent under such conditions as humidity and temperature cycling per MIL-R-93. Other features include close tolerances, low inductance and capacitance characteristics with uniform frequency response. Eleven standard rectangular types and four standard tubular types are available. Power ratings range from 1/4 to 2 w.

Chicago Telephone Supply Corp., Dept. ED, Elkhart, Ind.

CIRCLE 43 ON READER-SERVICE CARD



ANALOG TO DIGITAL CONVERTER

Silver Graphite Wipers Provide Longer Life for this unit than is obtainable with available converters equipped with precious metal wipers. Type AB-00003 has ruggedized construction permitting operation under shocks of 50 g for 9 msec, accelerations of 100 g and vibrations of 36 to 2000 cps at 20 g. Service free life expectancy is given as 1.12×10^8 contact closures.

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

CIRCLE 44 ON READER-SERVICE CARD

SPEED

Research and Development!

PRECISION

Trimmer Piston Capacitors

for expediting experimental circuitry design



actual size

Minaturization • Automation • Navigation
Communication • Guidance Systems • Missiles
Telemetry • Radar • Nucleonics • Computers

At your fingertips the JFD Trimmers you want when you want them—when you keep these versatile JFD Piston Capacitor Kits on hand. Complete with electrical characteristic charts and handy dust-proof styrene case. Also available—comprehensive PK260 Laboratory Assortment—260 essential JFD Piston Capacitors in compact metal cabinet. Write for engineering bulletins.



No. PK10 KIT Glass & Quartz Trimmers (Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC5	1	0.6-6
VC11	1	0.8-10
VC12	1	9-21
VC1G	1	0.7-9
VC3G	1	0.7-9
VC4G	1	0.8-18
VC8GA	1	1-8
VC11G	1	0.6 to 14
VC13GA	1	1.5-12
VC30G	1	0.8 to 30

No. PK11 KIT Miniature Trimmers (Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC20G	1	0.8-8.5
VC21G	1	0.8-4.5
VC22G	1	0.7-12
VC23G	1	0.8-18
VC24G	1	1-30

No. PK12 KIT Miniature Printed Circuit Trimmers (Lug and Lead Type)		
Cat. No.	Quantity	Cap. (mmf)
VC9G	1	0.8-8.5
VC10G	1	0.8-4.5
VC31G	1	0.8-12
VC32G	1	0.8-18
VC43G	1	0.8-30

No. PK13 KIT Miniature Printed Circuit Trimmers (4 Wire Lead Type)		
Cat. No.	Quantity	Cap. (mmf)
VC9GW	1	0.8-8.5
VC10GW	1	0.8-4.5
VC31GW	1	0.8-12
VC32GW	1	0.8-18
VC43GW	1	0.8-30

No. PK14 KIT Glass Dielectric Split Stator Trimmers (Standard Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC16G	2	*0.8-2.5
		0.5-5.0
VC17G	2	*1.1-4.5
		0.6-8.5
VC18G	1	*1.8-7.5
		0.7-14.0

No. PK15 KIT Quartz Dielectric Split Stator Trimmers (Standard Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC80	1	*0.4-1.0
		0.3-2.0
VC81	1	*0.6-1.6
		0.4-3.2
VC82	1	*0.85-2.8
		0.5-5.5
VC83	1	*3.0-6.0
		4.8-11.0

* PLATE TO PLATE

No. PK16 KIT Glass Dielectric Trimmers (Standard Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC1G	1	0.7-9
VC3G	1	0.7-9
VC4G	1	0.8-18
VC5G	1	0.8-18
VC6GA	1	0.8-18
VC7G	1	2-30
VC11G	1	0.6-14
VC13GA	1	1.5-12
VC30G	1	0.8-30

No. PK17 KIT Quartz Dielectric Trimmers (Standard Panel Mount Type)		
Cat. No.	Quantity	Cap. (mmf)
VC2	1	0.7-4.5
VC5	1	0.6-6
VC11	1	0.8-10
VC12	1	9-21



Pioneers in Electronics since 1929

ELECTRONICS CORP.

Brooklyn 4, New York

JFD INTERNATIONAL

15 Moore Street
New York, N.Y.

JFD CANADA LTD.

51 McCormack Street
Toronto, Ontario, Canada

CIRCLE 45 ON READER-SERVICE CARD



DESIGNER'S



ROUND MODEL



SQUARE MODEL



PORTABLE MODEL



PROTECTIVE CONDUIT CASE

New General Electric time meters provide easier reading, cost less

OLD
(Life Size)



99940.9

NEW
(Life Size)

Now, at a new low cost, you can build-in a far more readable measurement of operating time of your electronic equipment with new General Electric Time Meters. New, easy-to-read dials are 2½ times larger than dials on ordinary time metering equipment. This reduces the chances of errors in readings, speeds up routine checking.

More precise, wider-range measurement is provided, too. Each of the meters in this new and complete line has an extra 1/10 digit to permit finer measuring . . . from 0 to 99999.9 minutes or hours.

Operating temperature range—now from -67 F to 150 F—has been widened to increase possible uses, lengthen meter life.

On all but sealed models, a conveniently located reset knob is available optionally. Extended terminals on all models simplify hookup, and totally enclosed construction provides dustproof protection.

A special model is also available to meet military specifications MIL-M-6A, paragraphs 4.6.1, 4.5.16, and 4.6.18A.

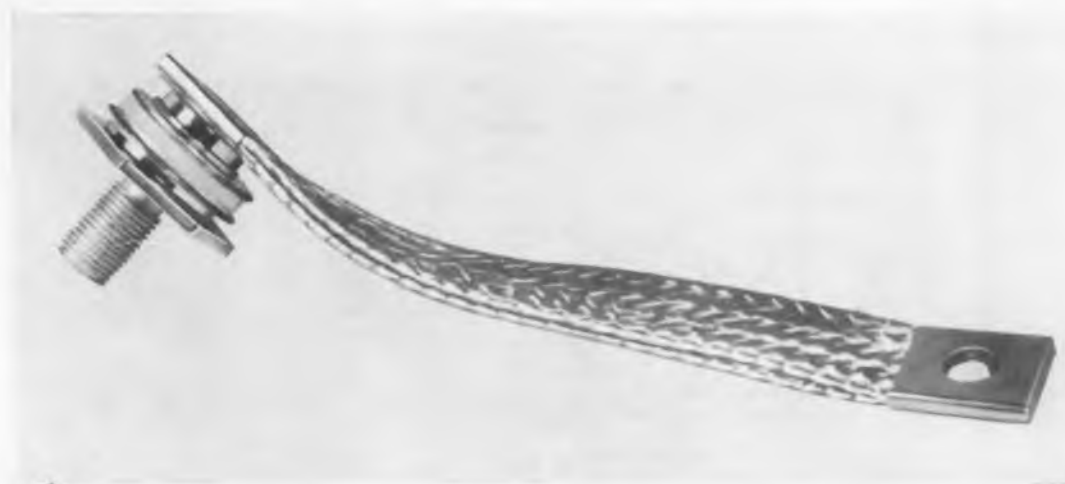
Round and Square models, with or without reset, for mounting on panels or test equipment, are made in 2½ and 3½ inch sizes. **Portable stand meter** is for laboratory use or where a permanent mounting is not desirable. **Protective conduit case** is easily installed, helps protect against moisture. For details, see Bulletin GEA-6710.

Now—G-E silicon cells with either polarity simplify equipment design

New high-power silicon rectifiers made by General Electric are now available with either positive or negative base, to simplify your design of power supply equipment. You can now use the negative and/or positive busbar for a combination heat sink, current conductor, and mechanical support for the cells. Construction of stacked assemblies is also simplified.

Large flexible take-off leads are used to increase the effectiveness of heat transfer from the cell. Axial or radial flexible leads are provided according to the particular application.

Hermetically sealed General Electric silicon component rectifiers are available in all voltage ratings up to 350 PIV. Low forward-voltage drop and efficient thermal package permit current ratings up to 140 amperes. For more information, check Bulletin GEC-1470.



HERMETICALLY SEALED silicon cell shown above is mounted on a standard ½-20 stud for mounting on a plate-type heat sink. Cell can also be furnished on a ¼-in. pipe thread stud for other types of heat sinks, including liquid-cooled busbars.

ACTUAL-SIZE VIEW of G-E silicon rectifier cell shows the hermetically sealed silicon wafer. This construction has been performance-tested for 4 years in G-E high-power germanium rectifier equipment totalling over 55,000 kw.



GENERAL ELECTRIC

CIRCLE 46 ON READER-SERVICE CARD

At half the cost of metal-clad tubular capacitors— Subminiature molded PVZ* capacitors operate from -55C to +125C

Critical space and temperature problems in electronic design can be solved with less effort and at far less cost with the help of General Electric's molded PVZ paper tubular capacitors. Now immediately available, these capacitors are priced at less than half the cost of comparable metal-clad tubulars. Subminiature units are designed for a minimum of one year's life at rated voltage and 125C operation.

MEETING EXACTING CIRCUIT NEEDS

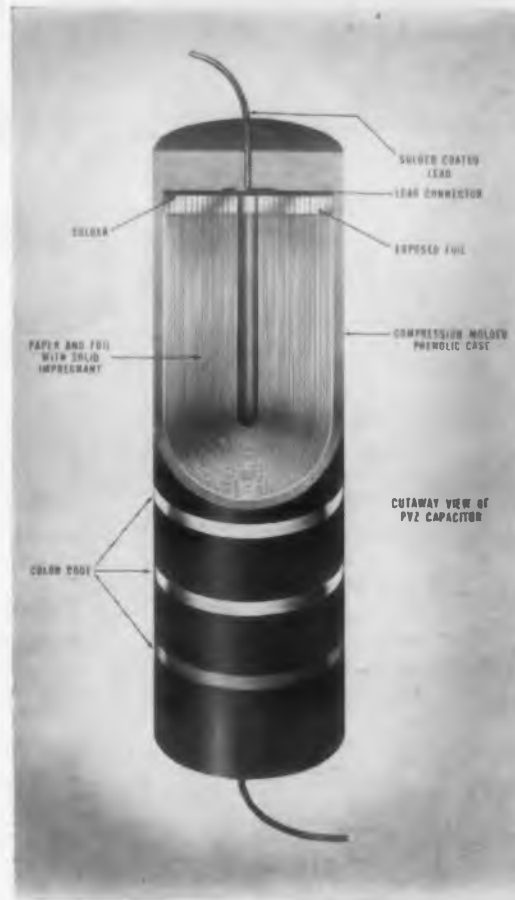
These molded PVZ capacitors meet the performance requirements of Characteristic "E" for MIL-C-91A, and at the present time are being widely used in computers, missiles, and other high-grade military and commercial electronic equipment. PVZ paper tubular capacitors are impregnated with a high-temperature organic resin and feature extended foil construction throughout. The solid capacitor rolls are contained

*Trade-mark of General Electric Company.

in a mineral-filled phenolic plastic case. Completely solid after molding, the unit offers high lead strength and excellent resistance to shock, vibration and moisture because of the high-grade case material and controlled molding techniques.

RATINGS COVER WIDE RANGE

General Electric PVZ capacitors are supplied in 100, 200, 300, and 400 volt ratings. Microfarad values range from .00047 to .15 uf at 100 volts; .00047 to .1 uf at 200 volts; .00047 to .068 uf at 300 volts; and .00047 to .022 uf at 400 volts. Units are available with $\pm 20\%$, $\pm 10\%$ and $\pm 5\%$ tolerances. Nine different sizes are offered, ranging from .175 inch diameter by .625 inch long to .375 inch diameter by 1.0625 inches long. Microfarads, volts, and capacitances are indicated by a convenient color code. See Bulletin GEC-1452, listed below.



CUTAWAY VIEW OF PVZ capacitor shows its insulated body and solid impregnant. These features provide resistance to shock, moisture.



SPACE-SAVING, subminiature PVZ capacitors range in size from .175 inch diameter by .625 inch long to .375 inch diameter by 1.0625 inches long.

High power, extra-fast response are combined in space-saving d-c motor-tachometer unit

Small size, great power and fast response are the outstanding features of this General Electric d-c motor-tachometer unit. It is readily applicable to practically any servo system. An example of its use is the driving

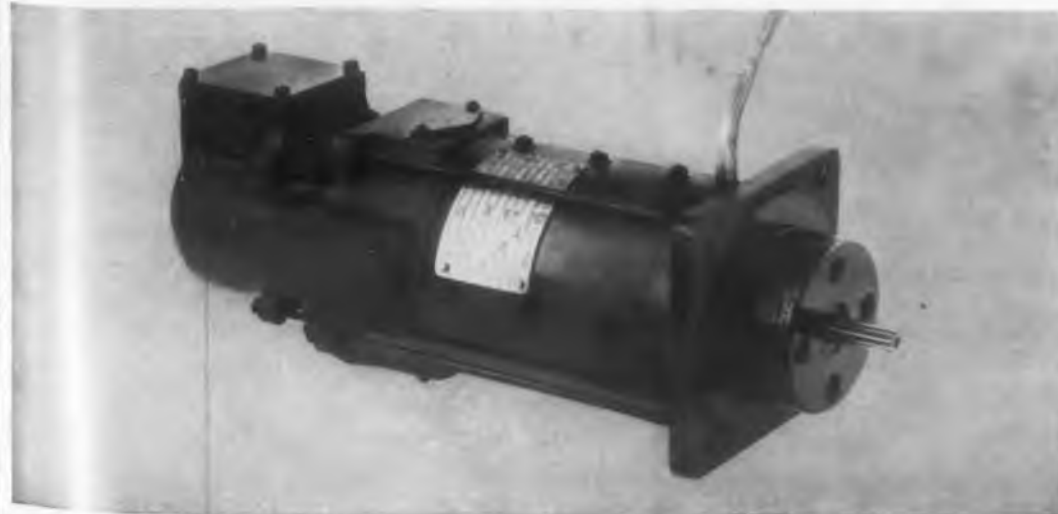
of a ground radar antenna in a missile guidance system.

Model shown is less than 15 inches long and only 5.16 inches in diameter—yet it packs 2.2 hp at 5500 rpm, 200 volts d-c,

with Class B insulation. Motor reaches 63 per cent of rated speed in only .014 seconds from standstill. When blower-cooled by the customer, it delivers 2.65 lb-ft of torque over the entire speed range from standstill

to 4500 rpm. Stall torque is 10 lb-ft.

Motor is made in two frame sizes, operates at any angle, and uses any d-c control power supply. For more information, check your nearest Apparatus Sales Office.



GENERAL ELECTRIC COMPANY, APPARATUS SALES DIVISION, SECTION B667-38,
SCHENECTADY 5, NEW YORK

Please send me the following:

for reference only

for planning an immediate project

GEA-6710 Time meters

GEC-1452 Molded tubular capacitors

GEC-1470 High-current silicon rectifiers

For more information on other products, contact your nearest G-E Apparatus Sales Office.

NAME

COMPANY

CITY

STATE

CIRCLE 46 ON READER-SERVICE CARD



- LESSON ONE
Transistors**
Fundamental Theory
- Junction Theory
 - Atomic Structure
 - Quantum Theory of Valence
 - Carrier Bands
 - Semiconductor "N" Type
 - Semiconductor "P" Type
 - Hole Conduction
 - Junctions
 - Semiconductor Junction
 - Forward and Reverse Bias
 - PN Junction Transistor
 - Currents
 - Half-Arrhenius Transistor
 - Power Tube Construction



To help you...

4 NEW

CBS

TECHNICAL

AIDS

Here are four new CBS technical publications on tubes and semiconductors. Each is especially designed to make life easier for electronic technicians and engineers:

Technician's Handbook...

compact, comprehensive ready-reference data by and for the electronic service technician. Only \$1.50 net.

Engineer's Handbook...

complete EIA data and two-color curves by and for engineers — and technicians who want all the facts. Only \$7.50 net.

Transistor Course...

fast, fascinating home-study course — teaches basic fundamentals of transistors through use. Available from CBS Tube distributors.

Tube Tips...

monthly inside information on tubes and semiconductors — especially for service technicians. From CBS Tube distributors only.

You'll want all four of these CBS technical aids. See them . . . examine them . . . get them at your CBS Tube distributor's . . . today!

ELECTRON TUBES



SEMICONDUCTORS

CBS-HYTRON, Danvers, Mass.

A Division of
Columbia Broadcasting System, Inc.

For the best in entertainment tune to CBS

NEW PRODUCTS

Transmitter-Receiver

Frequency Division Multiplex Type



The Voiceplex model VP-55-1A utilizes a frequency division multiplex method to permit transmission of two voice channels in the same frequency spectrum normally occupied by one. The system may be used on radio circuits, land-line telephones, vhf links, scatter relays, or similar facilities. Spectrum requirements are 300 to 3000 cps. The transmitter contains a two-channel switching encoder circuit, a high-stability low-frequency oscillator, a synchronizing signal generator, and an audio frequency amplifier. The receiver includes decoder, synchronizing receiving circuitry, filters, two audio amplifiers.

Kahn Research Laboratories, Inc., Dept. ED,
22 Pine St., Freeport, L.I., N.Y.

CIRCLE 48 ON READER-SERVICE CARD

High Directivity Couplers

3 and 6 Db



Two new series of high directivity couplers, of 3 db and 6 db values and with six models in each category, cover the frequency range from 2.6 to 18 kmc. The units, like previous models, are multi-holed and consist of a primary and secondary line with the coupling holes contained in a common wall. In this series, however, the common wall is the broad wall and therefore permits a high degree of uniformity of coupling as well as a minimum frequency sensitivity to be maintained in the unit. One end of the secondary line has a built-in low vswr termination to insure high directivity.

Narda Microwave Corp., Dept. ED, Miraflores,
N.Y.

CIRCLE 49 ON READER-SERVICE CARD

Sampling Switch

Low Level, High Speed Unit
with Replaceable Contacts



Intended for use in systems where it is necessary to measure voltages in the low millivolt region, this switch uses a permanent magnet rotor to sequentially operate individually hermetically sealed stationary type contacts. Shown is a 40-contact, 30-rps, 5-in. diam switch with a 110-v, 60-cps synchronous motor and one of the individually replaceable contacts. Also shown on the switch is a magnetic head, available as optional equipment. One or more of these heads may be used to provide pulses for channel identification, system timing, and gates.

Specifications include dynamic contact resistance below 0.25 ohms; open circuit resistance above one million meg; minimum switch cycle time including break-away, transit, and dwell times under 500 μ sec; contact make or break current up to 10 ma; voltage up to 10 v; life in excess of 50 million contact operations.

Magnavox Co., Dept. ED, 2255 Carmelina Ave., Los Angeles 64, Calif.

CIRCLE 50 ON READER-SERVICE CARD



Universal Meter Case
For 2- or 3-in. Meter

This meter case can accommodate either a 2-in. or a 3-in. meter, accomplished by means of a knock-out ring. Bottom and back are easily detachable for installing and servicing. Another universal type enclosure offered is a sloping panel cabinet. Both products may be obtained in steel or aluminum with grey hammertone finish.

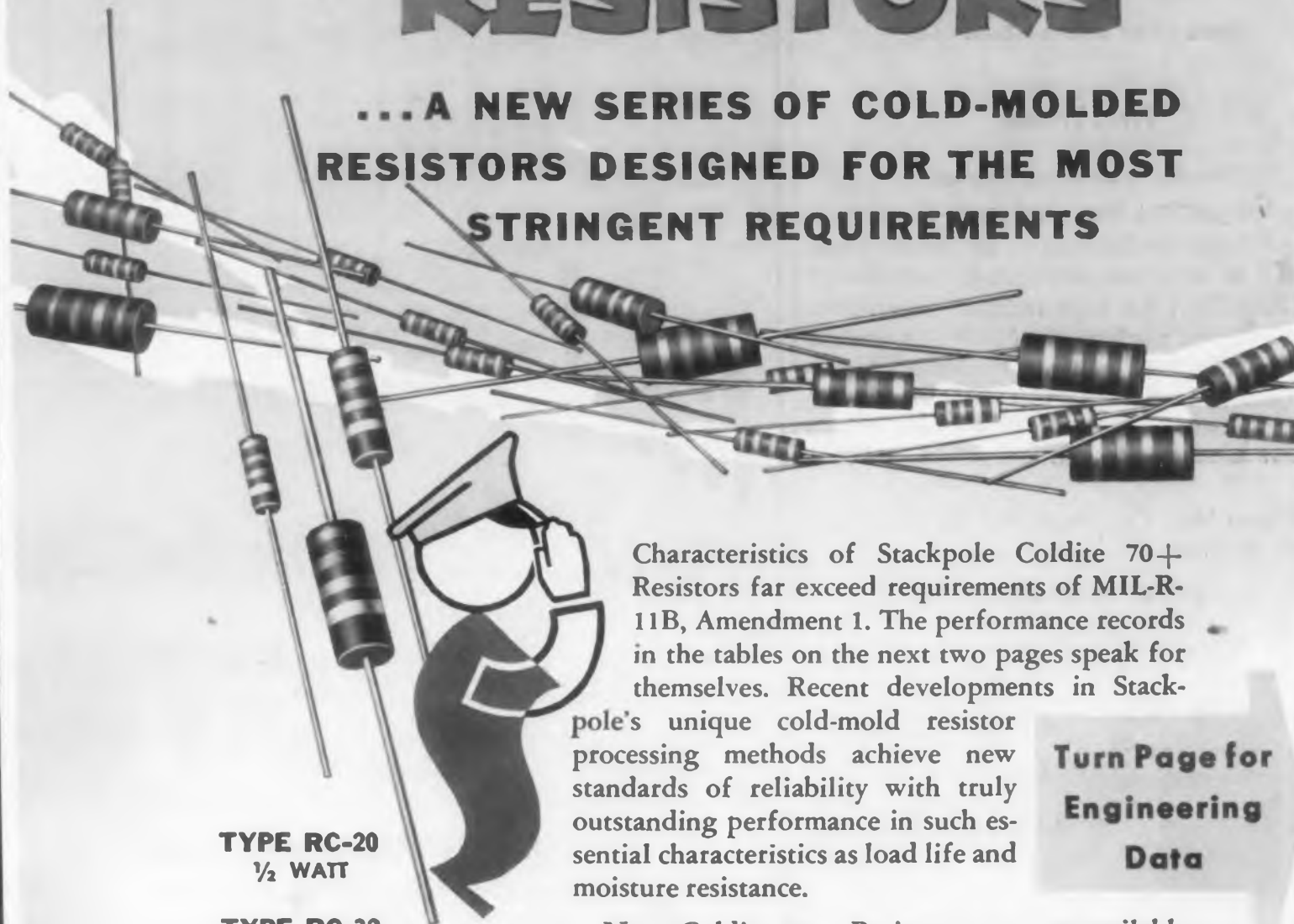
Boyd Radio, Inc., Dept. ED, 2118 E. 55th St., Cleveland, Ohio.

CIRCLE 51 ON READER-SERVICE CARD

Announcing...

STACKPOLE Coldite 70+[®] FIXED COMPOSITION RESISTORS

...A NEW SERIES OF COLD-MOLDED
RESISTORS DESIGNED FOR THE MOST
STRINGENT REQUIREMENTS



TYPE RC-20
1/2 WATT

TYPE RC-32
1 WATT

TYPE RC-42
2 WATTS

Characteristics of Stackpole Coldite 70+ Resistors far exceed requirements of MIL-R-11B, Amendment 1. The performance records in the tables on the next two pages speak for themselves. Recent developments in Stackpole's unique cold-mold resistor processing methods achieve new standards of reliability with truly outstanding performance in such essential characteristics as load life and moisture resistance.

New, Coldite 70+ Resistors are now available in MIL-R-11B Styles RC-20 (1/2-watt) RC-32 (short 1-watt), and RC-42 (2 watts) . . . in all standard resistance values . . . and at regular resistor prices.

Turn Page for
Engineering
Data

CIRCLE 52 ON READER-SERVICE CARD

NEW PRODUCTS



**Volt-Ohm-Frequency
Meter**
Battery Operated

Model B volt-ohm-frequency meter is a battery-operated combination instrument with these characteristics: frequency range from 380 to 420 cps; ac-dc ranges to 300 v; resistance ranges to 2 meg; and accuracies of ± 0.25 cps, 3 per cent dc, and 5 per cent ac full scale.

Avco Manufacturing Corp., Lycoming Div., Dept. ED, Stratford, Conn.

CIRCLE 53 ON READER-SERVICE CARD

Twin Triode

for Pulse or Servo Drivers

Type CK5687WA twin triode is for use in pulse or servo driver applications in equipment which operates in a severe mechanical environment. The CK5687WA has high emission capabilities, high perveance, medium μ (18.5) and controls for plate emission as well as for minimum formation of cathode interface resistance. Cathode current maximum for each section is 65 ma dc and the total allowable dissipation for both plates is 7.5 w.

Raytheon Mfg. Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE 54 ON READER-SERVICE CARD



Console Cabinet

for Machine Controls

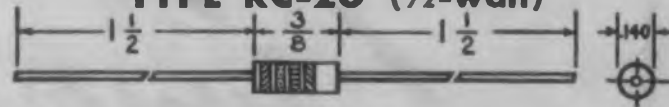
This console cabinet is offered in a standard stock size for machine controls. The unit is constructed from 14 gauge steel and is oil and dust tight. Inside the body there is a removeable 27 x 19 in. subpanel for mounting relays.

Hoffman Engineering Corp. Dept. ED, Anoka, Minn.

CIRCLE 55 ON READER-SERVICE CARD

STACKPOLE Coldite 70+

TYPE RC-20 (1/2-watt)



Average Percent Resistance Change

10 ohms		270,000 ohms		22 megohms	
COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B
1.6	3.25	2.1	7.5	5.6	12.5
3.8	6.5	7.1	15.0	16.2	25.0
1.4	2.5	0.1	5.0	3.7	7.5
2.0	5.0	3.2	10.0	3.5	15.0
not applicable		0.0164	0.0350	0.0277	0.0350
0.2	2.0	0.2	2.0	1.5	2.0
0.05	3.0	0.1	3.0	0.2	3.0
0.1	4.0	0.1	4.0	0.4	4.0
3.5	10.0	4.7	10.0	4.4	10.0
0.3	2.5	0.4	2.5	0.3	2.5
0.3	6.0	1.6	6.0	0.2	6.0
0.5	6.0	0.9	6.0	0.7	6.0
0.2	6.0	0.6	6.0	1.2	6.0
0.3	6.0	0.5	6.0	1.0	6.0
0.02	1.0	0.1	1.0	0.5	1.0
0.4	3.0	0.5	3.0	0.5	3.0

All Stackpole Type RC-20 Coldite 70+ Resistors withstand standard tests of 700 volts r.m.s. at atmospheric pressure for 5 seconds as well as 450 volts r.m.s. at 3.4 inches of mercury for 5 seconds without damage, arcing, or breakdown.

All Stackpole Coldite 70+ Resistors withstand the standard 5-pound pull test.

New!

... A Major Resistor Development for Major Companies

STACKPOLE

Compare
THESE SPECS!

RESISTANCE-TEMPERATURE CHARACTERISTICS

(a) -15°C
(a) -55°C
(a) +65°C
(a) +105°C

VOLTAGE COEFFICIENT per volt

LOW-TEMPERATURE STORAGE

LOW-TEMPERATURE OPERATION

TEMPERATURE CYCLING

MOISTURE RESISTANCE

SHORT TIME OVERLOAD

LOAD LIFE at 70°C

after 50 hours
after 250 hours
after 500 hours
after 1000 hours

LEAD TWIST TEST

EFFECT OF SOLDERING

DIELECTRIC STRENGTH

SECURITY OF TERMINALS

TOPS IN SOLDERING TOO!



Thanks to an extra solder coating—applied as the final step in manufacture after the usual tin-lead coating—Stackpole Coldite 70+ Resistors solder perfectly by any method . . . dip or iron.

Moreover, the effects of normal soldering heat on Coldite 70+ Resistors causes average resistance variations far below today's critical requirements.

PACKAGED for AUTOMATION



For fast, convenient assembly . . . manual or automatic . . . Stackpole Coldite 70+ Resistors are supplied either in Reels, or Strip-pack as required.

CIRCLE 57 ON READER-SERVICE CARD

STACKPOLE Coldite 70+

TYPE RC-32 (1-watt)



Average Percent Resistance Change

STACKPOLE Coldite 70+

TYPE RC-42 (2-watts)



Average Percent Resistance Change

10 ohms		270,000 ohms		22 megohms		10 ohms		120,000 ohms		22 megohms	
COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B	COLDITE 70+	MIL-R-11B
1.5	3.25	2.2	7.5	6.7	12.5	1.5	3.25	2.1	7.5	9.8	12.5
3.7	6.5	6.2	15.0	15.7	25.0	3.7	6.5	5.9	15.0	22.7	25.0
1.6	2.5	1.1	5.0	4.0	7.5	1.6	2.5	1.2	5.0	7.2	7.5
2.1	5.0	5.7	10.0	3.7	15.0	2.1	5.0	4.4	10.0	8.0	15.0
not applicable		0.0068	0.0200	0.0160	0.0200	not applicable		0.0051	0.0200	0.0177	0.0200
0.1	2.0	0.1	2.0	1.0	2.0	0.2	2.0	0.25	2.0	1.3	2.0
0.1	3.0	0.2	3.0	0.5	3.0	0.1	3.0	0.1	3.0	0.7	3.0
0.1	4.0	1.1	4.0	0.2	4.0	0.1	4.0	0.8	4.0	0.4	4.0
3.7	10.0	7.4	10.0	3.2	10.0	1.4	10.0	4.4	10.0	1.8	10.0
0.2	2.5	0.13	2.5	0.2	2.5	0.1	2.5	0.2	2.5	0.4	2.5
0.2	6.0	3.0	6.0	0.25	6.0	0.7	6.0	2.2	6.0	0.2	6.0
0.4	6.0	1.9	6.0	0.9	6.0	1.1	6.0	2.6	6.0	0.4	6.0
0.5	6.0	1.9	6.0	1.9	6.0	1.6	6.0	2.7	6.0	0.8	6.0
0.5	6.0	1.5	6.0	2.3	6.0	2.0	6.0	2.1	6.0	0.6	6.0
0.04	1.0	0.0	1.0	0.1	1.0	0.1	1.0	0.03	1.0	0.08	1.0
0.2	3.0	0.6	3.0	0.4	3.0	0.1	3.0	0.07	3.0	0.4	3.0

All Stackpole Type RC-32 and RC-42 Coldite 70+ Resistors withstand standard tests of 1000 volts r.m.s. at atmospheric pressure for 5 seconds as well as 625 volts r.m.s. at 3.4 inches of mercury for 5 seconds without damage, arcing, or breakdown.

All Stackpole Coldite 70+ Resistors withstand the standard 5-pound pull test.

Commercial & Military Equipment Producers

Coldite 70+[®] FIXED COMPOSITION RESISTORS

Electronic Components Division

STACKPOLE CARBON COMPANY, St. Marys, Pa.

In Canada: Canadian Stackpole Ltd., 550 Evans Ave., Etobicoke, Toronto 14, Ont.

SAMPLES . . .

for your critical appraisal

Available either from your local electronic parts distributor or direct from Stackpole.



CIRCLE 57 ON READER-SERVICE CARD



Multicoder

Samples 88 Channels

The G-Series multicoder is a sensitive low-level multiplexing and coding instrument for telemetering and data acquisition applications. The unit makes possible the sampling of up to 88 data channels in pulse width form, with sampling speeds of 10 or 1-1/4 samples per sec, in the 15 mv range. Output can be recorded on magnetic tape, transmitted over a line, or used to modulate a transmitter.

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

CIRCLE 58 ON READER-SERVICE CARD

Image Orthicon

High Sensitivity

The photocathode used in type 7037 image orthicon features relatively wide spectral response with high blue sensitivity, high green sensitivity, and good red sensitivity. A stabilized target reduces tendency toward an increase in picture sticking throughout the life span of the tube. The 7037 may be used in place of the type 6474 in color TV cameras.

Radio Corporation of America, Dept. ED, RCA Building, 30 Rockefeller Plaza, New York, N.Y.

CIRCLE 471 ON READER-SERVICE CARD



Megohmmeter

Measures 10¹⁶ Ohm

The Teraohmmeter measures impedances up to 10¹⁶ ohm with 100 v. The instrument is equipped with a self-balancing bridge to take quick readings when measuring capacity loaded test objects. The unit comes in several models, each having up to eight measuring ranges. It can be graduated for current measurements up to 10¹⁴ amp.

Epic, Inc., Dept. ED, 154 Nassau St., New York 38, N.Y.

CIRCLE 59 ON READER-SERVICE CARD



Transitron

Announcing

Medium Power SILICON TRANSISTORS



Type	Maximum Collector Voltage Vc Max. (volts)	D.C. Common Emitter Current Gain at Specified Current B	Maximum Collector Saturation Voltage at Specified Current, Vcs (volts)	Maximum Collector Cut-off Current at Specified Voltage 25°C Ico (ua)
FAST SWITCHING 500 ma TYPES				
2N545	60	15 min.	5(10 Ω)	15 @ 60V
2N546	30	15 min.	3(6 Ω)	15 @ 30V
Rise time: .5 μ sec. max. Storage + Fall time: .6 μ sec. max.				Ib = 50ma Ic = 500ma
500 ma TYPES				
2N547	60	20-80	5(10 Ω)	15 @ 60V
2N548	30	20-80	3(6 Ω)	15 @ 30V
200 ma TYPES				
2N498	100	12-36	8(40 Ω)	100 @ 100V
2N549	60	20-80	4(20 Ω)	3 @ 60V
2N497	60	12-36	8(40 Ω)	100 @ 60V
2N550	30	20-80	4(20 Ω)	3 @ 30V
50 ma TYPES				
2N551	60	20-80	2(40 Ω)	15 @ 60V
2N552	30	20-80	2(40 Ω)	15 @ 60V

Featuring:

- Low R_{CS} , 6 Ohms Typical
- Operation to 500 ma
- Power Ratings to 5 watts @ 100°C
- Fast Switching Time
- Voltage Ratings to 100V
- JETEC 30 Package

Transitron's medium power NPN silicon transistors are designed for switching and amplifying applications requiring low collector saturation resistance (R_{CS}) combined with high current handling ability. These applications include output stages, servo-motor control, core switching, solenoid operation, DC to DC converters, and medium power oscillators.

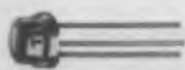
Manufactured by diffusion, these units have closely controlled electrical characteristics plus a high degree of mechanical ruggedness. They can be used with confidence in the most exacting military applications.

Send for Bulletin TE-1353



Transitron

electronic corporation • wakefield, massachusetts



Transistors



Diodes



Regulators



Rectifiers



NEW PRODUCTS

Insulation Tester
Measures 50,000 Meg



The model 250 insulation resistance tester for measurements from 1 to 50,000 meg has been redesigned to include these characteristics: 4 overlapping ranges for wider scale spread; assured calibration through new circuit design; regulated 500 v test potential.

Associated Research, Inc., Dept. ED, 3758 West Belmont, Chicago 18, Ill.

CIRCLE 61 ON READER-SERVICE CARD

X-Band Windows
7.5-10 KMc Range



Two microwave window designs, the flange mounted MA-1329 and solderable types MA-1350 and MA-1350A, are available for 7.5 to 10 kmc operation. Power ratings are 500 kw and 320 kw respectively, with the MA-1350A having a slightly higher frequency of 8.6 to 10.6 kmc. The thin flange (0.06 in.) construction of the MA-1329 provides weight and space saving. The MA-1350 solderable window is designed primarily for sealing rf cavities or other evacuated or pressurized RG-51/U waveguide components. All models have a vswr of 1.15 at band edges.

Microwave Associates, Dept. ED, Burlington, Mass.

CIRCLE 62 ON READER-SERVICE CARD

← CIRCLE 60 ON READER-SERVICE CARD

Telemetry Power Supply

Resists High Temperature and Shock



A transistorized unit occupying less than 58 cu. in., model PS-100 regulated dual output telemetry power supply provides 2 outputs, 180 v at 0.70 ma and 108 v at 0.85 ma. Regulation of each output is within ± 2 per cent. Ripple is below 100 μ v. Regulation will hold over an input of 28 v dc ± 8 per cent and from zero to full load. The unit is capable of continuous operation under conditions of 100 g shock, 150 g at 2000 cps vibration, and sustained accelerations of 100 g. It has an operating temperature range of -55 to $+85$ C. The unit is designed to operate with a heat sink mounting temperature of 185 C during its final 30 sec of flight.

Power Sources, Inc., Dept. ED, Burlington, Mass.

CIRCLE 63 ON READER-SERVICE CARD

Ionization Gauge

10^{-2} to 5×10^{-12} Range



This ionization gauge is a non-burnout type and does not suffer emission decay due to accidental exposure to the atmosphere. It can be employed in the vacuum range from 10^{-2} to 5×10^{-12} mm Hg.

Resatron Labs. Inc., Dept. ED, 2908 Nebraska Ave., Santa Monica, Calif.

CIRCLE 64 ON READER-SERVICE CARD

CIRCLE 65 ON READER-SERVICE CARD



Lambda power supplies have varied uses in the North Carolina Works of the Western Electric Company. This representative installation includes among its components eight Lambda Com-Pak power supplies.

Western Electric uses standard Lambda supplies to power defense system tests

NEW COM-PAK® POWER SUPPLIES SAVE VALUABLE PANEL SPACE
Models through 1.5 amperes
Three voltage ranges: 0-200, 125-325, 325-525 VDC



C-200 series— 200 MA—5¼" panel height—from \$159.50
C-400 series— 400 MA—5¼" panel height—from 244.50
C-800 series— 800 MA—7" panel height—from 315.00
C-1500 series—1500 MA—8¾" panel height—from 550.00

Lambda power supplies provide Western Electric Company with power for testing components of the United States continental air defense system.

These are standard Lambda models, supplied from stock, with front-panel modifications only.

Available for immediate delivery, Lambda power supplies from stock also are being used in major rocket and missile programs.

Your request will bring the current Lambda catalog by return mail. It covers the complete new space-saving Com-Pak series, as well as other rack, bench and portable models, for all needs through 1.5 amperes.



LAMBDA Electronics Corp.

11-11 131 STREET • COLLEGE POINT 56, NEW YORK
INDEPENDENCE 1-8500

Cable Address: Lambdatron, New York

NEW PRODUCTS

Decoders High Speed Conversion



Model 10B and 10BR decoders give digital-to-analog conversion of up to 200,000 parallel 10-bit binary codes per sec. Code accuracy is ± 0.05 per cent. A four unit standard rack is provided for plug-in assembly of up to four decoders with integral power supplies. Drift is less than ± 0.001 per cent of full range. Analog output range is ± 50 v at 25 ma. The amplifiers are chopper stabilized. Model 10BR decoder is also equipped with a reference voltage source of ± 0.005 per cent stability, and capability for supplying reference current to three other model 10B decoders. Model 10B is rated at 120 w, and model 10BR at 160 w.

Andromeda, Inc., Dept. ED, 3742 Howard Ave., Kensington, Md.

CIRCLE 66 ON READER-SERVICE CARD

VOR Test Generator Tests and Calibrates

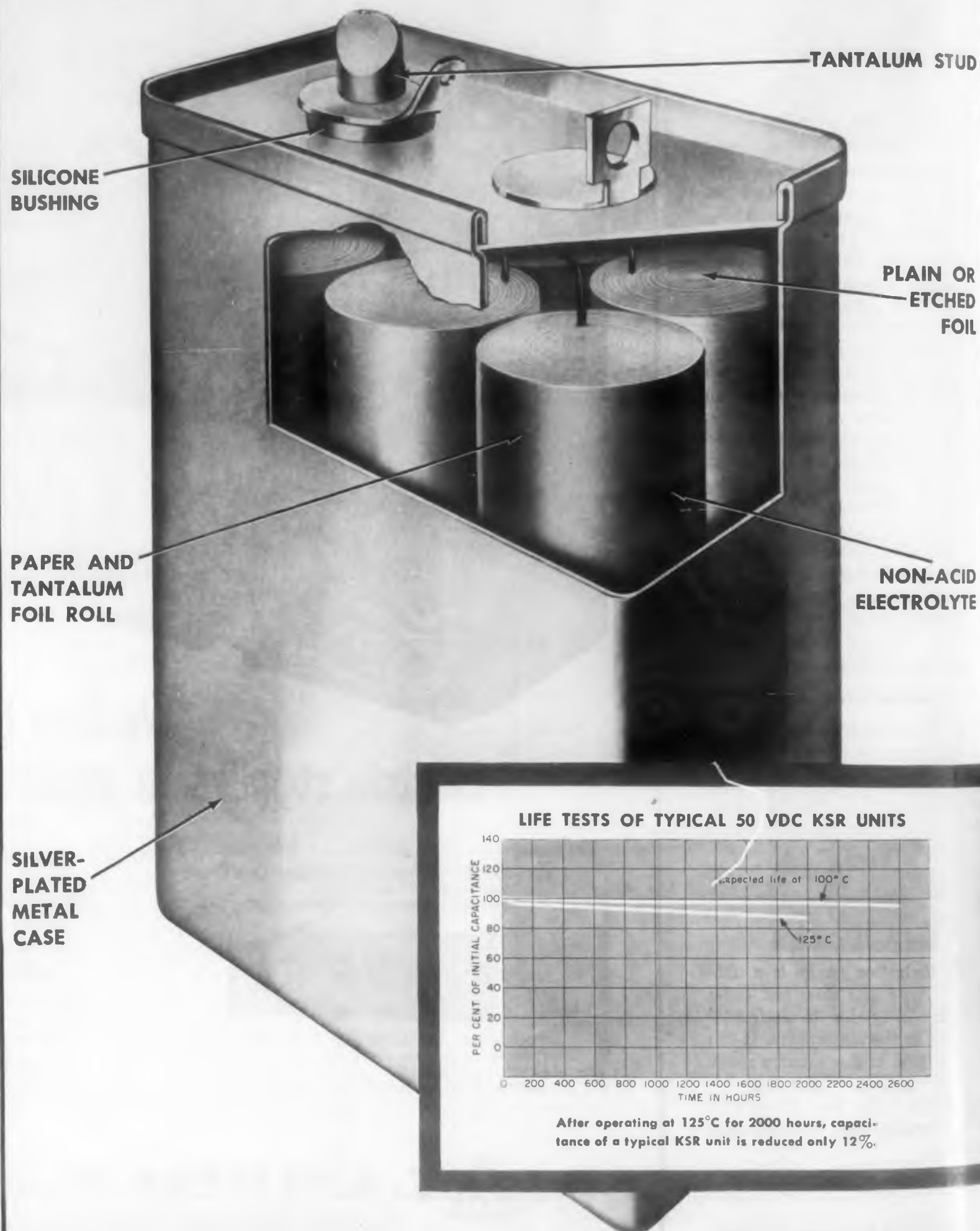


Model TA-1040 vor test generator is designed to provide standard signals for accurate testing and calibrating of vhf omnirange equipment. Standard signals available from the generator are a 30 cps variable-phase signal and two fm signals (test and auxiliary). Each of the fm signals has a mean frequency of 9960 cps modulated by a 30 cps sine wave (reference phase signal) having a deviation ratio of 16. With the 9960 cps signal as center frequency, the swing is ± 480 cps. The phase relationship between the 30 cps variable-phase signal and the reference-phase fm signal on the 9960 cps carrier is continuously adjustable from 0 to 360 deg. This simulates the corresponding VOR course.

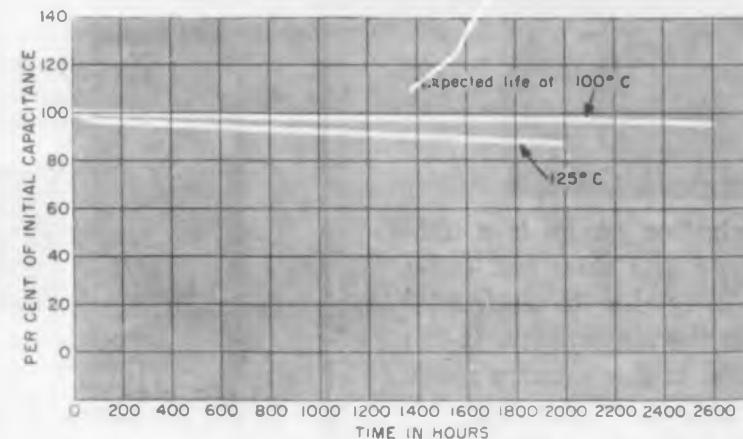
Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N.Y.

CIRCLE 67 ON READER-SERVICE CARD

General Electric announces . . .



LIFE TESTS OF TYPICAL 50 VDC KSR UNITS



After operating at 125°C for 2000 hours, capacitance of a typical KSR unit is reduced only 12%.

...new KSR[†] Tantalytic* Capacitors

KING SIZE RECTANGULAR units offer thousands of microfarads in lighter, smaller cases

Now General Electric offers a completely new Tantalytic capacitor for use in computers, missiles, radar, and airborne electronic equipment—the King Size Rectangular Capacitor. This unit offers more joules per size, weight, and cost than any other tantalum capacitor available.

On a volt-microfarad basis, the new KSR's are 40% lighter, 30% smaller, and 40% less expensive than other 125°C rectangular capacitors. Compared with 125°C cylindrical designs, KSR's may be as much as 50% lighter, 30% smaller, and 15% lower in cost.

Like other General Electric Tantalytic capacitors, the KSR units offer "bulk capacitance," i.e., high volt-microfarads in an extremely small case. Now, one King Size Rectangular capacitor can often be used where several lower rated units were needed before. As a result of this bulk capacitance, costly connections are reduced and extra mounting brackets are eliminated.

† Trade-mark of General Electric Co.

In addition to the great size and weight advantages, the KSR capacitors offer these outstanding features:

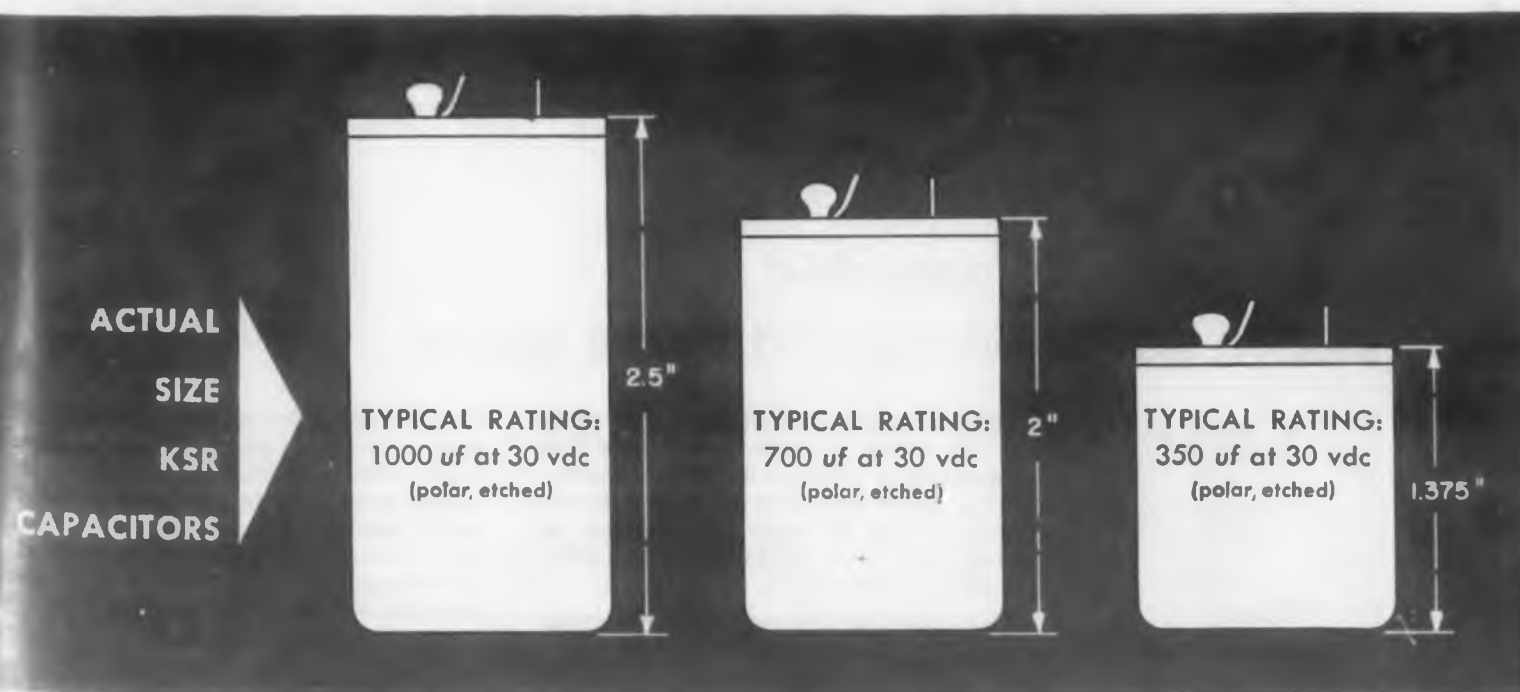
- High reliability from -55°C to $+125^{\circ}\text{C}$.
- Polar or non-polar construction; plain or etched foil.
- Long operating life at 125°C ; extra long life at 85°C .
- Excellent shock and vibration characteristics.
- Non-acid electrolyte for long shelf life.
- Dual temperature and voltage ratings.

KSR Tantalytic capacitors are now available in three case sizes: 1.375 inches, 2 inches, and 2.5 inches in height. All three have the same base size: 1.316 inches by .75 inch. For more information on these new capacitors or for assistance with your capacitor applications, contact your General Electric Apparatus Sales Office. Or write to General Electric Co., Section 449-1, Schenectady, N.Y.

* Registered trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



CIRCLE 72 ON READER-SERVICE CARD



Miniature Power Connectors
Carry 10 Amp

Series 250 miniature power connectors are available in 20, 34, 50 and 75 contacts, with or without polarizing screwlocks. Contact terminations include conventional solder cup for no. 16 wire, turrent, or taper pin for solderless wiring. Voltage breakdown at sea level is 2500 v dc. Current rating is 10 amp continuous.

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

CIRCLE 68 ON READER-SERVICE CARD

Temperature Control

Holds Temperature Within 1 Deg F



Temperatures are maintained within a total spread of 1 deg F, by means of this simplified proportioning control. The control uses the electrostatic attraction across the contacts of a meter-relay both to proportion the amount of time the heat is turned on and to cause an anticipated, or premature, closure of the contacts before the limit point is reached by the signal pointer. This anticipation keeps the cumulative effect of a heat build-up from raising the temperature past the limit.

The amount of electrostatic attraction varies inversely with the square of the distance between the moving contact and the control point. The attraction thus increases very sharply as the contacts approach each other and a small distance means a disproportionately large difference in attraction. While originally designed for the accurate control of temperatures anywhere from -200 to $+300$ F, the new circuit may be used to monitor other variables with comparable precision. In general any other function may be controlled in the limits of about 10 μamp to 50 amp.

Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 69 ON READER-SERVICE CARD

NEW PRODUCTS

Acceleration Test Machines Test Instruments and Assemblies



For accurate pre-testing of components, instruments and assemblies under simulated operational g-loading, the model RCT-1 and 2, centrifuge acceleration test machines are suited for both laboratory and mass production testing as required by MIL-E-5272A.

By utilizing a low-axial design, the balanced rotor arm minimizes bending moment effect due to the acceleration force on the specimen mass, thus providing extreme stability during test operations. A range of nine models with arm radius of 2 to 35 ft, and g-rating of 1 to 150 are available.

Rucker Co., Dept. ED, 4700 San Pablo Ave., Oakland, Calif.

CIRCLE 70 ON READER-SERVICE CARD

Switch Assembly Miniature Telemetering Type



Packaged in a standard size 10 synchro housing, this switch is available as standard in one to six circuits. Length is 1.319 in. for six circuits and decreases with number of circuits. The switch assembly has been successfully tested at speeds to 5000 rpm. Construction achieves negligible noise levels and necessary driving torque as low as 0.2 in.-oz. The unit has passed complete testing of MIL-E-5272A, including temperature range of -65 to +125 C.

Electro-Miniatures Corp., Dept. ED, 1060 Elm Ave., Ridgefield, N.J.

CIRCLE 71 ON READER-SERVICE CARD



MICRO SWITCH Precision

These outstanding MICRO SWITCH precision switches enable Electronic engineers to save space, time, maintenance and installation costs

High quality with reliability has made MICRO SWITCH the leading manufacturer of precision switches with the largest line of switches from which to select. MICRO SWITCH plants and development laboratories are equipped with scientific tools for painstaking

precision, quality control and testing techniques. Field Engineering offices blanket the country. There is always a MICRO SWITCH man near you—ready to cooperate on switching problems. Consultation costs you nothing—can save you much.

Small, safe door interlocks for protection of electronic equipment

These MICRO SWITCH door interlock assemblies are for use on cabinets housing hazardous equipment—such as radio, radar, x-ray, etc. The interlock automatically cuts off the power supply when the door is opened.

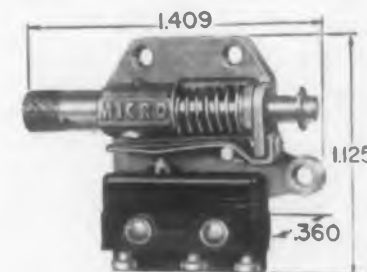
By pulling the rod actuator to the maintained contact position, it is possible for service personnel to check the circuits with the power on.

When the door is closed, the rod

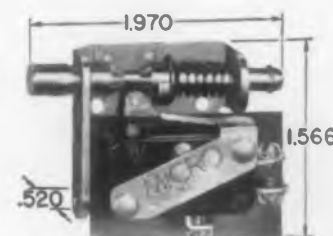
automatically returns to the normal position so that the next door opening will automatically break the circuit. This eliminates the danger involved in "tying down" conventional door interlocks.

Interlock-assemblies shown are but two of over 70 such assemblies available with subminiature, V-3 type switches and other basic switches.

(Send for Catalogs 74 and 75)



MICRO SWITCH subminiature door interlock switch assembly.



MICRO SWITCH V-3 door interlock switch assembly.

This screwdriver-operated switch saves wiring and panel space



This subminiature switch assembly is operated by 90° turn of a screwdriver

Here is an ideal switch for locations to which access is limited and where it is desirable to prevent accidental operation. Designers have found it particularly suited to such applications as computers, electrical devices and electronic equipment.

The switch is operated by a 90-degree

turn of a screwdriver. The slotted head gives visual indication of the position of the switch. Because this switch can be mounted deep in equipment, either on or below the chassis, it saves wiring cost and valuable panel space. All that is necessary for its operation is an access hole and a long screwdriver.

(Send for Data Sheet 115)

Switches have uses unlimited



How to get more pushbutton switches on a panel

MICRO SWITCH Series 100 PB Lighted Pushbutton Switches provide an unusually neat, good looking panel. Their compact mounting allows more switches per panel.

Important features include:

Three types of illuminated signal—

(1) one-color buttons, (2) two colors (lighted singly or in combination) and (3) choice of either of two colors—neither of which is visible when button is unlighted.

Large, easily engraved buttons—

Buttons are large enough to allow two lines of clearly legible engraving.

Wide choice of circuitry—

Because separate terminals are provided for each lamp and for each element of the contact structure, these switches permit intermixing of voltages, a-c or d-c current and even combinations of opposing polarities.

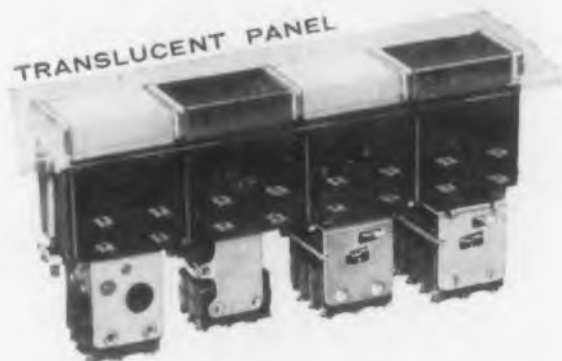
Matching lamp assemblies available—

Matching indicating lamp assemblies are available with the same button and lamp combinations and the same means of mounting as the complete 100 PB switch assembly.

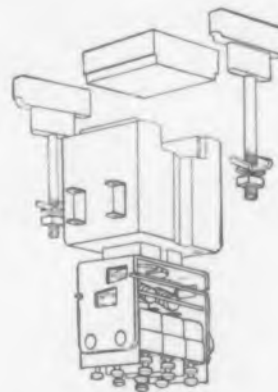
(Send for Data Sheet 143)



Typical switch module on a 3-circuit dc-sign.



A typical compact assembly of switches in panel slots. Indicates choice of button color and number of circuits.



Exploded view showing switch assembly, button and mounting means.

A roller-lever switch with the stability of pin-plunger switch



A new design in roller-lever actuators is this MICRO SWITCH Type W.

This small, compact roller-lever basic switch is ideal for use of such control mechanisms as radar units, precision machine tools or other devices where precise actuation with little variance in operating points is required.

This Type W switch incorporates a new design in roller lever actuators which gives it an operating stability similar to a pin-plunger switch—low pre-travel, narrow differential travel and close re-

peatability but also permits exceptionally high overtravel.

The roller is located on top of a double lever. As the roller is depressed, both levers move downward until the switch is actuated. The upper level then proceeds on downward, providing the high overtravel. The limited overtravel given to the snap spring and a low break gives this switch a long, trouble-free mechanical life.

(Send for Data Sheet 127)

MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



First in Precision Switching

CIRCLE 73 ON READER-SERVICE CARD

Carrier Amplifier High Gain, Stable Unit



Model 8110-A universal carrier amplifier achieves high gain as well as stable operating characteristics. The unit attains a sensitivity equal to 1 v output for 1.5 ppm change in one leg of a bridge circuit. When used to drive direct-writing oscillographs, long term drift is less than 1/4 mm of pen deflection. The amplifier is equipped with 10-turn resistive and capacitive balance controls, and comprises a complete system to amplify resistive, capacitive or inductive bridge unbalance. The phase sensitive amplifier may be used to observe both direction and amplitude.

Edin Co., Inc., Dept. ED, 207 Main St., Worcester 8, Mass.

CIRCLE 74 ON READER-SERVICE CARD

Encoder

Converts 2000 Codes Per Sec



Analog-to-digital conversion of up to 2000 codes per second may be obtained with model 2KB encoder. The code is binary having 10 bits plus sign. The code accuracy is 1 part in 2048. The maximum bit rate is 22,000 per second. An integral power supply and a reference voltage source of ± 0.005 per cent stability are built in. Drift of the comparator is less than ± 0.001 per cent. Analog input impedance is 1000 ohms per full scale volt. Input ranges are 1, 10, 100, and 1000 v. Parallel coded outputs are at 115 v 10 ma for each of 11 outputs. Coded serial output is at 30 v, 10 ma.

Andromeda, Inc., Dept. ED, 3742 Howard Ave., Kensington, Md.

CIRCLE 75 ON READER-SERVICE CARD

NEW PRODUCTS

Telemetry Power Supply

Weights 28 Oz



Model MIC-5-1R teletesting power supply operates from a nominal 28 v dc input and supplies 5 v dc at 0-1 amp. Regulation is better than ± 1 per cent for line changes of 26 to 30 v and from no load to full load. This regulation is obtained over an ambient temperature range from -55 to $+71$ C. The dimensions of the unit are 5 x 3 x 2-3/4 in. and weight approximately 28 oz.

Modern Industries, Inc., Dept. ED, 2601 Colorado Ave., Santa Monica, Calif.

CIRCLE 76 ON READER-SERVICE CARD

500 Amp Germanium Junction

Low Current Density



A large active area in this single crystal junction results in a low current density, in spite of the high current rating. The junction is the heart of a 500 amp air-cooled and a 670 amp liquid-cooled junction for use at voltages from 26 to 66 v. The low current density provides added reliability in cases of over-temperature and overload.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE 77 ON READER-SERVICE CARD

CIRCLE 78 ON READER-SERVICE CARD >

STOPPED IN HIS TRACKS...



BY

Filton

Filt
relays in
existing
In
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attainin
miniatur

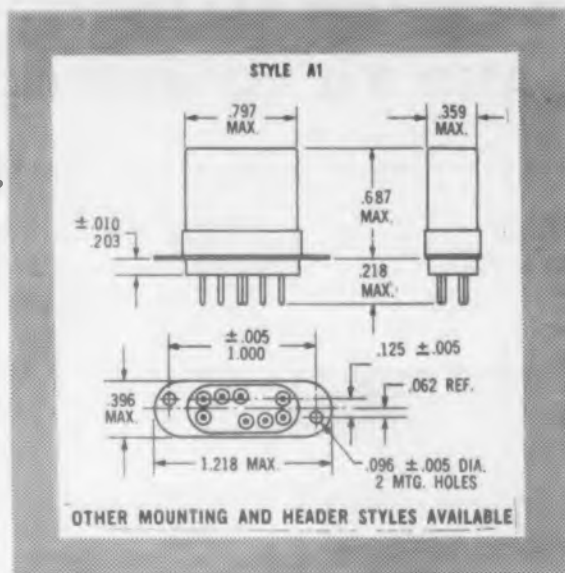
AMBIEN
DIELECT
INSULAT
CONTACT
CONTACT
SHOCK
VIBRATI

PICK-UP
RELEASE
NOMIN
COIL R
ALTITU
DUTY
PICK-U



ELE

Now! A West Coast Office
For Immediate Service



BY THE NEW POWRMITE®

Filters new and greatly advanced micro-miniature relay.

Filtors, the leading specialists in the development and manufacture of sub-miniature relays is proud to announce the addition of the new Powrmite micro-miniature relay to its existing line of traditionally outstanding relays.

In every field of achievement there is always one leader. In relays with highest available reliability the leader is Filtors, Incorporated. All of the experience and know how gained in attaining its position of leadership have gone into making Filtors new Powrmite micro-miniature relay *truly reliable*—again the leader in a field of many.

MICRO-MINIATURE SPECIFICATIONS

AMBIENT TEMPERATURE RANGE	.....	-65°C. TO +125°C.
DIELECTRIC STRENGTH	.....	1000 VOLTS. (750 VOLTS BETWEEN OPEN CONTACTS).
INSULATION RESISTANCE	.....	10,000 MEGOHMS MINIMUM AT 25°C.
CONTACT ARRANGEMENT	.....	2C (2 POLE DOUBLE THROW).
CONTACT RATING	.....	2 AMPS RESISTIVE AT 28 VOLTS DC OR DRY CIRCUITS.
SHOCK	.....	50 Gs 11 MILLISECONDS.
VIBRATION	.....	10 - 55 CPS AT .06 AMPLITUDE. 55 - 2000 CPS AT 20 G.
PICK-UP TIME	.....	7 MILLISECONDS MAXIMUM AT NOMINAL COIL VOLTAGE, 25°C. TEMPERATURE.
RELEASE TIME	.....	7 MILLISECONDS MAXIMUM.
NOMINAL COIL VOLTAGE	.....	26.5 VOLTS DC.
COIL RESISTANCE	.....	550 OHMS ±10% AT 25°C.
ALTITUDE	.....	70,000 FEET.
DUTY	.....	CONTINUOUS.
PICK-UP	.....	RELAY SHALL PICK-UP WHEN COIL VOLTAGE IS 18 VOLTS DC OR LESS OVER THE AMBIENT TEMPERATURE RANGE.

Leading manufacturers of hermetically sealed micro and sub-miniature relays.

FILTORS, INC.

Main office and plant: Port Washington, N. Y., POrt Washington 7-8220
West coast office: 13273 Ventura Blvd., Studio City, Cal., STanley 3-2770

CIRCLE 78 ON READER-SERVICE CARD

Ring Modulator

Complete Circuitry in Small Package



Ring Modulator, type RM 6-6A, contains in one package a bridge of four matched diodes and a pair of transformers especially designed for the application. Its operating range extends through 100 cps and 100 kc where it produces a double-sideband modulation with both the carrier and modulating signal suppressed. Single-sideband modulation may be achieved by passing the desired frequencies through an appropriate filter. The device may also serve as a modulator in recovering the original signal from either or both of the sidebands. RM 6-6A is one of a series of new modulators which differ from each other in frequency range, impedance, and degree of carrier suppression.

Gopic Designs Co., Dept. ED, 4924 Voltaire St., San Diego 7, Calif.

CIRCLE 79 ON READER-SERVICE CARD

Integrator

Integral Is Displayed Digitally



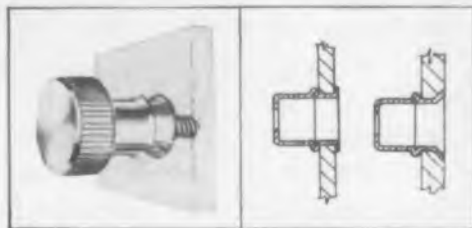
Model 270 accepts analog voltage signals, digitizes by heterodyne technique, and integrates area under signal curve by counting at rate of 10,000 per sec for high resolution of transient phenomena. Integral can be total area under curve, area above a preselected signal level, area under curve for a pre-selected time interval. Both integral and elapsed time are displayed digitally. The instrument provides highly accurate measurements of energy by integrating power vs time.

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

CIRCLE 80 ON READER-SERVICE CARD

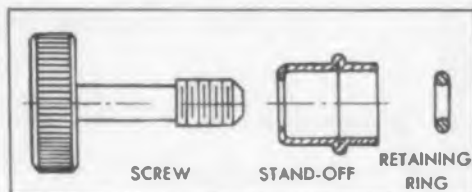
SELECT CLOSURE HARDWARE TO IMPROVE UTILITY, APPEARANCE, AND TO LOWER COST

QUICKLY INSTALLED SOUTHCO CAPTIVE PANEL SCREWS END MISALIGNMENT PROBLEM . . .



Simplicity of design contributes to clean, distinctive appearance and fast, low-cost installation. Stand-off is slipped into panel hole and secured by flaring. Screw is passed through stand-off and made captive by vinyl o-ring.

"Floating" screw design eliminates costly close tolerance manufacture and permits easy engagement regardless of panel distortion encountered under adverse use conditions.



SPECIFICATIONS

Material: Screw is brass, chrome plated; can be supplied in stainless steel. O-ring is vinyl plastic.
Overall length of screw: 1 3/16"
Depth of screw head: 1/4"

Sizes:

SCREW HEAD DIAMETER	THREAD SIZE
3/4"	1/4-20
5/16"	1/4-20, 12-24
3/16"	10-24, 10-32

Length of thread: 3/8"

Screw head is supplied plain, as shown, or slotted for screw driver.

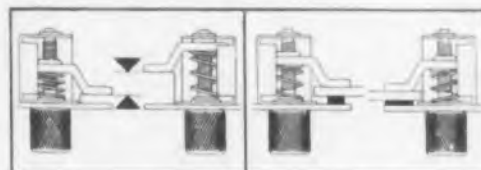
PRE-ASSEMBLED PAWL ADJUSTS TO DESIRED THICKNESS AND PRESSURE



This neat, compact Southco panel and door fastener is supplied assembled, requires but two rivets or bolts for low cost installation. It is available in three models—large, intermediate and midget.

The unique feature of Southco Pawl Fasteners is the fact that, by merely turning the knob, the pawl is adjusted to a wide range of frame thicknesses. This assures a tight grip without precision setting regardless of variations in frame or door dimensions or changes that are produced by wear or warping of sheets.

Pressure exerted by the pawl on the frame is controlled in the same way, by merely turning the knob. Against gasketed frames, pressure can be easily applied to compress the gasket.



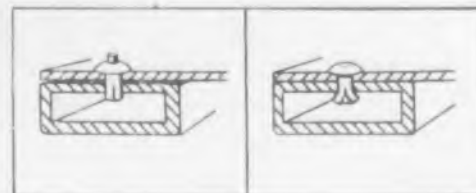
SPECIFICATIONS

Knob: Cadmium or chromium plated steel.

Head Styles: Protruding ribbed or knurled knob; flush screw driver slotted for large size only.

	LARGE	INTERMEDIATE	MIDGET
Knob diameter	7/8"	5/8"	1 1/2"
Total width	2 1/2"	1 3/4"	1 1/8"
Total height	1 3/8"	7/8"	25/64"
Back of panel depth	1 23/32"	1 1/4"	7/8"
Knob length	1 1/8"	1 5/16"	3/2"

FAST, HAMMER- DRIVEN BLIND RIVETS CUT INSTALLATION TIME



You "hit-the-pin" and the rivet's in. No special tools to limit production or require maintenance, no bucking, no finishing. For blind or open applications, Southco Drive Rivets save time, reduce costs.

Automatic "pull-up" action assures uniform, tight grip.

Southco Rivets are made of aluminum or cadmium plated steel with cadmium plated or stainless steel pins. Diameters are from 1/8" to 1/4", grip range is from 1/16" to 3/8".

Increased widespread use is due to low installed cost and elimination of down time and maintenance associated with fasteners requiring special tools.

FREE! Fastener Handbook



Send for your free copy of Handbook No. 7, just released. Gives complete data for designers on these and many other specialty fasteners. 52 pages, in two colors.

Write on your letterhead to Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.

NEW PRODUCTS

Microwave Circulator

5.925 to 6.425 Kmc



Model J-437 microwave ferrite circulator has been developed for use as a duplexing and multiplexing device in microwave communication systems. It operates over the common carrier band of 5.925-6.425 kmc and transmits 15 w of average power. Insertion loss is less than 0.5 db and isolation is greater than 20 db. The vswr at any arm with other arms terminated in flat loads is 1.25. The unit is for use with 3/4 x 1-1/2 in. waveguide and comes equipped with UG-344/U flanges.

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

CIRCLE 82 ON READER-SERVICE CARD

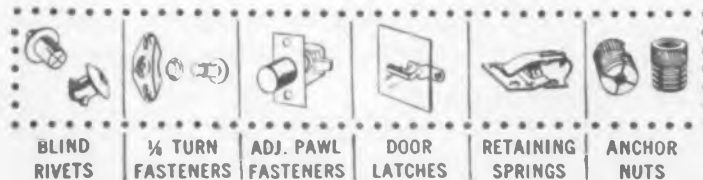


Magnetic Amplifier Signal Mixing and Summing

Model 410 magnetic amplifier is designed for signal mixing and summing. The unit is a completely self-contained, plug-in magnetic amplifier and power supply weighing less than 9 oz. Regulated power supplies, bias supplies, and external gain and balance controls are not required; the amplifier is inherently stable. Transimpedance is 25,000 ohms, and 100 μamp dc control current give 2.5 v dc output. Less than 10 μw of signal energy are required for full control. Frequency response is dc to 50 cps depending on circuits used. Model 410 is hermetically sealed, ruggedized, and has a standard 11 pin plug with octal type key.

Acromag, Inc., Dept. ED, 22519 Telegraph Rd., Detroit 41, Mich.

CIRCLE 83 ON READER-SERVICE CARD



SOUTHCO FASTENERS
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LION

CIRCLE 81 ON READER-SERVICE CARD

Differential Transformer

Double Range, Low Null



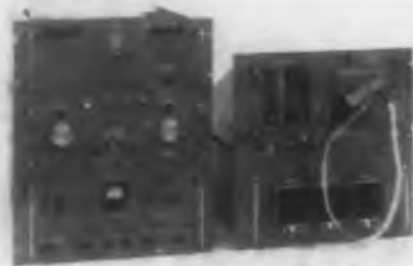
This differential transformer features a double range and extremely low null voltage. The coil has an input of 120 v 400 cps and an output of 50 v into 10,000 ohm load. Construction permits a phase angle shift of 2 deg from null to maximum displacement. The short range specifications are ± 0.125 in. with 2-in. long armature; the longer range, ± 0.250 in. with 2.5-in. long armature. The coil is supplied in an explosion-proof housing. Coil case dimensions are 1-5/16 in. od by 3-3/4 in. long.

Automatic Timing & Controls, Inc., Dept. ED,
King of Prussia, Pa.

CIRCLE 84 ON READER-SERVICE CARD

Programmed Circuit Tester

High Speed Production System



The supertester model 180, is a high-speed, accurate production tester for performing complex tape-controlled measurements. Tests including measurements of impedance, ac-dc voltage, resistance, leakage, and continuity, are performed on a go/no basis according to the sequence, value, and tolerance information punched into a standard tape. The device can be programmed to energize equipment under test, provide warm-up delay periods, stop when the operator is to perform a manual operation, and can be supplied with an accessory printer to provide a permanent record of rejected tests.

For each measurement, any two test points designated on the tape are selected from 300 test leads by a crossbar switching unit. A parallel arrangement allows the selection of four or more test points at a time, two usually being used for the measurement, and the others available for such operations as controlling relays or providing signal voltages to the unit under test.

Textron, Inc., Calif. Technical Industries Div.,
Dept. ED, 1444 Old County Rd., Belmont, Calif.

CIRCLE 85 ON READER-SERVICE CARD



At last! A large-capacity electronic computer you use right at your desk! ROYAL PRECISION LGP-30

High-speed computation at the lowest cost ever for a complete computer system

No more waiting in line for those answers you need! No more lost time in executing preliminary calculations or modifying equations! Not with the LGP-30! Wheeled right to your desk, operated from a regular wall outlet, LGP-30 allows you to follow your work personally from beginning to end . . . to change formulae on the spot . . . to simulate optimum designs without weeks of mathematical analysis. Thus you get faster answers . . . added time for *creative* work.

Easy to use. LGP-30 is a general-purpose stored-program computer — internally binary, serial, single address. Just the few orders in the command structure give complete internal programming. Controls are so simplified, you get an "overnight" feel for your computer.

Unusual memory capacity. With a magnetic drum memory of 4096 words, LGP-30 is the most powerful computer of its size yet developed. Fully automatic, it executes self-modifying programs.

Exceptional versatility and value. Both the scope of LGP-30's applications and the range of calculations it

can perform are almost limitless. It gives speed and memory equal to computers many times its size and cost, yet initial investment is the smallest ever for a complete computer. Maintenance costs are extremely low . . . service facilities available coast-to-coast.

Outstanding features of LGP-30

- Alpha-numeric input-output via electric typewriter or punched paper tape.
- Optional input-output equipment available.
- Unusually large memory — 4096 words.
- Library of sub-routines . . . programs for wide variety of applications.
- Mobile . . . no expensive installation . . . self-cooled.
- Nation-wide sales and service.

For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

ROYAL MCBEE

WORLD'S LARGEST MANUFACTURER OF TYPEWRITERS
AND MAKER OF DATA PROCESSING EQUIPMENT

CIRCLE 86 ON READER-SERVICE CARD

Miniature Potentiometers

Dissipate 2 W at 60 C



Called Acesets, these miniature wire-wound potentiometers will dissipate 2 w at 60 C. They are available in nine different resistance values between 100 and 25,000 ohms. Temperature cycling stability is achieved by using wire with 20 ppm temperature co-efficient. Voltage breakdown is 1000 v dc; electrical angle, 325 deg nominal; resistance tolerance, ± 10 per cent; linearity, ± 5 per cent.

Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville, Mass.

CIRCLE 87 ON READER-SERVICE CARD



Magnetic Tape Handler

Speeds of 75 In. per Sec

Increased tape speed of 75 in. per sec with 40 start-stop cycles per sec is featured in the model 101 digital magnetic tape handler. From 6 to 20 tracks are available. Choice of tape speeds ranges from 2 to 75 in. per sec. Complete remote control of start, stop, reverse and speed change functions is furnished as well as single or dual tape speeds as required. Starting and stopping time for the tape is 5 msec. The tape handler takes 24-1/2 in. of standard rack height, and is 9 in. deep.

Digitronics Corp., Dept. ED, Albertson Ave., Albertson, N.Y.

CIRCLE 88 ON READER-SERVICE CARD

Silicon Unijunction Transistor

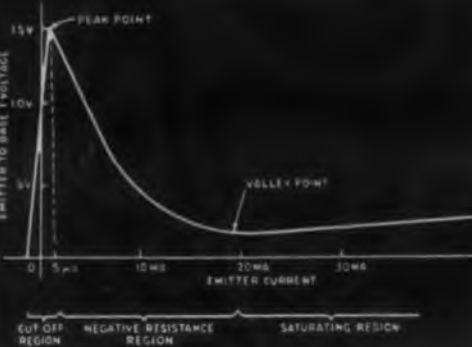
SPECIFICATIONS OF THE SIX SILICON UNIUNCTION TYPES

Absolute maximum ratings (25°C)

RMS power dissipation—stabilized	350 mw
RMS emitter current	50 ma
Peak emitter current	2 amps
Emitter reverse voltage	60 volts
Operating temperature range	-65°C to 150°C

Major electrical characteristics (nominal)

	2N489	490	491	492	493	494
Interbase resistance at 25°C junction temp.	5.6	7.5	5.6	7.5	5.6	7.5
Intrinsic standoff ratio.	.56	.56	.62	.62	.68	.68
Modulated interbase current	12	12	12	12	12	12
Emitter reverse current (T _j =25°C)	.07	.07	.07	.07	.07	.07
(T _j =150°C)	28	28	28	28	28	28



BASIC UNIUNCTION TRANSISTOR CIRCUIT

Circuit function

- Pulse generator
- Pulse amplifier
- Multivibrator
- One-shot multivibrator
- Flip-flop
- Sawtooth generator
- Triangular wave generator
- Pulse rate modulator (1)
- Pulse rate modulator (2)
- Time delay circuit
- Sensitive current detector
- Temperature indicator
- Peak voltage detector

Components removed from basic circuit

- D, R2, R5, R6
- D, R4, R6
- R2, R4
- R4
- C, D, R4, R5, R6
- D, R2, R4, R5, R6
- R2, R3, R4
- D, R1, R2, R4, R5, R6
- R2, R4, R5, R6
- D, R2, R5, R6
- D, R1, R2, R4, R5, R6
- D, R2, R4, R5, R6
- D, R1, R2, R5, R6

Unijunction transistor takes advantage of negative resistance to spark circuit savings

The new unijunction transistor has the useful property of negative resistance. Briefly, the current rises with the voltage input as usual, but only up to a certain peak, past which the current keeps on increasing though the voltage starts going down. This principle gives the unijunction two stable states—one "off" and the other "on"—so that it can be used to take the place of two conventional transistors (minus much other circuitry) in many switching and oscillator applications. A few of these applications—making use of the unijunction's high peak current capabilities combined with high temperature rating and stability are shown above.

To put the unijunction to work for you, you'll want all the specs, plus application data with sample circuits. Please write for information. As you'll see, the unijunction is actually a new type of semiconductor, the first since the conventional transistor itself to reach commercial success.

G-E High-voltage Silicon Triodes



Photo shows top view of G-E silicon high-voltage transistor, with cap removed. 1. Gold emitter ribbon. 2. Aluminum base-lead ribbon. 3. Gold-silicon alloy. 4. Collector tab. 5. Base region. 6. NPN diffused meltback silicon bar. Cantilever design for shock resistance. Silicon bar is alloyed firmly to tab; ribbons are flexible to minimize constraints.

General Electric can now supply your needs for popular, industry-accepted high-voltage silicon transistors—types 2N332, 2N333 and 2N335. Every unit is aged at 200°C for more than 500 hours, and takes a drop test considered more rugged than the standard military 500 G shock test. That's why you can depend on ratings and performance characteristics shown. Rated at 45 volts (collector to base), these transistors are designed for amplifier use, both audio and RF, and general purpose switching. Among its many features are low output capacity, high cutoff frequency and low leakage. Full specs are available from your Semiconductor Sales representative or from the factory.

SPECIFICATIONS, Types 2N332, 2N333, 2N335

Absolute maximum ratings	
Storage temperature	200°C
Operating temperature	-55°C to 175°C
Collector to base voltage	45 volts
Emitter to base voltage	1 volt
Collector current	25 ma
Power	
Collector dissipation (25°C)	150 mw
Collector dissipation (100°C)	100 mw
Collector dissipation (150°C)	50 mw

Transistor Reliability

enhanced by spotless factory, stringent controls

The production section of G.E.'s Buffalo semiconductor plant resembles a medical research laboratory. Production workers are dressed in white; white walls and ceilings predominate. The entire plant is air conditioned and slightly pressurized so any dust will flow out instead of in when doors are opened. Water is super-purified and tested electronically, for chemical testing is not accurate enough. Alcohol used to dry transistors has to be so pure that a single drop of water in a barrel of it would ruin it.

These are just three of the manufacturing techniques that have their pay-off in reliability. They are supported by special quality control techniques using over \$500,000 worth of test equipment, to help assure G-E transistors do not fail or permanently change parameters.

Military specifications call for dozens of rugged tests. But commercial and industrial transistors undergo most of them also, plus a few of their own. Here are some examples: Shock test: a transistor is mounted on a heavy metal block and dropped as much as 4 feet to a metal base. 20,000 G centrifuge test: transistors are spun about 36,000 rpm in various positions, then checked both mechanically and electrically. 15 minute temperature cycling test: transistors are frozen at -65°C and then immediately placed in an oven set at maximum temperature (up to 250°C). Vibration test: transistors are rattled at 40 to 100 cps for 96 hours. Salt spray test: corrosion and hermetic sealing properties are tested for periods ranging up to 12 days.



A section of the test area in G.E.'s Buffalo transistor plant. In the foreground is a humidity control box in which transistors are inspected prior to encapsulation.

G-E Silicon Stud-mounted Rectifiers

If you're looking for greater current at higher temperatures, with no sacrifice of chassis space . . . this is just one of several advantages offered in G-E silicon low-current stud-mounted rectifiers. Other features include: • Ratings up to 170°C ambient • Low forward drop • Forward current up to 1.5 Amperes • Low leakage at high temperatures • Operating reliability assured under all conditions • May be mounted directly to heat sink using a tapped hole or a nut and lockwasher, or electrically insulated with mounting kit which is supplied with each unit.

RATINGS AND SPECIFICATIONS

	IN1115	IN1116	IN1117	IN1118
40 cps, resistive or inductive				
Peak inverse voltage	100	200	300	400 v
RMS voltage	70	140	210	280 v
Cont. Reverse DC V	100	200	300	400 v
DC Output C (150°C Case Temp.)	600	600	600	600 ma
DC Output C (85°C Case Temp.)	1.5	1.5	1.5	1.5 amps
Full load forward voltage drop (Full-cycle ave at 150°C)	.65	.65	.65	.65 v
Leakage current (Full-cycle ave at 150°C)	0.4	0.3	0.3	0.3 ma
Max. operating freq.	100	100	100	100 kc
Ambient operating temp.	170	170	170	170°C max.
	-65	-65	-65	-65°C min.
Storage temp.	175	175	175	175°C max.
	-65	-65	-65	-65°C min.



Need a few semiconductors in a hurry?



Check your local G-E distributor

For fast delivery of transistors and rectifiers, see your local G-E distributor first. Just check and see, for yourself, if his service facilities and prices don't work out to your great advantage.

Florida engineers, for example, can call on Thurow Distributors. Thurow recently put in the most complete line of semiconductors available (G.E. of course) to better serve the greatly expanding electronic and aircraft industries throughout Florida. Shown at left are Thurow and General Electric executives looking at part of their initial shipment of G-E semiconductors.

Quick-reference transistor manual—This famous pocket-size reference is now in its enlarged second edition. Gives you all the facts—basic semiconductor theory, parameter symbols, specifications of G-E transistor types, circuit diagrams, applications, registered types of all manufacturers, and other data frequently needed. 112 pages. Available at your local G-E Tube distributor, or enclose 50 cents (no stamps, please).

YOUR G-E SEMICONDUCTOR SALES REPRESENTATIVE

will be glad to give you further information and specifications on General Electric transistors and rectifiers. Manual, bulletins, and other data can also be obtained by writing Section 523158 Semiconductor Products Dept., General Electric Company, Electronics Park, Syracuse, New York.

GENERAL ELECTRIC

CIRCLE 89 ON READER-SERVICE CARD

Thermal Conductivity Apparatus

Tests Insulating Materials

This thermal conductivity apparatus is for measurement of the K factor of all types of insulating materials within a temperature range of -120 to 500 F. The apparatus is available as a complete unit or as components including a guarded hot plate assembly; a power, control and measuring console; and a water or mechanically refrigerated temperature bath.

Testing Equipment Sales Co., Dept. ED, Murray Hill, N.J.

CIRCLE 90 ON READER-SERVICE CARD



Vacuum Switch
300 Amp Peak Current

The 5TA-75 vacuum switch is a normally closed, spdt high voltage device. It is externally operated by a dc solenoid and is suited for switching purposes in dc pulse systems. It can, however, be employed in many circuits where the switching of current and the isolation of high voltage is required. Breakdown test voltage between open contacts is 20 kv dc. Typical pulse operation is: pulse duration of 2.4 μsec ; pulse repetition of 420 pps, and peak current of 300 amp. Temperature rating is -65 to $+125$ C. Typical dc operation is 1.5 amp at 5 kv. This may be switched under load in non-inductive circuits.

Pioneer Electronics Corp., Dept. ED, 2235 S. Carmelina, Los Angeles 64, Calif.

CIRCLE 91 ON READER-SERVICE CARD

PC Modules

Aid in Design of Original Equipment

These printed circuit modules enable the assembly of prototype equipment and small production units with a minimum time in designing, building or testing. Layout sheets with a duplicate of the pattern on the printed circuit board enable the engineer to build the unit as he designs the schematic diagram. Modifications and corrections can be quickly made. The sizes of the modules conform to the Air Force standards for modular construction.

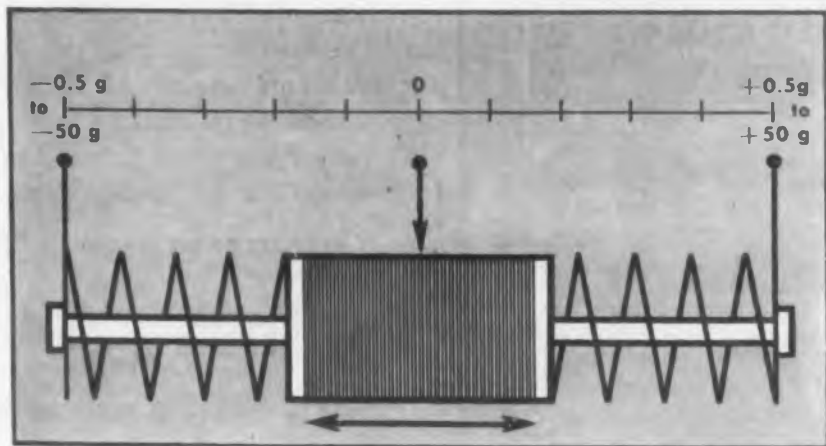
Dunlap Electronics, Inc., Dept. ED, Des Moines, Iowa.

CIRCLE 92 ON READER-SERVICE CARD

LINEAR ACCELEROMETERS for Aircraft and Missiles

ZERO CROSS-COUPLING NON-PENDULOUS TYPE

Honeywell Linear Accelerometers sense positive or negative accelerations or both in either the vertical or horizontal plane. Designed for use in aircraft and missiles, they are available in a variation of ranges from ± 0.5 g to more than ± 50 g's depending upon requirements. These units consist of a centrally located mass restrained by coil springs and supported on a linear-type ball-bearing. Any movement of the mass on either side of the null displacement position is measured by a potentiometer pick-off, providing a high level output signal. Viscous damping is incorporated for improved dynamic response. Zero cross-coupling is inherent with this true linear non-pendulous design. (Cross-coupling is defined as a change in output signal caused by an acceleration applied from any direction in a plane normal to the sensing axis) Excitation may be as high as 100 volts (A-C or D-C) depending on the potentiometer resistance. *Write for Bulletin LA* . . . Minneapolis-Honeywell, Boston Division, Dept. 10, 1400 Soldiers Field Road, Boston 35, Mass.



MINNEAPOLIS
Honeywell **H**
HONEYWELL

BOSTON DIVISION

CIRCLE 93 ON READER-SERVICE CARD



Shown Actual Size

- LINEAR RESPONSE
- D-C OUTPUT SIGNAL
- VISCOUS DAMPING
- HERMETICALLY SEALED
- EXTREMELY RUGGED
- WEIGHT: APPROXIMATELY 0.9 POUNDS
- ENVIRONMENT: MEETS MIL-E-5272A

Write for Bulletin LA

NEW PRODUCTS

Coaxial Terminations Complete Line for 1000-12,000 Mc



A complete line (including LT and HN connectors) feature a long taper of lossy, heat-resistant microwave absorber. The terminations are suitable for precision test applications or as medium-power dummy loads in the 1000 to 12,000 mc frequency range. Other types have N, C, BNC, LC, 7/8 and 1-5/8 in. connectors.

Radarc Design Corp., Dept. ED, 2360 James St., Syracuse, N.Y.

CIRCLE 94 ON READER-SERVICE CARD



Transparent Enclosures Colored or Clear

The PE series of transparent plug-ins is offered in clear and colored plastic. The units have high impact characteristics, excellent electrical properties, and are rated for 85 C ambient. Base pins carry 10 amp. Size: 1-3/8 x 1-3/8 x 2-1/8 high. Weight approximates 1-1/4 oz.

Line Electric Co., Dept. ED, 271 S. 6th St., Newark 3, N.J.

CIRCLE 95 ON READER-SERVICE CARD

Limit Switches Roller and Plunger Types

These two-circuit limit switches include a roller-plunger switch, designated 5LSI, which can be rotated 90 deg from the switch cover plate.

and plunger actuated switch, designated SLSI, which offers a 1/4-in. of overtravel. The electrical rating for the series is 10 amp, 120, 240, or 480 v ac; 2 hp, 120 v ac; 1 hp 240 v ac; 0.8 amp, 115 v dc; 0.4 amp, 230 v dc; 0.1 amp, 550 v dc. Pilot duty rating is 600 v ac max.

Minneapolis-Honeywell, Micro Switch Div., Dept. ED, Freeport, Ill.

CIRCLE 96 ON READER-SERVICE CARD



High Speed Sampling Switch 120 Contacts

Model 5220-120 sampling switch has miniature multipin connectors attached to barrier strips on either side of the switch, and consists of 2 poles, 120 contacts, 60 non-shorting channels per pole. The switch is available with or without a drive motor. Approximate dimensions are 5-1/4 in. high by 5-3/8 in. wide by 10 in. long.

General Devices, Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE 97 ON READER-SERVICE CARD

Miniature Terminals Teflon Insulated



The advantages of Teflon and turret connections are available in the smallest of the Press-Fit terminal line. Types ST-SM-16 TUR and FT-SM-16 TUR install in 0.08-in. holes with maximum channel thickness to 0.075 in. Overall length including one or two lugs is 0.35 in. for standoffs, 0.5 in. for feedthrus. Lugs are brass, solder finish.

Salectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 98 ON READER-SERVICE CARD



NEW RATE SWITCHES OFFER SUPERIOR SENSITIVITY

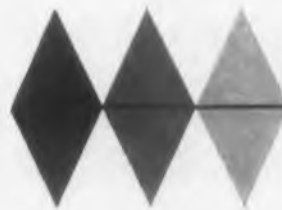
New rate switches now in production at Humphrey, Inc. for virtually all major missile programs offer rate ranges from 1° per second to 500° per second. A rate switch can also be supplied that has external adjustments for rate, saving time and money on experimental programs.

Rate switches are available for either a-c or d-c power. They are equipped with primary switches that handle up

to 100 ma. For higher ratings, the instruments can be furnished with built-in relays.

These rate switches withstand tough environmental conditions. Typical specifications are: temperature—-65°F to +165°F; acceleration—80G; shock—80G for 5 milliseconds; and vibration—±10G to 2000 cps.

Write and tell us about your rate switch requirements.



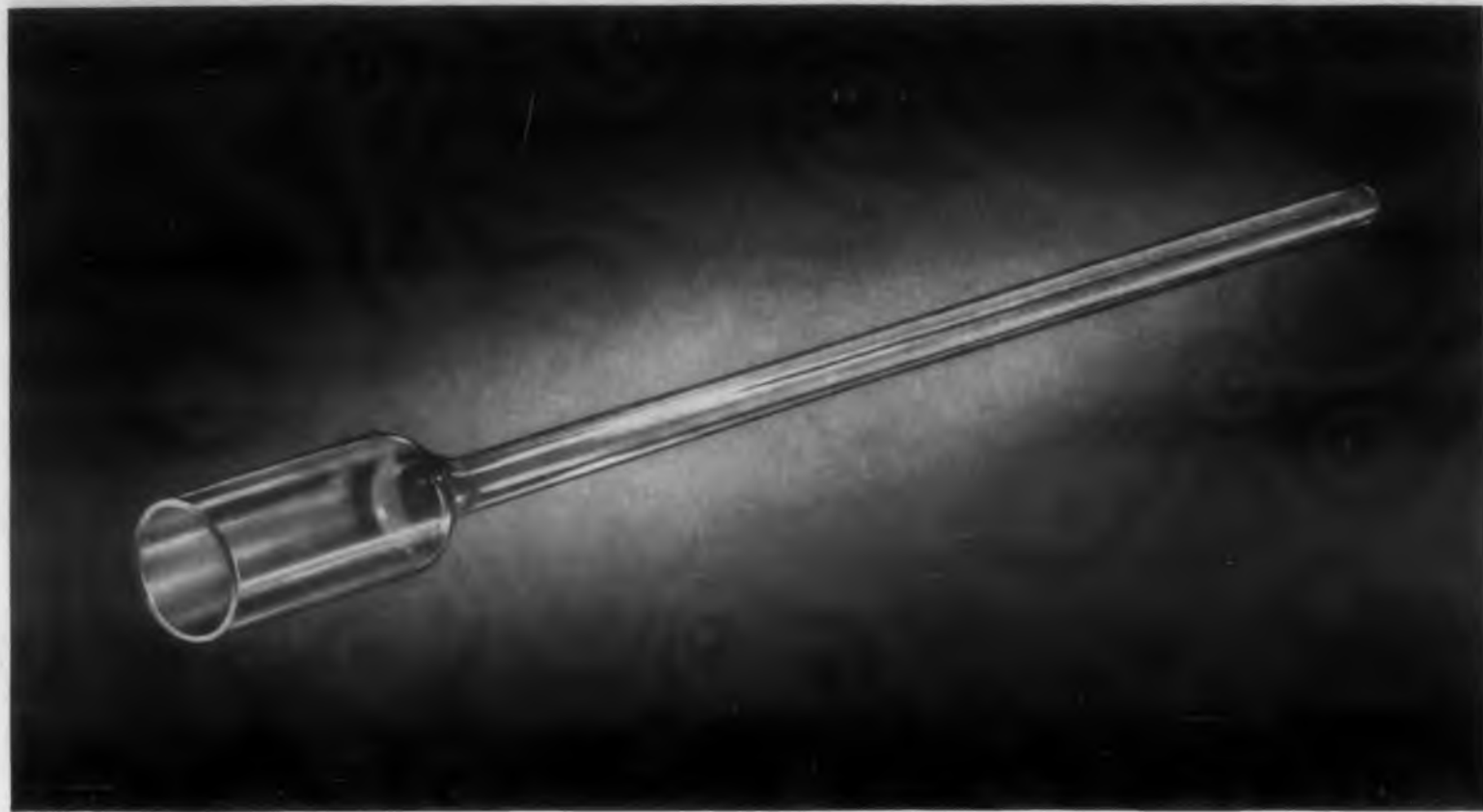
Humphrey Inc.

ELECTRO-MECHANICAL INSTRUMENTS

DEPT. ED-18 2805 CANON STREET
SAN DIEGO 6, CALIFORNIA

FOR COMPLETE SYSTEMS, SPECIFY HUMPHREY GYROSCOPES, ACCELEROMETERS, POTENTIOMETERS

CIRCLE 99 ON READER-SERVICE CARD



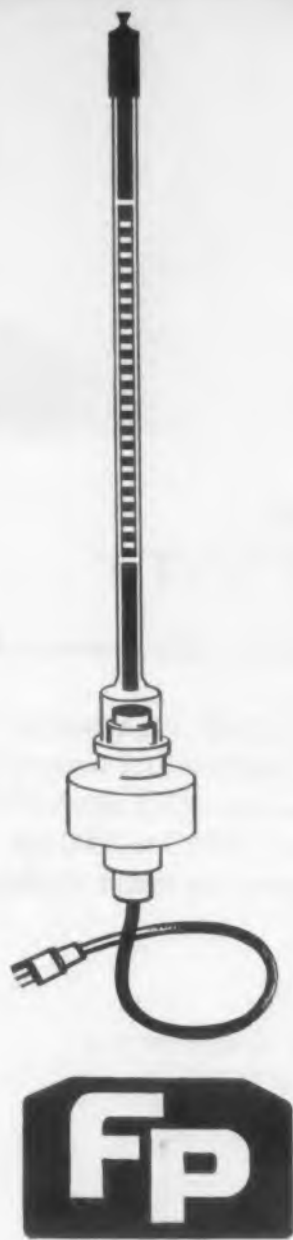
precision glass component plays vital part in new traveling-wave tube design

Glass tubing made to near-perfect concentricity with diameter tolerances of ± 0.0001 in.! . . . that's the kind of tolerance required by a new traveling-wave tube design . . . the kind of tolerance F&P can and does meet everyday for a variety of glass applications.

The two-section glass tube shown above must be formed to near-perfect concentricity in order to precisely locate the electron gun in relation to the helix. A pencil beam of electrons—shot from the gun and traveling through the tube—must interact continuously with the electromagnetic wave produced by the helix. The relative position of the beam with respect to the helix is extremely critical . . . any deviation from set tolerances, any scratches or imperfections in the glass would result in faulty amplification.

Mighty tough specs to meet! But F&P handles them with ease . . . with production techniques backed by more than 20 years' experience in the field of precision glass forming and fabricating. Other glass products made by F&P for the electronic industry include special types of glass tube enclosures, glass switch components, miniature glass battery enclosures, and precision molds.

If you would like to explore the possibilities of using precision glass in your designs, contact the Glass Products Division, Fischer & Porter Company, 5718 County Line Road, Hatboro, Pennsylvania.



FISCHER & PORTER CO.
Glass Products Division

CIRCLE 100 ON READER-SERVICE CARD

NEW PRODUCTS



Variable Inductors
1 Mc to 200 Mc

Designated the MF series, these inductors have been added to the company's line of electrically variable inductors, and have wider range, higher sensitivity, and higher Q than previous types. Permanent magnet bias is employed, using stabilized ceramic magnets. Types are available for frequencies from 1 to 200 mc, and the higher frequency types have been employed in conjunction with conventional tank circuits at frequencies up to 400 mc.

Vari-L Co., Inc., Dept. ED, 432 Fairfield Ave., Stamford, Conn.

CIRCLE 101 ON READER-SERVICE CARD



Pulse Transformer
For Recording Head
Circuits

Series 70-3420 transformer is suitable for high current magnetic recording head drive circuits. Primary and secondary as well as two secondaries are close coupled to permit use as a read-write circuit. Packaging is designed for close stacking, and the entire unit is potted in a high temperature moisture resistant epoxy. Turns ratio of 1:2:1 can be modified to match circuits for various heads.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 102 ON READER-SERVICE CARD

Wheatstone Bridge

High Accuracy

Specifications on the model 17 Wheatstone are: Ratio arms—double set ratio resistors, two each of 1, 10, 100, 1000 and 10,000 ohms, with reversing switch for resistor checking; Decades—1 to

100,000 ohms, adjustable in steps of 0.1; Error limit—ratio resistors 0.001, decade resistor 0.01 of absolute accuracy; Temperature coefficient—15 ppm between 20 and 30 C; Current rating—determined by highest decade in use with rheostat arm as resistor box, ranging from 0.7 to 0.022 amp; Applied voltage—determined by lowest ratio resistor present in either ratio arm, ranging from 1.5 to 50 v.

Cal-Ohm Labs., Inc., Dept. ED, Sterling, Kans.

CIRCLE 103 ON READER-SERVICE CARD



Sequence Timer

High Switching Capacity

Model HDC sequence timer has a switching capacity of 10 amp at 115 v dc or 15 amp at 115 v ac, using a driving motor drawing 8 ma at 6 v dc. The timer employs a heavy duty cam actuated switch of the magnetic quench type. Speed regulation of the motor is ± 1 per cent over a voltage shift of ± 50 per cent.

Brailsford & Co., Inc., Dept. ED, 670 Milton Rd., Rye, N.Y.

CIRCLE 104 ON READER-SERVICE CARD

Voltage Calibrator

Provides 0.001 Per Cent Stability

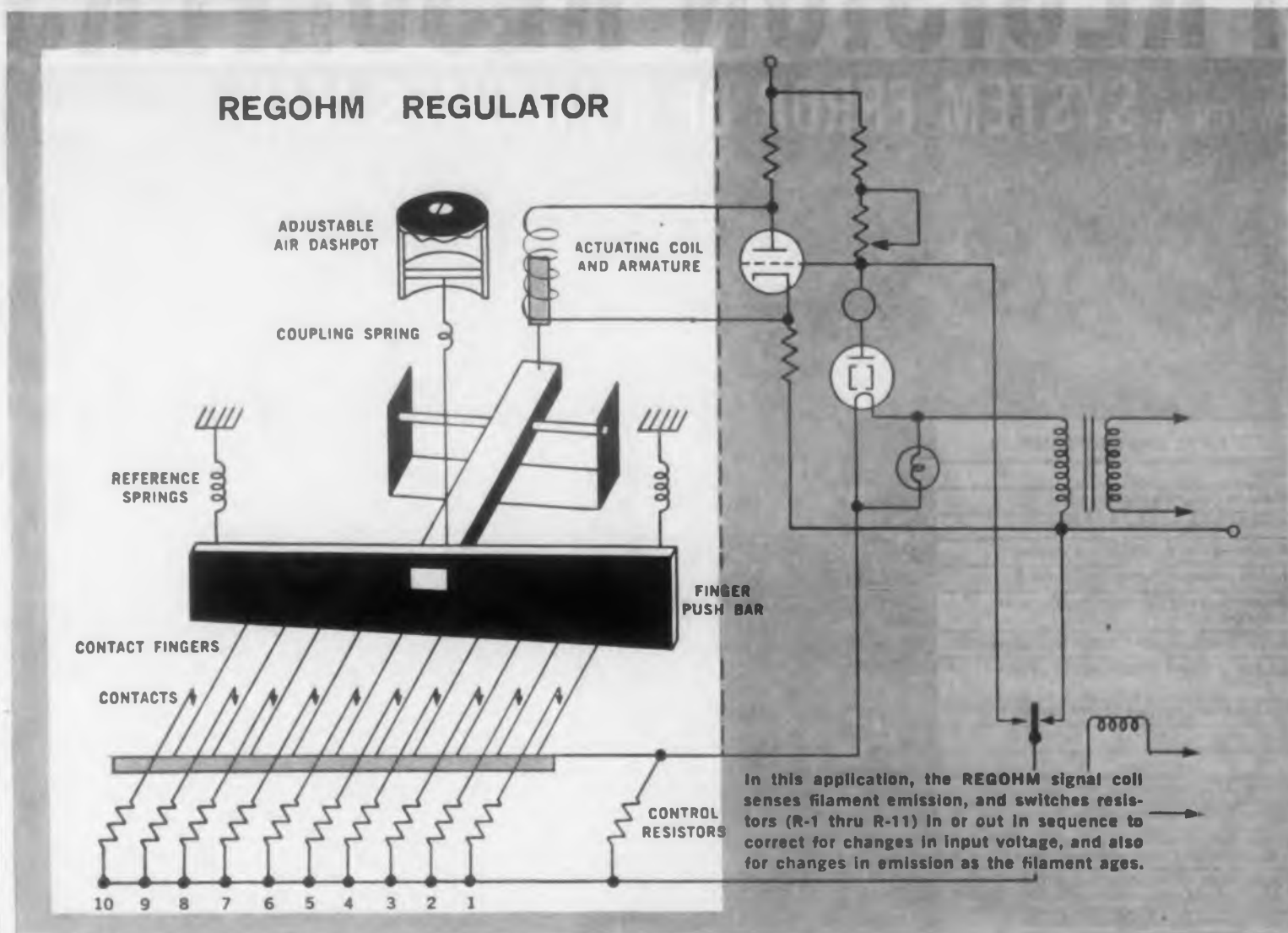


Model 6020B voltage and current calibrator is designed primarily for use in conjunction with magnetic core testing and grading, but is also applicable to general pulse dc and sine wave measurement. Two variable calibrated reference voltages of 0.001 per cent stability and the signal to be measured are sampled and furnished to an oscilloscope for a superimposed display. The two references may be set for tolerance checking or for 0.5 per cent amplitude measurement. Ten ranges cover 0 to 500 v (100 mv full scale on lowest range) and 0 to 1000 ma.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

CIRCLE 105 ON READER-SERVICE CARD

REGOHM SOLVES Another Electronics Control Problem



REGOHM REGULATOR MAINTAINS CRITICAL 0.05% ELECTRONIC EMISSION IN DIATRON CIRCUIT

"The final design was made possible by the Electric Regulator Corporation's ten step contact finger regulator . . ."

That is the tribute paid to REGOHM'S multi-contact voltage control by Consolidated Electrodynamics' engineers in speaking of their Type 24-210 Leak Detector.

The REGOHM regulator is used to provide an accurately controlled voltage to the tungsten filament in the Diatron mass spectrometer tube. It is this filament that produces the electron bombardment of the sampled gases passing through a magnetic field—causing each gas ion to assume a distinctly different path. This selective action affords the means for detection, and quantitative measurement, of the specific gas concerned.

Tests with other regulating devices, such as thyatrons or mercury-wetted contact relays, were unsatisfactory—either because of poor performance or excessive costs.

The following distinct advantages were acclaimed for REGOHM by Consolidated Electrodynamics . . .

1. The enormous power gain provided through flat compounding; the current needed to operate all ten contacts being only 5% more than that required for the first stage.
2. Relatively low power dissipation in the parallel resistors in ratio to the power fed into the filament.
3. Adjustable dashpot to check oscillation tendency in the circuit.
4. A compensating relay by-pass provision for holding voltage in the regulator tube when relays are open—to prevent destructive surging when filament is switched on.

The REGOHM'S unique combination of advantages—flexibility, plug-in design, compact size, outstanding reliability, and low cost—is providing the answer to difficult regulation problems in many types of circuit. Why not consult our engineering staff to see how well it can fit your application? Please contact Electric Regulator Corporation, Norwalk, Connecticut.

CIRCLE 106 ON READER-SERVICE CARD

Please write for design data and performance specs on REGOHM multi-stage regulators in applications similar to this.



REGOHM



ELECTRIC REGULATOR CORPORATION
NORWALK CONNECTICUT

PRECISION RESOLVERS

WHEN A SYSTEM ERROR OF 8 MINUTES MAX. IS REQUIRED,

two 15-4042-06 compensated resolvers can be used as a matched pair*

Oster



All units can be varied to meet your exact specification. Write for further information today, detailing your requirement.

ELECTRICAL CHARACTERISTICS

	Other Oster Resolvers						
Size	*15	10	10	11	15	15	15
Rotor—(No. wires/No. phases)	4/2	3/2	2/1	3/2	3/2	2/1	3/2
Input voltage (to rotor) (Volts)	16	26	26	26	26	26	7.45
Stator—(No. wires/No. phases)	4/2	4/2	4/2	4/2	4/2	4/2	4/2/0°
Input voltage (to stator) (Volts)	16	11.8	11.8	11.8	11.8	18	26
Rotor current (stator open) (Milli-amperes)	14	29	9.2	46	52	11	38
Rotor power input (stator open) (Watts)	.03	.29	.06	.27	.2	.09	.05
Stator current (rotor open) (Milli-amperes)	13.5	49	15.3	78	91	12.6	12.4
Stator power input (rotor open) (Watts)	.05	.18	.05	.16	.17	.06	.08
Zro	139 +J 1134	352 +J 843	753 +J 2740	127 +J 550	72 +J 497	831 +J 2381	37 +J 194
Zso	254 +J 1160	75 +J 231	261 +J 1727	26.4 +J 149	21 +J 128	351 +J 1385	588 +J 2060
Rotor D.C. resistance per phase (Ohms)	70	240	450	75	55	375	22
Stator D.C. resistance per phase (Ohms)	175	44	165	16	14	160	206/408
Rotor output voltage per phase (stator excited) at maximum coupling (Volts)	14.9	19.7	20.3	19.5	20.7	21	7.45
Stator output voltage per phase (rotor excited) at maximum coupling (Volts)	15.3	11.8	11.8	12.6	11.8	17.8	26.2
Voltage gradient (stator) (Milli-volts/degree)	268	206	206	220	206	310	458
Phase shift (rotor to stator)	2.3°	14.6°	6.8°	6.3°	6.8°	7.28°	4.56°
Phase shift (stator to rotor)	8.1°	9.4°	10.6°	4.8°	6.5°	5.47°	4.6/9.8°
Null (residual voltage)							
Total R.M.S. (Millivolts)	(Quadrature)	50	30	30	50	40	40
Fundamental (Millivolts)	12% of input voltage	35	21	21	35	28	28
Angular accuracy	Functional error: 14% of input voltage	24' spread	24' spread	10' max.	20' spread	20' max.	45' max.
MECHANICAL CHARACTERISTICS							
Friction at +25°C (Gcm)	22	5	5	4	5	10	10
at -55°C (Gcm)	45	15	15	16	15	30	20
Weight (Ounces)	8.0	1.75	1.75	3.0	5.0	5.0	5.0
Leads (color coded) (Number/length)	TERMINALS	(7)-12"	(6)-12"	(7)-12"	(7)-12.5"	(6)-12"	TERMINALS
OSTER type number	*15-4042-06	10-4061-01	10-4065-02	11-4117-03	15-4011-02	15-4015-04	15-4043-02

- Operating temperature ranges - 65°F to + 400°F. • Meets MIL-E-5272. • Sizes 8, 10, 11, 15, 18 and 23 can be supplied. • Transformation ratios and phase shift to your design specs. • Functional accuracies as low as .05%.

Other products include servos, synchros, motor-gear-trains, AC drive motors, DC motors, servo mechanism assemblies, servo torque units, motor tachs, reference and tachometer generators, actuators and motor driven blower and fan assemblies.



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Interesting, varied work on designing transistor circuits and servo mechanisms.
Contact Mr. Robert Burns, Personnel Manager, in confidence.

CIRCLE 107 ON READER-SERVICE CARD

NEW PRODUCTS

Precision Condenser Drive

Direct Linear Reading



This precision drive and condenser combination is for use in precision direct-setting interpolation type oscillators. A 2000:1 gear ratio permits precision setting of capacity to within ± 5 parts in 10^4 . Temperature coefficient at 80 per cent of maximum capacity for 50 C rise from ambient room temperature is less than 3 parts in 10^4 per deg C.

National Co., Inc., Dept. ED, 61 Sherman St., Malden 48, Mass.

CIRCLE 102 ON READER-SERVICE CARD

Miniature Wirewound Resistor

Dissipates 0.1 W at 125 C



The NS6AZ is the smallest encapsulated wirewound resistor in a line of 15. Measuring 1/8 x 1/4 in., the unit is available with resistance values up to 125 K with tolerance to 0.1 per cent. The resistor will dissipate 0.1 w at 125 C.

Eastern Precision Resistor Corp., Dept. ED, 675 Barbey St., Brooklyn 7, N.Y.

CIRCLE 109 ON READER-SERVICE CARD

Standard Switch Line

with True Hermetic Seals

This company announces the availability of a true hermetic seal, including around the shaft, on all their standard switches. The hermetic seal is accomplished within an enclosing case which adds little to the size of the switch and no apparent increase in torque. The seal at the shaft is

ELECTRONIC DESIGN • January 22, 1958

retained by a specially designed rotary seal and provides a full 360 deg bi-directional rotation. The enclosure in manufacturing is out-gassed, vacuum dried, flushed with pure dry nitrogen, then back-filled with a nitrogen-helium mixture. This provides the helium tracer necessary to check the seal. Normal production now will provide a leakage rate not to exceed 1 micron per cu ft per hr at a pressure differential of 1 atmosphere.

Daven Co., Dept. ED, Livingston, N.J.

CIRCLE 110 ON READER-SERVICE CARD



**Multiple Strip Chart
Telemeter Receiver**

This telemeter receiver will print out up to 16 separate records from as many telemetering transmission centers.

The instrument prints on a 12-1/4 in. wide strip chart, and is available with either a 5-sec or 15-sec time-impulse telemetering system.

The Bristol Company, Dept. ED, Waterbury 20, Conn.

CIRCLE 111 ON READER-SERVICE CARD

Transistorized Decade Amplifier

Range of 10 Cps to 50 Kc



Model 194F transistorized ac decade amplifier is designed to extend the sensitivity of high impedance input devices or to amplify ac strain gauge signals. The amplifier has a range of 10 cps to 50 kc, ± 3 db, and a noise level of less than 2 mv, input short circuited. Having gains of 1, 10 and 100, the amplifier operates from two 5-v mercury batteries. Load stability is achieved through utilizing dc coupled stages with 80 db of dc feedback around the complete amplifier.

Taber Instrument Corp., Dept. ED, 107 Gountry St., N. Tonawanda, N.Y.

CIRCLE 112 ON READER-SERVICE CARD



JOIN WITH HANDY & HARMAN SILVER BRAZING FOR PERMANENT PROFIT



EASY-FLO Brazing Simplifies Multiple Joint Design and Production

Silver brazing with EASY-FLO makes possible simplicity of design and assembly, often abolishing machining operations like stamping, riveting, staking and threading. You see here some of a large variety of brass connectors for radar equipment, manufactured by the King Electronics Company, Incorporated, Tuckahoe, New York. All must meet rigid performance requirements which in turn, establish equally exacting production specifications.

Many different types of joints are involved. Prime performance requirement of these connectors is unimpaired electrical conductivity, for they must in no way impede the current flow of the wires they house. All must be 100% moistureproof and gasproof, have high mechanical strength and take uniform plating without prior finishing. Joined connectors must be perfectly aligned and undistorted.

Each of these requirements is fully met by Handy & Harman silver alloy brazing with EASY-FLO 45 and HANDY FLUX at considerable savings in money and time. Savings that warrant your attention, whatever your product or production methods. Our experience proves that savings through silver alloy brazing can be enjoyed by many manufacturers of many different products in a host of industries. This "King Connector" story is but one example of how silver alloy brazing meets the needs of one product from *start to finish*.

It is worth thinking about—worth getting in touch with Handy & Harman to find out. We will work with you all the way.

TAKE TWENTY

BULLETIN 20 tells you why high strength, speed and economy are inherent in EASY-FLO brazing. Also gives Handy information about joint design and fast brazing methods. We'll be pleased to send you a copy.



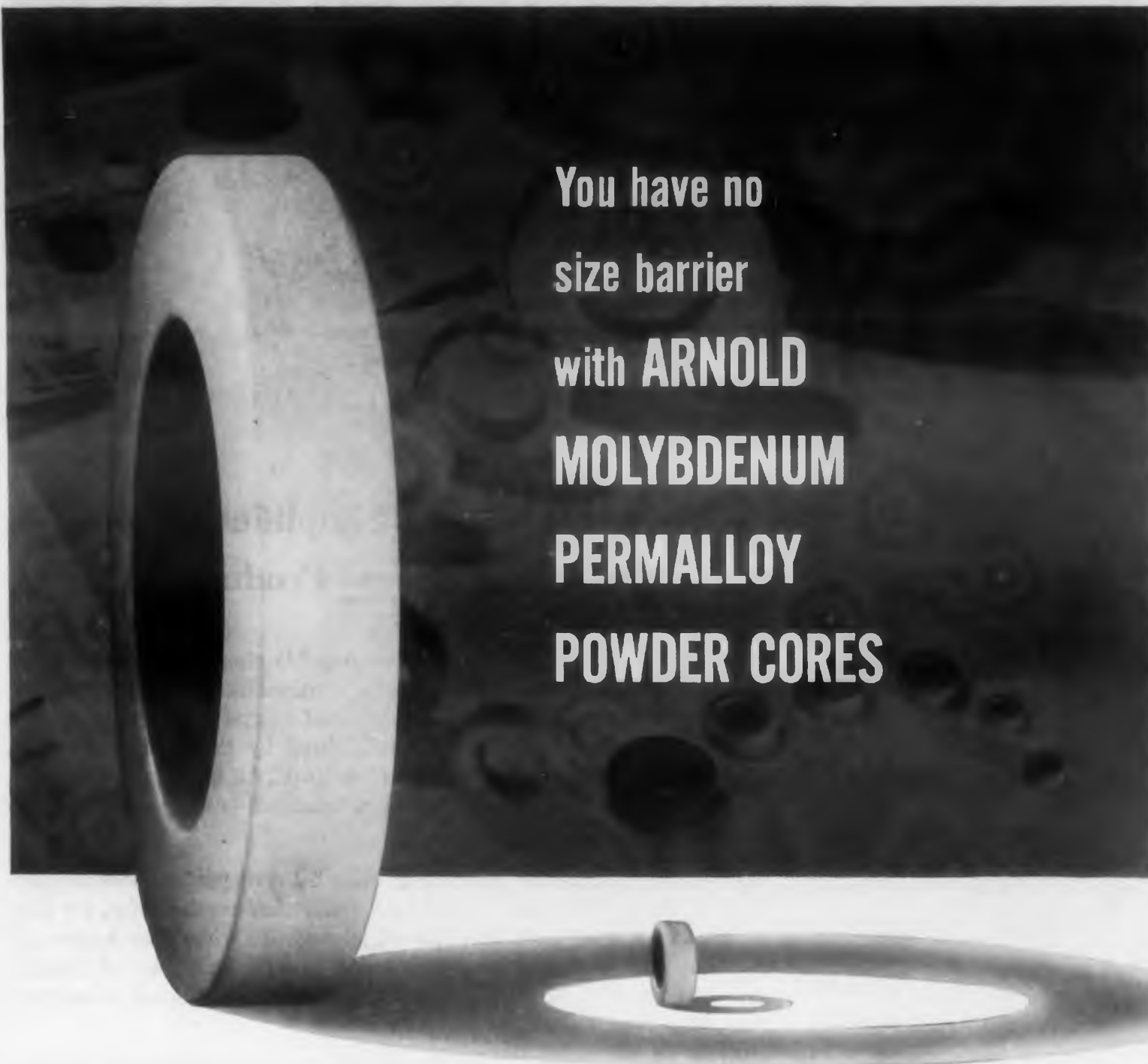
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You have no
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MOLYBDENUM
PERMALLOY
POWDER CORES

Starting with the smallest up to the largest, Arnold leads the way in offering you a full range of Molybdenum Permalloy Powder cores for greater design flexibility . . . from 0.500" O.D. to 5.218" O.D.

As long ago as 1953 Arnold pioneered and developed for production use the small "Cheerio" core illustrated above. Today, hundreds of thousands of Arnold "Cheerio" cores are filling the requirement for miniaturization in circuit design in industrial and military applications. And even smaller sizes are now under development at the Arnold Engineering Company.

Arnold also is the exclusive producer of the largest 125 Mu core commercially available. A huge 2,000 ton press

is required for its manufacture and insures its uniform physical and magnetic properties. This big core is also offered in the other three standard permeabilities of 60, 26 and 14 Mu.

Most core sizes can be furnished with a controlled temperature coefficient of inductance in the range of 30° F to 130° F. Many can be supplied temperature stabilized over the wide range covered by the MIL-T-27 specification of -55° C to +85° C . . . another of the special features only Arnold provides. • Let us handle all your magnetic materials requirements from the most extensive line in the industry: Powder cores, tape cores, cast or sintered Alnico permanent magnets, and special magnetic materials.

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Lists complete line of Mo-Permalloy Powder cores . . . available in 23 sizes from 0.500" O.D. to 5.218" O.D. Furnished also with various types of temperature stability from Type "A" unstabilized to Type "W" stabilized over the temperature range of -65° F to +185° F.

ADDRESS DEPT. ED-81

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CIRCLE 114 ON READER-SERVICE CARD

NEW PRODUCTS

Tube Socket and Shield Telescoping Type



This line of tube socket and shield combinations incorporate telescoping slide construction. Since the shield is not removable from the base, hazards of shock displacement or failures to replace shields are eliminated. Totally enclosed to reduce rf radiation effects, variations are furnished for both conventional and printed wiring applications in seven and nine pin sizes.

Methode Manufacturing Corp., Dept. ED, 7447 W. Wilson Ave., Chicago 31, Ill.

CIRCLE 115 ON READER-SERVICE CARD



Silicon Rectifiers 250-750 Ma, 1600-4500 PIV

Five models (four full wave and one half wave) have been designed with current ratings from 250 to 750 ma dc with piv from 1600 to 4500. Features include high efficiency, rugged construction, vertical or horizontal mounting, and good regulation.

Sarkes Tarzian, Inc., Dept. ED, 415 N. College Ave., Bloomfield, Ind.

CIRCLE 116 ON READER-SERVICE CARD

Tubes

Thyratrons, Sharp Cutoff Pentodes

Four tubes have been recently announced. The 5727 is a gas-tetrode thyratron of the 7-pin miniature type, designed for use in relay, grid-controlled rectifier, and pulse-modulator circuits. The 7086 is a three-electrode, forced-air cooled, xenon thyratron having a negative-control characteristic, high commutation factor, and relatively

short dieonization time. It is designed primarily for use where high peak currents are required. The 6BU8 and 6BU8 are sharp-cutoff twin pentodes of the 9-pin miniature type intended for use in sync circuits and agc amplifier circuits of TV receivers. The 6973 is a beam power tube of the 9-pin miniature type designed for audio output. Maximum-signal output is 20 w with total harmonic distortion of 1.5 per cent. Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 472 ON READER-SERVICE CARD



Relay
Miniature, Shock
Resistant Unit

Type SC relay measures 0.359 wide by 0.875 high by 0.795 in. deep. The unit stands shocks of 100 g and vibrations of 30 g to 2000 cps with no contact openings. Minimum contacts pressure is 13 grams. The relay operates on approximately 1 w, and is a dpdt type capable of switching 2 amp at 30 v dc or 1 amp at 115 v ac resistive. Ambient temperature range is -65 to +125 C.

Potter & Brumfield, Inc., Sub. American Machine & Foundry Co., Dept. ED, Princeton, Ind.

CIRCLE 117 ON READER-SERVICE CARD

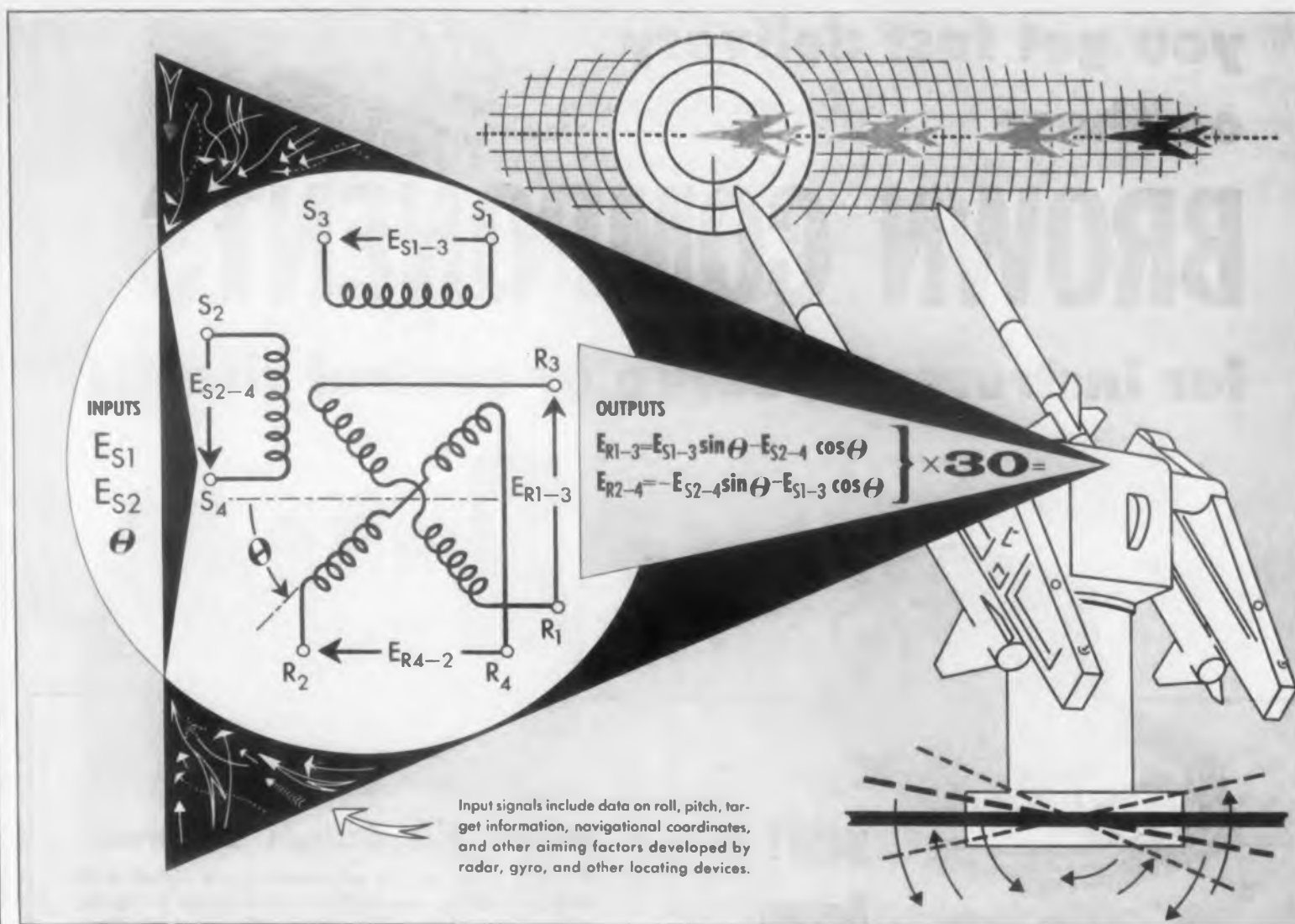


Potentiometers
High Temperature Series

Series 5000 potentiometers cover a temperature range of -55 to +150 C. Power rating of the 1/2-in. units above 5000 ohms is 2.5 w at 60 C derating to 1 w at 150 C. Below 5000 ohms, ratings are 1.5 w at 60 C, derating to zero at 150 C. Standard resistance range is 500 to 70,000 ohms with a linearity tolerance of ±5 per cent. Best practical linearity tolerance is ±0.25 per cent. Three models are available, each weighing 0.3 oz. Model 5001 has a bushing mount, and 5002 a servo mount. Model 5016 is a high-torque trimmer with slotted bushing mount.

Beckman-Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 118 ON READER-SERVICE CARD



This New High Impedance Resolver by Norden-Ketay controls the Terrier missile from a rolling deck

Take the computer problem in aiming a supersonic missile from solid ground — add the variable factors of a rolling ship and a jet-propelled, airborne target. The answer to that problem combines 30 Norden-Ketay precision resolvers in a phenomenal computer capable of launching the Navy's 'Terrier' with incredible accuracy.

Norden-Ketay standard 105D2V Resolver met these difficult requirements perfectly for the Navy's 'Terrier' project — again demonstrating the value of the special characteristics designed into all Norden-Ketay components.

If your problem concerns computer accuracy or power, consider Norden-Ketay Resolver advantages. The high impedance circuitry requires smaller volume and reduces the size of power supply equipment.

Write for additional data on high impedance and other resolvers to:
Norden-Ketay Corporation, Precision Components Division, Commack, L.I., N.Y.

CIRCLE 119 ON READER-SERVICE CARD



The high degree of accuracy and reliability of this new resolver helps the designer achieve new levels of performance in computer systems. Here is an outstanding example of the way Norden-Ketay developments simplify the solution of complex problems.

General Specifications

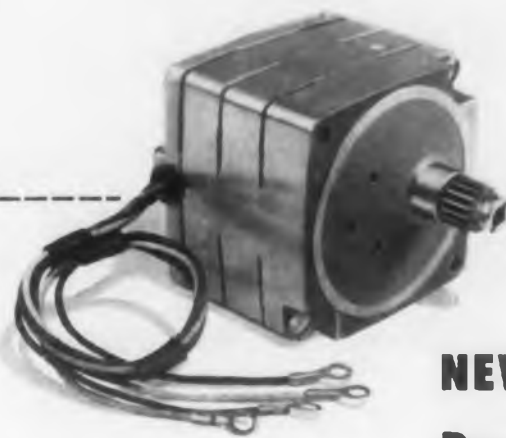
Norden-Ketay Type: 105D2V • Designated by BuOrd as Mark 4 Mod 1
Tuned Input: 12,000 ohms • Accuracy: ±0.1% • Frequency: 400 cps.



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for instrument, servo or control circuits



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Brown
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for chart drives, servos, balancing circuits

These newly-designed synchronous and two-phase Brown motors have many maintenance saving features: new, sectioned die-cast housing . . . new wicking to prevent oil leakage . . . printed circuits . . . ball bearings to reduce friction. You can replace any part in two minutes, usually without disconnecting the leads from your installation.

TWO-PHASE INDUCTION

Nominal No Load RPM†	Gear Ratio	Intermittent Rated Load (oz.-in.)	Max. Starting Torque (oz.-in.)	Power (watts) Loaded††	Current (amps) Loaded	Temp. Rise Deg. F.
330	44:1	4	10	7.6	.11	70
148	10:1	5	20	7.0	.11	70
44	30:1	15	60	7.6	.11	70
22	60:1	30	120	7.6	.11	70

SYNCHRONOUS

RPM†	Gear Ratio	Pull-In Torque, Min. (oz.-in.)	Continuous Torque (oz.-in.)	Power (watts) Loaded	Current (amps) Loaded	Temp. Rise Reg. F.
180	10:1	12	12	19	.21	100
180	10:1	3.5	4	13	.11	65
90	20:1	14	12	11	.095	55
60	30:1	13.5	12	13	.11	65
30	60:1	27.5	12	13	.11	65

†1/6 less at 50 cycles. Some speeds available at 25 cycles.

††6.0 watts in field winding, balance in amplifier winding.



BROWN *Electronik* AMPLIFIERS*

Amplify a d-c or a-c microvolt input signal sufficiently to drive one field of a two-phase balancing motor. Brown amplifiers have extremely low stray pickup, excellent stability, adjustable sensitivity and fast response. Proved in thousands of *Electronik* instruments.

SELECT FROM THESE BASIC MODELS

Nominal Gain	Sensitivity (Microvolts)	Nominal Input Impedance (Ohms)
1×10^6	4.0	370, 1400, 50,000
4×10^6	1.0	370, 2500
12×10^6	0.4	2500
40×10^6	0.1	1400

POWER SUPPLY

115 v., 60 cycles (fused power line)

OUTPUT

2 to 18 ma. into 12,000 ohm load

SENSITIVITY

Continuously variable screwdriver adjustment. Recessed slot protects setting

MOUNTING

Operation unaffected by mounting position

OPTIONAL FEATURES

(a) thermocouple burn-out protection, (b) without desensitizing adjustment, (c) parallel T feedback, (d) velocity damping, (e) special connecting cables and plugs, (f) without tubes, shields, and converter, (g) for 25 cycles, (h) 220-110 volt transformers.

*The sale of this device does not carry with it a license under any of our combination patents covering apparatus in which this device may be used.

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MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

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NEW PRODUCTS



Ferrite Isolator
Miniature Size

Having a depth of 1 in. and weighing 12 oz., model W177-1G-2 transverse field isolator consists of rectangular waveguide with permanent magnetic transverse field and ferrite sections built into the unit. Frequency range is 8.5 to 9.6 kmc, isolation is 15 db min, and insertion loss is 1 db maximum. Other characteristics include an input vswr of 1.10 max, and peak power at 125 kw with 2.1 load at any phase. Average power is 200 w and ambient rating is 150 C.

Kearfott Co., Western Div., Dept. ED, 14844 Oxnard St., Van Nuys, Calif.

CIRCLE 121 ON READER-SERVICE CARD



Carbon Film Resistors
Individually Tested

A test specification designated ME-3, outlines procedures used to reduce field failures to a minimum. All resistors go through 5 temperature cycles and a 10 minute power test. An x-ray of resistors is attached to packing containers. Resistance range is 5 ohms to 10 meg. Wattage range is 1/8 to 2 w.

Mepco, Inc., Dept. ED, 36-37 Abnett Ave., Morristown, N.J.

CIRCLE 122 ON READER-SERVICE CARD

Photocell

Resistance Varies with Illumination

The resistance of Type 40 photocell varies with the change of illumination falling on it, so that it has a resistance of greater than 1 megohm in the dark and only a few hundred ohms at a light level of 50 foot candles. A high dissipation series, the photocells will operate magnetic and thermal relays without any intermediate amplifier. An interdigital electrode material is used which is

completely ohmic, so that resistance remains independent of applied voltage. In its standard form the cell consists of a sensitive area of about 0.4 sq. in., with a thin layer of cadmium sulfide. Canadian Marconi Co., Dept. ED, 6035 Cote de la Besse Rd., Montreal, Canada.

CIRCLE 123 ON READER-SERVICE CARD



Pressure Pickup

Accuracy of 0.5 Per Cent

Series 70-2000 pneumatic transmitters are 0.5 per cent pressure pickups designed for low cost application in the process industries and ground environment testing for multiple pressure scanning and alarm systems. The pressure transmitter is available in five standard ranges, from 0-15 to 0-200 psig. It measures 2-1/4 in. diam by 1-3/4 in. deep.

International Resistance Co., Computer Components Div., Dept. ED, 401 N. Broad St., Philadelphia 8, Pa.

CIRCLE 124 ON READER-SERVICE CARD

Synchro

Maximum Error of 30 Sec Arc



Model 425506-1 synchro component has a maximum error from electrical zero of only a half minute. A resolver type unit, this synchro is capable of functioning as a 4-wire control transmitter, as a control differential transmitter, or as a control transformer which, when used in a 4-wire string to form a typical data transmission system, holds overall system error to less than one minute from electrical zero. The 400-cps unit may also be modified for operation at either 4000 or 10,000 cps. A compensator winding is provided to maintain the resolver's 30-sec accuracy despite variations in temperature and frequency.

Kearfott Company, Inc., Dept. ED, 1378 Main Ave., Clifton, N. J.

CIRCLE 125 ON READER-SERVICE CARD

multum in parvo . . . great oaks from little acorns . . . good things in small packages.

Decker's T-42 Ionization Transducer—though it is smaller than your little finger—made all of these instruments possible. It is blazing a man-sized trail in every area of basic and applied scientific inquiry. For behind this little tube was a truly great idea. And great ideas are truly Decker's business.



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preload
micrometer



cardiodynameter



ICBM
simulator



rotor micrometer



dynamic balancer



delta II



comparator
micrometer



Aerobee-Hi rocket
instrumentation



pressure meter



delta unit

T-42

THE DECKER CORPORATION *Bala Cynwyd, Pa.*

whenever a new development takes place, it is based on ionization and electrical gas discharge

CIRCLE 126 ON READER-SERVICE CARD

IF VOLTAGE REGULATION IS A PROBLEM THIS MESSAGE IS DIRECTED TO YOU

Developments at Victoreen open up many new applications which heretofore have been restricted to complex, expensive, conventional methods of regulation due to high current requirements.

Current ratings have been increased to as much as 4, 6 or even 8 ma in the new Victoreen corona regulators. These are produced for MIL and other applications in T6½ and T-9 envelopes in voltage ranges below 3500 v.

They offer many opportunities to simplify circuits . . . to decrease complexity and costs . . . to provide a type of regulation never before available.

Our Applications Engineering Department is eager to help you out of your voltage regulation dilemma. A letter or call may solve your problem.

AA-6700

The Victoreen Instrument Company

Components Division
5806 Hough Avenue, Cleveland 3, Ohio

CIRCLE 127 ON READER-SERVICE CARD

NEW PRODUCTS

AFC System Complete in One Chassis



This afc unit, IF67, is designed for use in a 0.1 μ sec pulse system, contains all the elements required for afc purposes such as the amplifier, diode phantastron, and an internal control for manual tuning of the LO. A sweep frequency of 3 cps and a sweep output of 45 v at an adjustable level of -115 to -195 v are also provided.

Lel, Inc., Dept. ED, 380 Oak St., Copiague, N.Y.

CIRCLE 128 ON READER-SERVICE CARD

Neon Driver for Camera Timing Lights



This neon driver furnishes power to flash neon camera marker lamps to display time code signals in optical instrumentation devices, such as high speed cameras or cine-theodolites. Measuring 1-3/8 x 1-1/4 x 3-5/8 in., the neon driver is completely transistorized. Use of the driver enables the distribution amplifier to be located next to the time code generator with only the neon drivers themselves located with the cameras.

Electronic Engineering Co. of Calif., Dept. ED, 1601 E. Chestnut Ave., Santa Anna, Calif.

CIRCLE 129 ON READER-SERVICE CARD

Electromechanical Counters Counting Rates of 40 per Sec

Featured in this line of electro-mechanical counters and counter-transmitters are counting rates to 40 per sec and a life span exceeding 10,000,000 counts. The line includes both uni-directional and bi-directional units, the latter



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THE RADIO-ELECTRONIC MASTER
60 Madison Ave., Hempstead, N.Y.

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...IF YOU NEED POWER SUPPLIES TRANSVAL

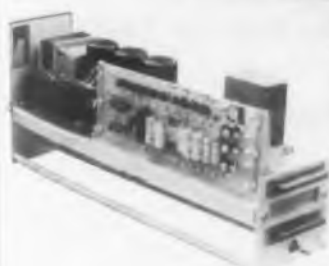
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HIGH VOLTAGE POWER SUPPLY

Output voltage to 1050 volts ($\pm 5V$). Regulation 0.5% with nominal load and input from 109 to 121 volts.
Size: 5" x 4" x 4 1/2"; 3 1/2 lbs.



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Stability of one millivolt over entire output range of 0 to 4 amps at 10 volts. Other voltages with the same stability may also be obtained.

MULTIPLE HIGH VOLTAGE POWER SUPPLY

Designed for multiple voltage control ranging from -150 volts at 600 ma, to +300 volts at 250 ma. Up to 6 different voltages per drawer. Can be made to ANY specification.



TRANSVAL engineers have set new standards for high stability, light weight power supplies based on advanced techniques of applying transistors. The units shown above are only a few of the many developed by Transval that meet specifications never before considered practical for transistorized power supplies. Among the leading builders of missiles, rockets, and piloted aircraft using Transval transistorized power supplies are Douglas, North American, Northrop, Hughes, Beckman, Norden Ketay, and Canadian Applied Research Ltd.

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10401 West Jefferson Boulevard
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Specialists in Transistorized Power Supplies

CIRCLE 131 ON READER-SERVICE CARD

accepting both add and subtract impulses, thus functioning as efficient summation counters. The basic element of each unit is a dynamically balanced incremental actuator.

Digitac, Inc., Dept. ED, 420 S. Beverly Drive, Beverly Hills, Calif.

CIRCLE 132 ON READER-SERVICE CARD

Silicon Rectifiers

600 PIV, 750 Ma



Designed to meet the requirements of USAF specifications, three types of silicon rectifiers are now in production. Types IN538, IN540 and IN547 cover the range of 200 to 600 v peak inverse, and are rated at dc output currents of 750 ma at 25 C ambients and 250 ma at 150 C ambients. These rectifiers are of alloyed junction construction, with all-welded hermetic seal.

General Instrument Corp., Automatic Mfg. Div., Dept. ED, 65 Gouverneur St., Newark 4, N.J.

CIRCLE 133 ON READER-SERVICE CARD

Transistorized Counters

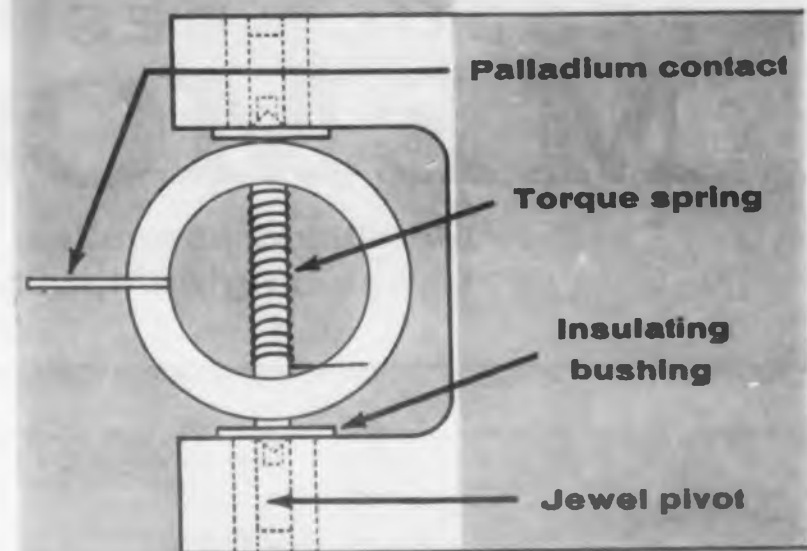
Low Power Consumption



Requiring only one voltage supply, low power consumption is achieved, such as 0.2 w average for a counter with 100 million count capacity, at 100 kc count rate. The units are available in package forms down to 1/4 cu-in. per binary counter stage or 1 cu-in. per decade stage. They are available as plug-in units, with solder lugs, or printed board mounting.

Mack Electronics, Dept. ED, 40 Leon St., Boston 15, Mass.

CIRCLE 134 ON READER-SERVICE CARD



2,000 CYCLE VIBRATION!

Now a totally different mechanical design overcomes limitations of conventional precision potentiometers. The heart of the matter is "dynamic balance" — (1) arm dynamically balanced on shaft (2) contact assembly dynamically balanced on arm. Advantages: low mass, low inertia, long life, .1% linearity, exceptional stability under extremes of vibration, shock and acceleration.

another result of

dynamic balance"

"Dynamic Balance" . . . it's the very essence of the "1000 series" of linear and functional precision potentiometers. It means a new dimension in circuitry design! Proved operationally successful in a variety of military equipments even under severe environmental conditions, "1000 series" pots open the way to reliable electronic systems withstanding higher frequencies and temperatures.

Get complete engineering data on the "1000 series" line. Write today.

kintronic

Division of
Chicago Aerial Industries, Inc.

10265 Franklin Avenue • Franklin Park, Illinois
CIRCLE 135 ON READER-SERVICE CARD

Incidentally, we know these are hot pots mechanically . . . but they're also hot for temperature, too. Power derates to zero at 165°C standard — 225°C special.

* Patent Pending

PRODUCT-DESIGN MEMOS FROM DUREZ

**Metallized phenolics
Dip coating compounds**

**Making epoxies
flame-resistant**



American Optical Company

Bright Idea

Next time you want to put a bright reflective surface on a part, think of *metallized phenolic*. It may save you a costly production step.

Object: economy For instance, this housing for a microscope lamp requires a mirror to focus the light.

To sidestep the cost of a custom-made mirror, the housing is molded of Durez phenolic. Then an aluminum mirror is deposited right on the plastic by vacuum evaporation.

This is easy to do with the Durez compound chosen for this part. It provides a good hard surface for metallizing. It incorporates other wanted properties: high impact strength and low thermal conductivity.

... or good looks More often, perhaps, you'd use metallizing for the sake of *appearance*. An example is this handle for a combination coffee-and-tea maker and carafe.

Molded of Durez phenolic, the handle stays cool regardless of the appliance's



The Silix Company

temperature. And it takes on a lustrous metallized finish, in copper or brass, to match the trim on the appliance and add sales appeal.

You're on sure ground when you base bright ideas like these on phenolics. They give you a bigger choice of controlled properties than any other material in their

class. You can select the right balance from *more than 150 Durez compounds*.

To take a fresh look at today's phenolics, just check the coupon for a new four-page bulletin describing some typical Durez molding compounds and what you can do with them.

Components in a package

These preassembled components can be great timesavers if you're producing printed circuits.

A package combines capacitors and resistors in one compact module, easily and quickly installed in a printed circuit.

You can have as many as 21 or more components in one subassembly, with complete choice of design. Known as "PAC" units, they're made by Erie Resistor Corp.

Their neat design points up an application of phenolics that may give you an idea. To insulate these units, Erie dips



Erie Resistor Corp.

them in a Durez phenolic resin compound. Dried and baked, the compound hardens to a tough, heat-resistant, moisture-resistant coating that doesn't melt or peel when a unit is soldered, and is hard enough to permit stamping or color coding.

For more information on Durez materials mentioned above, check here:

- Phenolic molding compounds—descriptive bulletin
- Phenolic resin compounds for dip coating
- HET Anhydride—Bulletins 19 and 43

Clip and mail to us with your name, title, company address. (When requesting samples, please use business letterhead.)



PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

2201 Walck Road • North Tonawanda, N. Y.

CIRCLE 136 ON READER-SERVICE CARD

Do you need a resin compound for electronic coating? For more information, check the coupon.

How to make epoxies resist flame

Your epoxy laminates and castings will shrug off heat, moisture—even fire—if you cure them with a new Durez product called HET[®] Anhydride.

In the picture, the laminate cured with a conventional hardener (left) ignites in less than 30 seconds and burns to destruction in about 3 minutes. Exposed to a similar flame source for the same time, a HET-cured laminate snuffs itself out as soon as the flame source is removed.

This leads to some interesting possibilities. For instance, you can now make



glass-reinforced laminates that keep practically all their flexural strength, even when heated within the 300-350°F range.

You can make potting resins that retain room-temperature electrical properties at high humidities and at temperatures above 300°F—and won't feed a fire.

If you'd like complete information on HET Anhydride, methods of use, and properties of cured resins, check the coupon for Bulletins 19 and 43.

NEW PRODUCTS

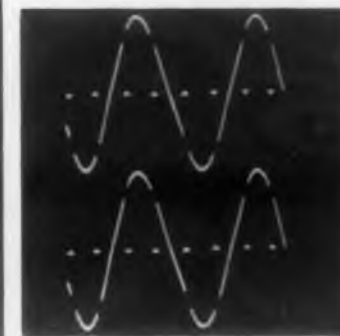
Power Converters
Convert 12 v to 150 or 300 v



The TPC-2 converter is designed for 12 v input and 150 v at 400 ma or 300 v at 200 ma output. Current drain is 6.85 amp full load and 1.12 amp no load. The units will operate at ambient temperatures up to 150 F under continuous full load. Regulated units with voltage variation less than 1 per cent no load to full are available.

Southwestern Industrial Electronics Co., Dept. ED, 2831 Post Oak Rd., P.O. Box 13058, Houston 19, Texas.

CIRCLE 137 ON READER-SERVICE CARD



DC/AC Choppers
Design Permits Firm
Contact Closure

This series of highly stable dc/ac choppers is manufactured as an spdt in both break-before-make and make-before-break types. Make-before-break models are unique in that the force developed by the vibrating element is exerted to hold the working contacts closed rather than to hold the non-working contacts open as in conventional designs. This results in firm contact closure and imperviousness to disturbances caused by shock and vibration. The oscilloscope presentation shows a break-before-make chopper operating from a network in which it is connected and phased to chop the driving sine wave at 45 deg each side of its 90 deg point.

Gollins Electronics Mfg. Corp., Dept. ED, Stevenson, Md.

CIRCLE 138 ON READER-SERVICE CARD



3-Turn Potentiometer

Linearity ± 0.25
Per Cent

Model 9303 servo mounting three-turn potentiometer measures 1-13/16 in. diam and weighs 3.75 oz. Standard independent linearity is ± 0.25 per cent with minimum noise characteristics. Ambient temperature range is -55 to $+80$ C, with a standard power rating of 3 w at 40 C. Up to 14 taps can be added during manufacture.

Beckman/Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 139 ON READER-SERVICE CARD

Event Recorder

4 to 32 Channels

For recording on-off events, 4-, 8-, 16-, 24- and 32-channel event recorders are available. The portable units consist of standard recorders used in the 150 series oscillographic recording systems, but with a four-styli model 189 multi-marker in place of each conventional galvanometer. Input impedance is 3000 ohms min with $+2$ v max required to supply multi-marker coil power. Rise time is approximately 10 msec.

Sanborn Co., Industrial Div., Dept. ED, 175 Wyman St., Waltham 54, Mass.

CIRCLE 140 ON READER-SERVICE CARD

Time Delay Relay

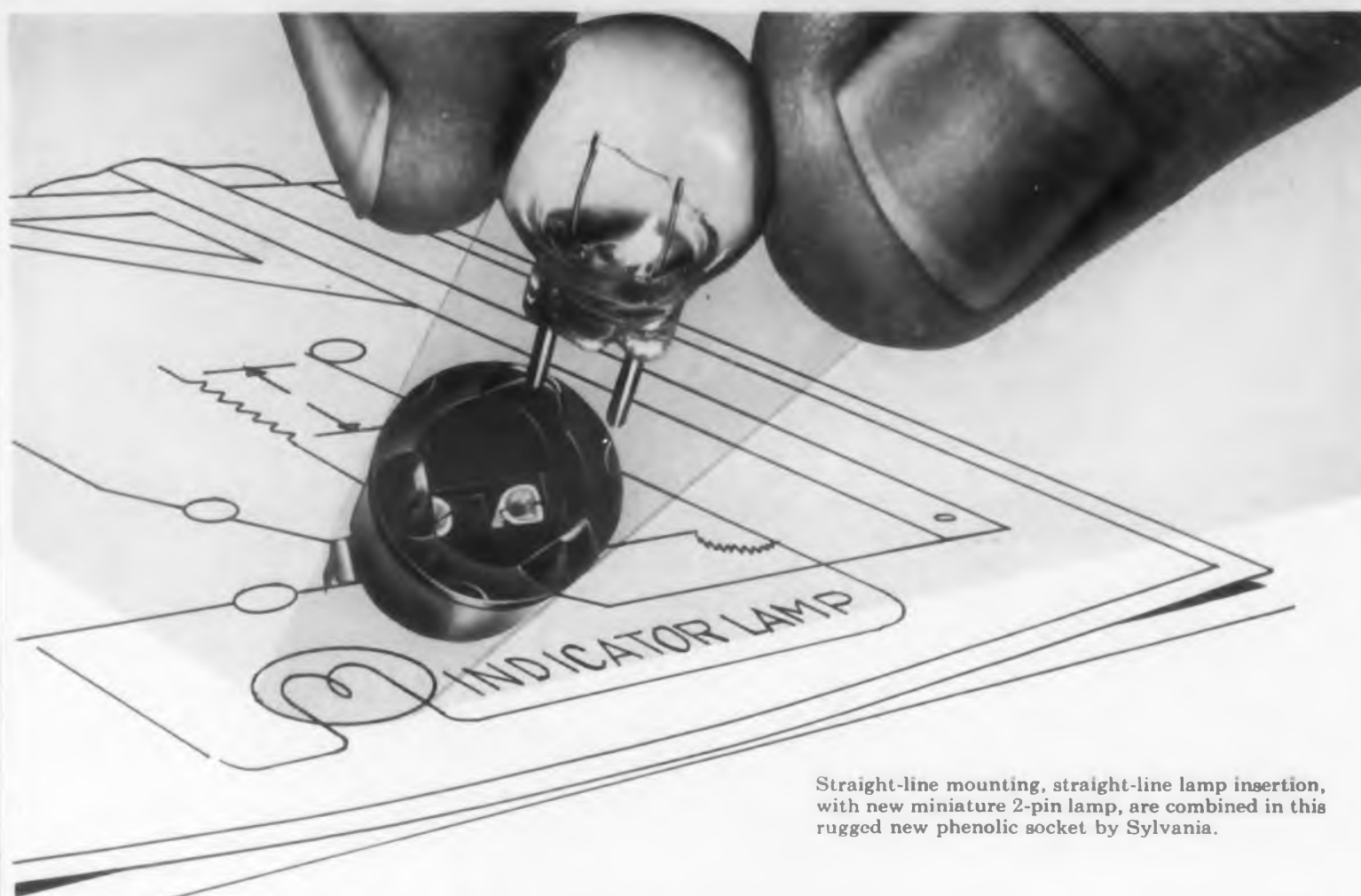
10 Msec to 120 Sec



Type MTRH time delay relay provides accurate repeatable delays from 10 msec to 120 sec. Characteristics include temperature compensation, voltage compensation for special applications and high speed recovery. Hermetically sealed, the unit measures 7/8 x 1-1/2 x 1-3/4 in. and weighs 3 to 4 oz.

Transton Corp., Dept. ED, P.O. Box 234, Whippany, N.J.

CIRCLE 141 ON READER-SERVICE CARD



Straight-line mounting, straight-line lamp insertion, with new miniature 2-pin lamp, are combined in this rugged new phenolic socket by Sylvania.

New Sylvania pinch-seal socket streamlines panel-light design

... cuts costs, too.

FASTER ASSEMBLY, easy lamp insertion, and new design freedom—these are the important benefits you get with the straight-line features of Sylvania's new pinch-seal panel-lamp sockets.

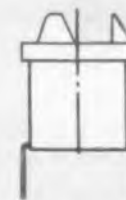
Designed to accommodate the new miniature 2-pin lamp available from leading lamp manufacturers, this sturdy, new socket lets you design indicator lamps into spots where heat and vibration have always ruled out standard lamps and sockets—lets you offer improved reliability wherever your designs now call for panel lights.

Straight-line, push-through mounting can help you cut assembly costs on printed circuits and standard panels.

Straight-line lamp insertion lets you cut space requirements since no extra clearance is necessary for lamp replacement. *And* beveled lamp-pin lead-in even lets you design for blind lamp replacement.

Wherever you now use indicator lamps—wherever you *plan* to use them, it will pay you to revise your specs to include this small, but tough phenolic socket by Sylvania. It's ideal for audio and radio equipment, appliances, switches and panelboards, vending machines, control panels and dials.

Write for complete specifications to Sylvania Electric Products Inc., Parts Division, Warren, Pa.



PRINTED CIRCUIT TYPE



PANEL TYPE



SYLVANIA

LIGHTING • TELEVISION • RADIO • ELECTRONICS
PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY

PARTS

DIVISION

Custom Molded Plastics
Custom Metal Stampings
Custom Welded Parts
Custom Ceramic Composites
Alloy, Clad, Plated Wire
Plated Metal Strip
Electronic Components
Fluorescent Components

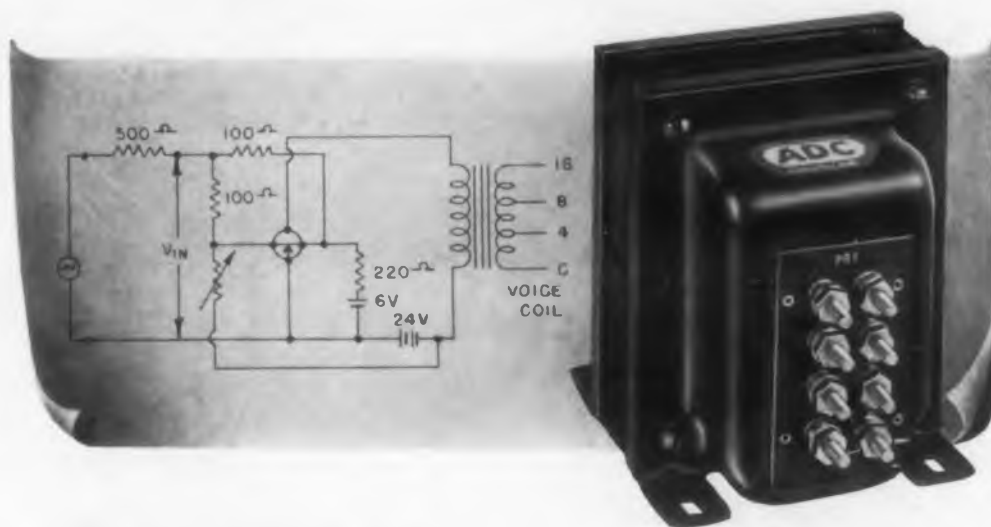
CIRCLE 142 ON READER-SERVICE CARD

Capable Transistor Transformer design is simple as



Capable transistor transformer design is simple at ADC. The problems are no different than those for vacuum tube circuits. And ADC has been solving these design problems for 22 years.

The transformer shown below at right, was ADC designed as an experimental output transformer for use by Minneapolis Honeywell with their H200E Power Tetrode. This transformer is capable of delivering up to 20 watts with low distortion through the frequency range of 20 to 20,000 cycles. A typical application is pictured below in the class A amplifier circuit.



The tiny transistor transformers such as those illustrated at the right are for low power applications. Introduction of new, low distortion, power transistors has required larger transformers, especially for operation at low frequency. While these may be new to transistor circuits, the design problems and solutions are identical with those of vacuum tube circuitry.

Whether you are interested in transformers for use with transistors or vacuum tubes, it will be to your advantage to come to a firm with the design experience of a pioneer like ADC.

Write for the **NEW** ADC CATALOG

ADC

AUDIO DEVELOPMENT COMPANY
2835 13th AVENUE SOUTH • MINNEAPOLIS 7, MINNESOTA
TRANSFORMERS • REACTORS • FILTERS • JACKS & PLUGS • JACK PANELS

CIRCLE 143 ON READER-SERVICE CARD

NEW PRODUCTS



**Line Voltage
Regulator**
Handles 3 KVA

Model MIR-3000 is a magnetic amplifier regulated, 3 kva ac line voltage regulator. The input voltage range over which the unit operates within specifications is 95-135 v, and output is adjustable from 110-120 v. Regulation is ± 0.5 per cent for any combination of line and load changes, and frequency range is 60 cps ± 10 per cent. Wave form distortion is 3 per cent max, and power factor range is 0.7 lagging to 0.9 leading.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE 144 ON READER-SERVICE CARD

Gear Reduction Kit

23 Different Reductions

The model 026 precision gear reduction kit contains a standard 20:1 ratio gear reducer with 16 interchangeable gear and pinion assemblies which permit conversion to any one of 23 different gear or speed reductions. Adapter kits are also available to facilitate use of this kit with various servo motors.

Link Aviation, Inc., Dept. ED, Binghamton, N.Y.

CIRCLE 145 ON READER-SERVICE CARD



Jack and Plug
Miniaturized

Model 2378 is 1/8-in. in diameter and 3/16-in. high. Model 2379 has a pin diameter of 0.054 in. Designed for quick, tight patch work on panel boards where space is at a premium, the pair have steadily maintained gripping power as a result of the design of the jack, which embodies a floating key and a compression spring that assures excellent electrical connection.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 146 ON READER-SERVICE CARD

The record-breaking
VOUGHT AIRCRAFT
INCORPORATED - DALLAS, TEXAS

CRUSADER

tested with
STATHAM
instruments.



The reliability of Statham transducers is demonstrated by an experience reported by Chance Vought:

Two Statham pressure transducers which had not been calibrated for six years were recently calibrated with a resulting curve that checked within 2% of the last calibration.

IF YOU NEED

Linear Accelerometers
Angular Accelerometers
Gage Pressure Transducers
Absolute Pressure Transducers
Differential Pressure Transducers
in your instrumentation programs, please outline your requirements so we may submit specific recommendations.

**WHEN THE NEED
IS TO KNOW...FOR SURE
SPECIFY STATHAM**

Statham

INSTRUMENTS, INC.
LOS ANGELES 64

CIRCLE 147 ON READER-SERVICE CARD

Stroboscopic Light Source

Variable Frequency



The Tacholite provides a variable frequency stroboscopic light source for a study of objects in motion. The unit is calibrated from 10 to 100 pulses per sec. For precision measurements an output is provided to drive a counter.

Northeast Electronics Corp.,
Dept. ED, Municipal Airport
Bldg., Concord, N.H.

CIRCLE 148 ON READER-SERVICE CARD

Pressure Pickup

Shock Resistant Miniature



Designated type 4-320, this pressure pickup measures 1/2-in. diam and 1/4-in. thick. Able to withstand 200 g acceleration without damage, the pickup has differential and gage pressure ranges from ± 7.5 to ± 50 psid and 25 or 50 psig, for operation at line pressures up to 300 psi. Another model type 4-321, extends the capabilities of the 4-320 by providing it with a stainless-steel casing, one inch square and 3/8-in. thick. Designed particularly for differential measurements, the 4-321 can also be used for gage pressures by venting the reference inlet to atmospheric pressure.

Consolidated Electrodynamics
Corp., Transducer Div., Dept. ED,
300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 149 ON READER-SERVICE CARD

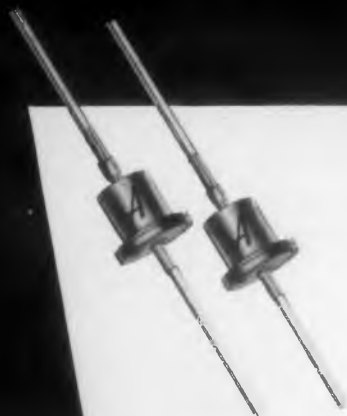
CIRCLE 150 ON READER-SERVICE CARD

GENERAL INSTRUMENT
SEMICONDUCTORS



important news for AIR FORCE contractors...

AUTOMATIC silicon rectifiers designed to meet the NEW USAF specification MIL-E-1/1089



PIGTAIL TYPES*

1N538 (USAF)

1N540 (USAF)

1N547 (USAF)

* Do not confuse these USAF types with commercial types having the same numbers.

AVAILABLE FOR IMMEDIATE DELIVERY

IN LARGE SCALE PRODUCTION QUANTITIES

General Instrument's semiconductor manufacturing skill assures contractors fast delivery of these special new pigtail type silicon rectifiers now covered by this Air Force specification. AUTOMATIC's outstanding group of USAF type silicon rectifiers meets and often exceeds the rigorous MIL-E-1/1089 (USAF) specification — And expanded facilities permit us to deliver them in quantity at prices that reflect volume production.

AUTOMATIC MANUFACTURING DIVISION also offers the industry's most complete line of silicon rectifiers for an extensive range of applications including types for magnetic amplifiers, power supplies, D.C. blocking and germanium replacement, as well as types for general purpose use.

Would you like a set of our engineering data sheets? Please write us today!

Maximum Values for AUTOMATIC Military Type Silicon Rectifiers meeting MIL-E-1/1089 (USAF) Specification

Type No.	Peak Reverse Voltage (VDC)	DC Output Current @ 25° C. Ambient (MA)	DC Output Current @ 150° C. Ambient (MA)	Maximum Reverse Current* (MA)	Mounting	MIL-E-1 Technical Spec. Sheet No.
1N538 (USAF)	200	750	250	0.350	Pigtail	1089a
1N540 (USAF)	400	750	250	0.350	Pigtail	1089b
1N547 (USAF)	600	750	250	0.350	Pigtail	1089c

* Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current at 150° C. ambients.

**AUTOMATIC
MANUFACTURING**

MASS PRODUCERS OF
ELECTRONIC COMPONENTS

AUTOMATIC MANUFACTURING
DIVISION OF GENERAL INSTRUMENT CORPORATION
65 GOUVERNEUR ST., NEWARK 4, N. J.

New! **ACESET[®]**

**MICRO-MINIATURE PRECISION WIRE-WOUND
POTENTIOMETERS**

Greater Heat Dissipation
2 watts at 60°C.

IMMEDIATE DELIVERY
in the following resistance values

100 Ohms	1,000 Ohms	10,000 Ohms
250 Ohms	2,500 Ohms	20,000 Ohms
500 Ohms	5,000 Ohms	25,000 Ohms

ACESETS shown approx. 1/2 size

Now you can select from nine different resistance values and improve the accuracy and dependability of your circuit performance. ACESET precision, wire-wound, micro-miniature potentiometers offer greater stability under temperature cycling through the use of 20 ppm temperature coefficient wire. Improved performance at lower costs have been achieved by mass producing to standard specifications. Shipments are guaranteed within 24 hours of receipt of order. Call, wire or teletype Dept. G at Ace Electronics Associates, Inc., 99 Dover Street, Somerville, Mass. SOMerset 6-5130. TWX SMVL 181

MECHANICAL SPECIFICATIONS

One piece precision-machined metal case
Passivated stainless steel shaft
Self-contained locking device
Panel anti-rotation pin
Mechanical rotation: 330° nominal
Size: 1/2" diameter x 3/16" body length

ELECTRICAL SPECIFICATIONS

Heat Dissipation: 2 watts at 60°C.
Voltage breakdown: 1,000 VDC
Electrical Angle: 325° nominal
Temperature coefficient of wire: 20 ppm
Resistance tolerance: ±10%
Linearity: ±5%

ACE ELECTRONICS ASSOCIATES, INC.

ACEPOT[®]

ACETRIM*

ACEOHM[®]

*TRADEMARK APPLIED FOR
ACESET[®]

CIRCLE 151 ON READER-SERVICE CARD

NEW PRODUCTS

**Linear Accelerometer
Air Damped**



Model A101 linear accelerometer provides an electrical null output at some pre-determined acceleration ambient to measure forward acceleration. Due to an air-damping system which provides a 0.7 ± 0.1 damping ratio, the linear accelerometer, despite variation of viscosity, provides an acceleration response which is in large degree insensitive to the temperature changes that plague fluid-damped instruments.

American Electronics, Inc., Dept. ED, 655 W. Washington Blvd., Los Angeles 15, Calif.

CIRCLE 152 ON READER-SERVICE CARD



**Remote Supervisory
System**

860 Functions on
Single Carrier

This pulse width selection system offers all the inherent advantages of pulse width selection whereby a minimum of 430 on/off control functions plus 430 supervisory functions may be handled by a single transmitter at the main station and remote slave units, over a single carrier. Of all-relay design, the system may be used as a two-way system for remote supervisory control, or as a one-way system for either control or supervision only. The master unit may be used with up to 15 remote units. The system is used to pulse dc as the signal, or to modulate a tone channel thereby offering the benefits of frequency multiplexing.

Hammarlund Mfg. Co., Inc., Dept. ED, 460 W. 34th St., New York 1, N.Y.

CIRCLE 153 ON READER-SERVICE CARD



**LIBRASCOPE
SHAFT POSITION-TO-DIGITAL
CONVERTERS**

Equipped with ANTI-AMBIGUITY
DOUBLE BRUSH PICKOFFS

Useful in a wide variety of applications, including digital aircraft and missile controls, machine tool controls, digital readout from strip chart recorders, and as the modulator and de-modulator in pulse-code modulated radio links.

GRAY CODE MODEL — Capacity of 8 binary digits (single brush pickoff).
BINARY MODEL — Capacity of 7 to 19 binary digits.
BINARY CODED DECIMAL MODEL — Capacity range from 0-1999 to 0-35,999.

Units for special codes or capacities are built to meet specific requirements.

SHOCK ENDURANCE 20g
TEMPERATURE RANGE -50° to 83°C min.
CODE DISCS Rhodium plated phenolic
PICKOFFS Multiple wire brush
Two pickoffs/channel
ROTATION Continuous, either direction

**RUGGED—NON-MAGNETIC—LONG LIFE
MAY BE READ WHILE IN MOTION**

**SPECIAL CONVERTERS DESIGNED TO MEET
YOUR INDIVIDUAL PROBLEMS**

Send for illustrated brochure
LIBRASCOPE
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

908 Western Avenue • Glendale, California

CIRCLE 154 ON READER-SERVICE CARD

for electronic and avionic devices

STEMCO® THERMOSTATS

give you more of what you want most

FEATURES such as snap or positive-action . . . various terminal arrangements or mounting provisions . . . different temperature ranges—there's a *standard* type Stemco thermostat for your *special* needs. That means you cut down on lead time, research and development costs, tooling and production inventory. Specify Stemco and you get *better thermostats, faster and for less* than you can make them or buy them elsewhere.

SIZE and weight are particularly important in avionic and electronic applications. And here Stemco thermostats score, too. Their compactness and lightness give a better product without sacrificing performance.

ECONOMY of mass production of many standard Stemco types with literally hundreds of terminal arrangements and mounting provisions means your product costs less to make.

AVAILABILITY of most types is good. Design is flexible for your special applications, tooling is in existence for short-term delivery. If heat control is your problem, Stemco thermostats can provide the answer.

AA-4092

*Refer to Guide 400 EO for U.L. and C.S.A. approved ratings.

STEVENS manufacturing company, inc.
Lexington and Mansfield, Ohio



TYPE A*
Semi-enclosed

Insulated, electrically independent bimetal disc gives fast response and quick, snap-action control. Operation from -10° to 100° F or higher on special order. Various mountings and terminals. Average rating 8 1/2 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. See Bulletin 3000.



TYPE A*
Hermetically sealed

Electrically identical to semi-enclosed Type A. Temperatures from -10° to 300° F. Various enclosures and mountings, including brackets, available. For appliance, electronic, apparatus applications. Request Bulletin 3000.



TYPE C
Hermetically sealed

Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Turret terminals or wire leads. Request Bulletin 5000.



TYPE C
Semi-enclosed

Small, positive-acting. Electrically independent bimetal strip for operation from -10° to 300° F. Rated at approximately 3 amps, depending on application. Terminals and mountings to customer specifications. See Bulletin 5000.



TYPE M*
Semi-enclosed

Electrically independent bimetal disc type for appliance and electronic applications from -10° to 350° F. Rating 8 amps at 115 volts AC, 4 amps at 230 volts AC and 28 volts DC. Virtually any type terminal. Bulletin 6000.



TYPE M*
Hermetically sealed

Electrically same as semi-enclosed Type M. Can be furnished with pin or solder-type terminals, wire leads and various mounting brackets. Write for Bulletin 6000.

STEMCO THERMOSTATS

NEW PRODUCTS

Magnetic Potentiometers
Nulls Total Less than 0.01



Transipot line of magnetic potentiometers is available in various models to accommodate nearly any combination of input and output voltages, or frequency. Model TL-10, shown, provides very linear output with infinite resolution over a linear mechanical stroke of ± 0.05 in. Input is 6.3 v 400 cps, and output is 0-5 v. Total nulls of less than 0.01 per cent are featured, as well as high output and low impedance. Also available is a rotary motion series with full scale ranges from ± 20 to ± 3600 deg rotation. All models can be built on special order to operate up to 500 F.

Instrol Inc., Dept. ED, 722 E. Gutierrez St., Santa Barbara, Calif.

CIRCLE 159 ON READER-SERVICE CARD

Bilateral Transistor
Alpha Cutoff of 0.5 Mc



Having symmetrical characteristics, the 2N462 has application in complementing circuits, bi-directional switches and amplifiers, and phase detectors. Ratings are 40 v, 200 ma, with a typical dc current amplification of 45 in either direction. Alpha cutoff frequency is 0.5 mc min, with carefully controlled rise and fall time.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia, Pa.

CIRCLE 160 ON READER-SERVICE CARD

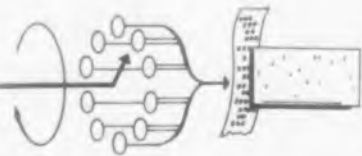
◀ CIRCLE 158 ON READER-SERVICE CARD

DIGITIZERS REPLACE COMPLEX ELECTRONIC EQUIPMENT

DIGITIZER

[Analog to Digital]

The Coleman DIGITIZER provides a simple, economical, and reliable method of recording, in digital form, the analogs of temperature, pressure, voltage, strain, distance, etc. This record may be produced automatically by printers, punched cards, electric input typewriters, and perforated-tape machines.



Shaft rotation input. Unambiguous contact setting. Digital contact output.



DECIMAL DIGITIZER



BINARY DIGITIZER



BINARY-CODED DECIMAL DIGITIZER

[Digital to Analog]

Conversion of digital signals to analog form is a common requirement in many applications. The Coleman DIGITIZER provides a simple, economical, and reliable method of recording, in digital form, the analogs of temperature, pressure, voltage, strain, distance, etc. This record may be produced automatically by printers, punched cards, electric input typewriters, and perforated-tape machines.

Your name:

Company:

Address:

Write for Free Data File.
Mention your application.

Coleman

Engineering Company, Inc.
6040 West Jefferson Boulevard
Los Angeles 16, California

CIRCLE 161 ON READER-SERVICE CARD

DIGITIZERS REPLACE COMPLEX ELECTRONIC EQUIPMENT

STANDOFF TERMINAL.—Consisting of two stand-off terminals coaxially held at both ends of a single Teflon bushing, the series DST Double-Header installs in a single chassis hole. Available in six standard types, and in eight code colors.

Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N. Y.

CIRCLE 162 ON READER-SERVICE CARD

EXPLOSION-PROOF SWITCH.—A control device for monitoring fluid pressures in applications where extraordinarily severe conditions of temperature, vibration and explosive pressure surge are encountered. The switch has been testing to 4000 psi at rates of pressure application up to 8,000,000 psi per sec. Temperature range is from -65 to +300 F.

Aerojet General Corp., Sub. General Tire & Rubber Co., Dept. ED, Azusa, Calif.

CIRCLE 163 ON READER-SERVICE CARD

250 V SILICON POWER RECTIFIERS.—Units are available in ac input ratings under 600 V, three phase, 60 cps. They are rated for dc outputs of 75 through 600 kw for two-wire 250-v systems.

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

CIRCLE 164 ON READER-SERVICE CARD

ELECTRONIC TACHOMETER.—Measures speeds from 0.1 to 10,000 rpm. Radial lines scribed on a rotary disc interrupt a light beam producing 360 pulses per revolution, which operate an accurate large-scale meter.

Southwestern Industrial Electronics Co., Dept. ED, 2831 Post Oak Rd., Houston 19, Tex.

CIRCLE 165 ON READER-SERVICE CARD

SURGE LIMITER.—The Surgevolt Master limits the initial surge of line current. After a suitable pre-heating period, a voltage regulator maintains the line voltage at full value. Available in 50 to 375 w models.

Atlantic Electronics Laboratories, Dept. ED, P. O. Box 918, Asbury Park, N.J.

CIRCLE 166 ON READER-SERVICE CARD

PIRANI VACUUM GAUGE.—Type GP-115 measures on two scales the total pressure of condensable vapors and permanent gases in a vacuum system. The device is useful for activating an alarm or protective circuit and aids in automatic cycling of a vacuum system.

Consolidated Electrodynamics Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 167 ON READER-SERVICE CARD

PICK-UP COIL.—Converts mechanical motion into electrical energy without direct contact. The coil produces an ac signal whose frequency is proportional to the rate of motion of the object near it.

Potter Aeronautical Corp., Dept. ED, Rt. No. 22, Union, N.J.

CIRCLE 168 ON READER-SERVICE CARD

Reduce

SIZE

WEIGHT

NEW BROAD-BAND STRIP-LINE ASSEMBLY

SIZE
REDUCED BY 65%

WEIGHT
REDUCED BY 60%

The Newest Concept in Microwave Plumbing

Printed circuitry in a sandwich type of construction has been adapted to produce microwave plumbing that offers a substantial reduction in size and weight. By standardizing on component parts, system package design for units within a frequency range of 500MC to 12,000MC can be accomplished. Electrical characteristics, in general, compare with coaxial.

OTHER KEARFOTT products include: Ferrite Isolators and Duplexers in a wide range of sizes and band widths and facilities to produce special configurations if desired. Our engineers can help you.



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LITTLE FALLS, NEW JERSEY
WESTERN DIVISION
MICROWAVE DEPARTMENT
DEPT. 10-A, 14844 OXNARD ST. • VAN NUYS, CALIF.

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Chicago, Ill.
South Central Office:
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Dallas, Texas
Northwest Area Office:
530 University Ave.
Palo Alto, Calif.

CIRCLE 169 ON READER-SERVICE CARD

NEW PRODUCTS

TWIN RECORDER.—Consists of two type CH recorder chart carriages and measuring elements in a single case. Features include 28 different chart speeds, ranging from 1/4 in. per hr to 120 in. per min, and 150-ft record rolls.

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

CIRCLE 170 ON READER-SERVICE CARD

SLOW NEUTRON SURVEY METER.—Model N-578 operates on current appearing in a boron graphite-coated ionization chamber, resulting from a neutron boron reaction. A high usable counting life, good time resolution and low inherent noise level are featured.

American Tradair Corp., Dept. ED, 34-01 30th St., Long Island City 6, N. Y.

CIRCLE 171 ON READER-SERVICE CARD

ULTRASONIC CLEANER.—Available for industrial and laboratory use, this cleaner produces an output of 50 w average with a peak of 200 w. A stainless steel one-gallon tank equipped with three transducers is capable of handling production jobs on a continuous basis.

Hermes Sonic, Dept. ED, 13-19 University Pl., New York 3, N. Y.

CIRCLE 172 ON READER-SERVICE CARD

TUBES.—Two 12-v miniature tubes, types 12K5 and 12U7 for automobile radios, and a miniature pentode, type 6BQ5 for use as an audio amplifier in TV receivers, are added to the company's renewal line.

Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 173 ON READER-SERVICE CARD

XB BAND FERRITE ISOLATORS.—Designed to cover different frequency ranges between 5400 and 8200 mc, a 5-in. version covers a 10 per cent band width with a max vswr of 1.15, and a 7-in. version covers a 15 per cent band width with a max vswr of 1.2. The units feature max insertion loss of 1 db, min isolation of 40 db, and a power handling capacity of 10 w average and 10 kw peak into a 2 to 1 load mismatch.

Airtron, Inc., Dept. ED, 1101 W. Elizabeth Ave., Linden, N.J.

CIRCLE 174 ON READER-SERVICE CARD

TRANSISTORS.—The following drift and i-f types have recently been announced. The 2N370, 2N371, and 3N372 are drift transistors of the germanium pnp type designed for use in all-wave battery-portable receivers. The 2N409 and its flexible-lead version, the 2N410, are designed especially for 455 kc i-f amplifier applications. The 2N411 and 2N412 meet the requirements of a-m converter and mixer-oscillator applications.

Radio Corporation of America, Semiconductor Div., Dept. ED, Somerville, N.J.

CIRCLE 473 ON READER-SERVICE CARD



meters for every

Custom-built or Stock, Simpson Offers a Complete Line

To meet your special requirements, Simpson can build electrical panel meters in many combinations of size, range, type, and style. For meters in small quantities, you can select from 60,000 stock units (over 900 sizes and types) available for *immediate delivery* through your Electronic Distributor. Many stock models now have the *self shielded Core Magnet Meter Movement*.

These fine panel instruments are known throughout industry for their ruggedness and long-lived accuracy. Write today for Technical Manual No. 17.



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instruments that stay accurate



CIRCLE 175 ON READER-SERVICE CARD

new



EDGEWISE

WIDE-VUE

METER RELAY

ELAPSED TIME

need.... Simpson



CIRCLE 175 ON READER-SERVICE CARD

SCINTILLATION DETECTOR.—A stainless steel basic probe adaptable for use with many crystal and shield configurations. The basic probe without crystal is available in three models: 11007 without preamplifier; 11008 with preamplifier, and 11009 with cathode follower.

Radiation Counter Labs., Inc., Dept. ED, 5121 W. Grove St., Skokie, Ill.

CIRCLE 176 ON READER-SERVICE CARD

INDUSTRIAL RELAY.—Series 300 controls up to 5 amp loads on signals of mw range. Features include automatic or manual reset controlled by internal slide switch, and fast recycling rate. Input power: 115 v, 60 cps, 15 w.

Datascan, Inc., Dept. ED, Little Falls, N. J.

CIRCLE 177 ON READER-SERVICE CARD

RELAYS.—Snap-action switching and double spiral springs are the two design features of series 33. The snap-over action insures high impact and contact wipe, and the double spiral spring provides good armature activity and stability from movement in undesirable planes.

Phillips Control Corp., Sub. of Allied Paper Corp., Dept. ED, Joliet, Ill.

CIRCLE 178 ON READER-SERVICE CARD

MAGNETIZERS.—Magnetizing coils and silicon rectifier are combined in one unit in both the light-duty model MF-200 and medium-duty model MF-300. The magnetizers can be used with all permanent magnet alloys.

General Electric Co., Magnetic Material Section, Dept. ED, Edmore, Mich.

CIRCLE 179 ON READER-SERVICE CARD

ANTENNA LOADING COIL.—Designed for operation at frequencies from 24 to 52 mc, model 0-21 permits inductance to be varied from 3 to 0.1 μ h. The coil's Q is greater than 50 at 52 mc and greater than 225 at 24 mc. Power handling capability is 25 w.

Alto Scientific Co., Dept. ED, 855 Commercial St., Palo Alto, Calif.

CIRCLE 180 ON READER-SERVICE CARD

BRAKE FOR FHP MOTORS.—For use with electric motors in frames 56-C and 66-C, and integral motor frames 182 and 184, the series HTC 50 brake is designed for use on stub, extended, or thru shaft applications. This model retains the basic single solenoid, lever action and construction of previous models.

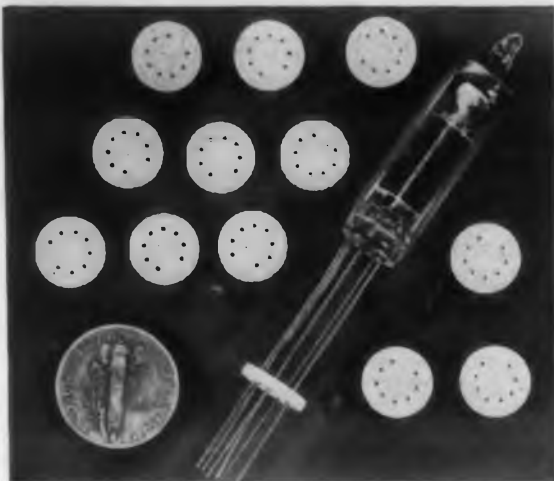
Stearns Electric Corp., Dept. ED, 120 N. Broadway, Milwaukee 2, Wis.

CIRCLE 181 ON READER-SERVICE CARD

UNDER-FREQUENCY CUT-OUT RELAY.—This addition to the Tynmag line is designed to cut out at 360 cps within ± 2 cps at 25 C or ± 10 cps over the range of -55 to $+125$ C. Excitation for the relay is derived from the line it monitors.

Torwico Electronics, Inc., Dept. ED, 1090 Morris Ave., Union, N.J.

CIRCLE 182 ON READER-SERVICE CARD



No. 1

TEFLON* Subminiature Tube Lead Insulators. Possess all the fine characteristics of TEFLON—high heat resistance (to 500° F), zero moisture absorption, low loss factor (less than .0005), tough, resilient, withstand shock and vibration.

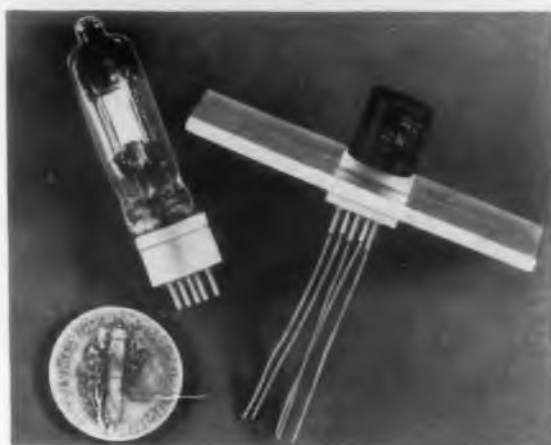
You Asked for Them...

THREE NEW CHEMELEC COMPONENTS ANSWERING URGENT MISSILE-GUIDANCE AND MILITARY ELECTRONIC NEEDS



No. 2

TEFLON Compression-mounted Subminiature Tube Sockets. Save space, assembly time. High reliability factor—withstand extreme shock, vibration, high temperature. Have low loss insulating qualities, zero moisture absorption. Versatile: can be used as chassis-mounted tube lead insulators, adaptable to printed circuit applications.



No. 3

TEFLON Compression-mounted, low-loss Transistor Sockets. Also applicable for Subminiature Tubes with "in-line" leads. Save assembly time and space. High Reliability factor—withstand high temperature, extreme shock, vibration. Adaptable to printed circuit applications.

*du Pont Trademark

Write for further information and prices.

FLUOROCARBON PRODUCTS, INC.

Division of United States Gasket Co., Camden 1, New Jersey

Fluorocarbon Products Inc.

CIRCLE 183 ON READER-SERVICE CARD

PRODUCTION PRODUCTS

Power Squaring Shears with Precision Gaging



A complete line of precision power squaring shears for the electronic industry now available features precision gaging, positive holddown and built-in blade clearance. The power squaring shears cut sheet metal, fiberboard, printed circuit material, plastics, cleanly and accurately. The shears have embedded scales; individual plunger, self-compensating holddown, four-edge alloy steel blade, T-slot full length in bed, clutch control single stroke or repeat action, full length clutch treadle, precision back gage, and fully visible cutting line.

Peck, Stow & Wilcox Co., Dept. ED, Southington, Conn.

CIRCLE 184 ON READER-SERVICE CARD

Welding Chamber Controlled Atmosphere

A new controlled atmosphere welding chamber with a plexiglass dome has been developed as an outgrowth of pressure welding chambers built for the AEC. The device offers maximum visibility for welding such metals as zirconium, titanium, zirconium-2, and other materials requiring controlled atmospheres. The chamber is also useful for metallurgical research and other activities requiring controlled pressure of inert gas. Technically, the chamber consists of a 24 in. diameter upright chamber with a bubble-type dome made from materials with low outgassing characteristics. The dome is spring loaded for production welding. By placing valving and pumping apparatus underneath the chamber, total floor space is held to 2-1/2 x 3 feet. Maximum vacuum is 10^{-4} mm Hg reached in approximately 15 minutes with a guaranteed leak rate of 15 microns per hour or less. Offered as a complete system, a welding torch and power supply are included in the package.

L & B Welding Equipment Company, Dept. ED, 2424 Sixth Street, Berkeley 2, California.

CIRCLE 185 ON READER-SERVICE CARD

Why do our customers
(bless 'em all) buy
our **SERVO**
AMPLIFIERS ?

WE RAN A POLL TO FIND OUT

and here's why!

FAIR PRACTICE

We just build servo amplifiers. We never compete against our customers on their systems contracts.

HUGE SELECTION

In eight years, 250 different servo amplifiers designed and manufactured. This engineering back-log ready to serve you.

VERSATILITY

Our servo amplifiers use tubes, transistors and magnetics according to their merits. We don't penalize the design thru specialization with only one technique.

COMPLETENESS

More than just input-output amplifiers. Designed for the **Servo Problem**, they include system damping, carrier phase control, modulators, demodulators, summing networks, synchro switching and power supply circuit where necessary. Nothing else to buy except servo motor, data system and gear train.

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Our standard units have been field proven in literally hundreds of systems from the NATO forces to our missile program. Our specials draw on this backlog for designs which are right the first time.

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Continued research by our staff in the servo amplifier problem means the very latest technique when you buy.

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CIRCLE 186 ON READER-SERVICE CARD

ON THE SHELF!



Ford Instrument's Oldham Couplings

Features

- No loose parts; when shafts are separated completely, there are no parts to fall.
- Low cost.
- Available in models for 3/16", 1/4" and 5/16" shaft diameters — and 3/16"-1/4" and 1/4"-5/16" shaft combinations.
- Maximum backlash of 10 minutes of arc.

Applications include

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|--------------------|---|----------------------------|
| Servomechanisms | • | Missile Control Systems |
| Computers | • | Aircraft Control Equipment |
| Indicating Devices | • | — and similar uses |

FREE— Circle reader-service card number for fully illustrated data bulletin giving specifications and performance information.



FORD INSTRUMENT COMPANY DIVISION OF SPERRY RAND CORPORATION

31-10 Thomson Avenue
Long Island City 1, N. Y.

Component Sales Division

Please send me prices on the following unit(s):

(Circle Model number desired)

Model No.	Shafts Accommodated	
C-316	3/16	3/16
C-416	1/4	1/4
C-516	5/16	5/16
C-316-416	3/16	1/4
C-416-516	1/4	5/16

No. of units desired _____

Name _____

Position _____

Company _____

Street _____

City _____ Zone _____ State _____

CIRCLE 187 ON READER-SERVICE CARD

Stainless Steel Saw

High-Speed Blade

A saw blade capable of cutting stainless steel is now in use on portable highspeed reciprocating saws. The special highspeed steel blades have been under test for both cutting efficiency and breakage resistance. In addition to stainless steel, the blade can make limited cuts in materials up to a hardness of 55 Rockwell on the C-scale. Initially, the blades are available in limited supply in the "bayonet" design for contour work. The blades come in five sizes, with teeth per inch specifications of 10, 14, 18, 24 and 32, and usable cutting length of 1-5/8 in.

Price & Rutzebeck, Dept. ED, P. O. Box 30, Hayward, Calif.

CIRCLE 188 ON READER-SERVICE CARD

Toolmaker's Projector for Wafer Inspection



A toolmaker's projector has been developed for economical engineering, production or tool room measuring operations. The instrument is portable and rugged. Uses for the projector include silicon and germanium wafer inspections, gear tooth forms, thread forms, stamped, formed, and machined parts.

Small tools and parts may be examined by substage and surface illumination, showing clearly both contour and surface details. The projector utilizes an opaque photometric white 6 in. x 6 in. square screen situated at the rear of the instrument hood. Magnified, parallax-free images projected onto the screen are shielded from extraneous light and reflections. An interesting feature is the illuminated screen tolerance lines which provide contrast by means of sharply defined lines of light.

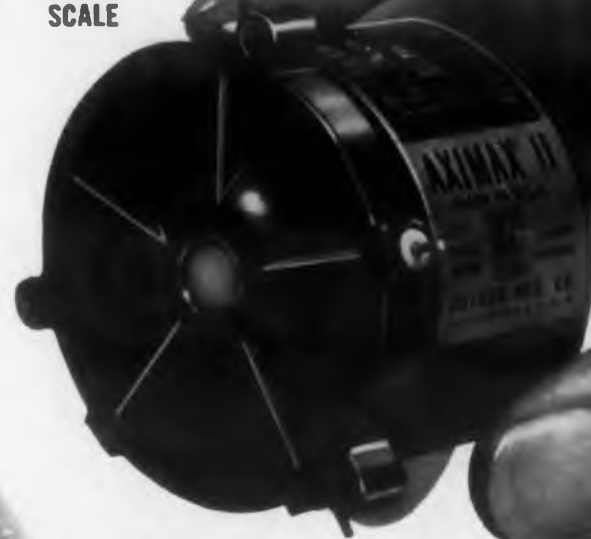
Stocker & Yale, Inc., Dept. ED, Marblehead, Mass.

CIRCLE 189 ON READER-SERVICE CARD

CIRCLE 190 ON READER-SERVICE CARD >

Aximax II airborne fan

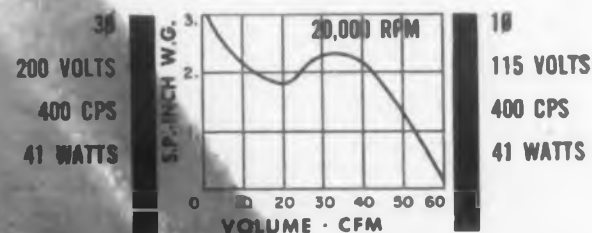
FULL
SCALE



PATENT PENDING

4 oz. net weight

2" DIAMETER • 1 1/2" LONG



WRITE FOR ROTRON CATALOG SHEET #50201-1



ROTRON mfg. co., inc.

SCHOONMAKER LAKE • WOODSTOCK • NEW YORK

Shallcross BRIDGES



Types
6100
and
6101



Type
6320



Type
638-R



617
Series



Type
6350

ACCURATE dc RESISTANCE MEASUREMENTS

... 1 micro-ohm to 10⁶ megohms

Among the many bridges manufactured by Shallcross, these six have become virtually "standards" for general-purpose resistance measurements. Each is easy to operate and ruggedly constructed to maintain accuracy and stability in every kind of field and laboratory service. Switch decks are inside the case for minimum maintenance.

Of special interest are the 617 Series Limit Bridges. These provide direct "GO-NO GO" production line resistor testing for any percent tolerance spread from $\pm 0.1\%$ to $\pm 20\%$.

NEW BULLETIN L-19B contains full specifications for each instrument. For your copy write to: SHALLCROSS MANUFACTURING COMPANY, 526 Pusey Avenue, Collingdale, Pa.

Model Number	Measurement Accuracy	Maximum Setting	Minimum Setting	Circuit	Special Features
6100	$\pm 0.1\%$ $\pm 0.01\Omega$ (.1 Ω to 1.011 Meg Ω)	1.011 Meg Ω	0.001 Ω	Fault Location—Wheatstone	Fault Location by Murray, Varley, Hilborn & Fisher Loop Tests.
6101	$\pm 0.1\%$ $\pm 0.01\Omega$ (1 Ω to 11.11 Meg Ω)	11.11 Meg Ω	0.001 Ω	Wheatstone	Four dial rheostat usable as decade box.
6320	$\pm 0.02\%$ $\pm 0.01\Omega$ (1 Ω to 11.11 Meg Ω)	111.11 Meg Ω	0.00001 Ω	Wheatstone	Most accurate five dial Shallcross bridge for direct resistance measurement.
	$\pm 0.05\%$ to $\pm 20\%$ on separate "+" and "-" percent selectors. (1 Ω to 10 Meg Ω)	11.111 Meg Ω	0.0001 Ω	Percent Limit	Rapid "GO-NO GO" percent limit testing. Built-in adjustable comparison standard.
638-R	$\pm 0.75\%$ or better (.001 Ω to 1 Ω)	11.11 Ω	0.000001 Ω	Kelvin	Overlapping Kelvin and Wheatstone ranges selected with single ratio dial.
	$\pm 0.2\%$ $\pm 0.01\Omega$ (1 Ω to 11.11 Meg Ω)	11.11 Meg Ω	.001 Ω	Wheatstone	
6350	$\pm 1\%$, (10 Ω to 10 Meg Ω) $\pm 2\%$, (10 Meg Ω to 10,000 Meg Ω) $\pm 5\%$, (above 10,000 Meg Ω)	1.111 x 10 ⁶ Meg Ω	0.01 Ω	Wheatstone with d-c Amplifier	Modular construction dual range power supply, null indicator-amplifier, for 115V. 60 cycle operation.
617 Series	$\pm 0.1\%$ to $\pm 20\%$ on separate "+" and "-" selectors from a minimum resistance consistent with number of dials in use to the maximum settings.	111,111 Ω 1,111,110 Ω 11,111,100 Ω	0.1 Ω *1 Ω 10 Ω	Percent Limit	For rapid "GO-NO GO" percent limit testing. Hand or foot operated for production testing. All models also usable for direct resistance measurements. Binding post for external d-c power supply.
	$\pm 0.2\%$ $\pm 0.01\Omega$ from a minimum resistance consistent with number of dials in use to the maximum setting.	111,111 Ω 1,111,110 Ω 11,111,100 Ω	0.1 Ω *1 Ω 10 Ω	Wheatstone	

† Except 617B and 617J $\pm 0.1\%$ $\pm 0.01\Omega$.

* Except 617G, 0.01 Ω .

CIRCLE 191 ON READER-SERVICE CARD

NEW LITERATURE

Laminated Plastics 192

Smaller than a postcard, this handbook contains information on all copper clad grades carried in stock as well as full details on engraving stock, standard sheet stock, 36 in. rod stock with 1/4 to 1 in. diam and CN end grain material. American Cyanamid, Formica Corp. Div., 4614 Spring Grove Ave., Cincinnati 32, Ohio.

Small Parts Welding 193

Data sheet S gives technical information and recommendations for use of a line of welding equipment for small and microscopically small parts. Welding heads, ac and stored energy power supplies and several portable thermocouple welders are shown. Ewald Instruments, Box 124, Kent, Conn.

Magnetic Storage Drums 194

This four-page bulletin describes the features of a line of magnetic storage drums. It includes drawings and photographic illustrations and describes the performance characteristics of the drums. Bryant Chucking and Grinder, Springfield, Vt.

New World of Electronics 195

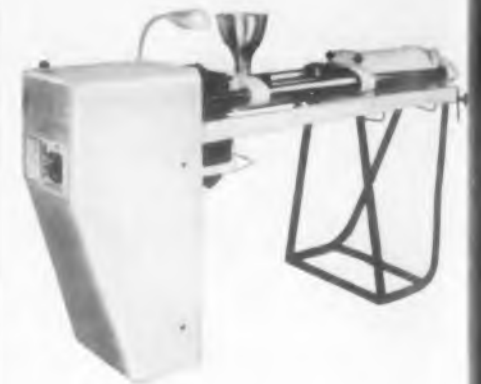
Handsomely illustrated, "The New World of Electronics" examines some of the basic factors which affect electronic development. With four-color illustrations, the 20-page brochure discusses the dynamic interplay of the component, research, engineering, quality control, and reliability, and shows how all are intertwined in the fascinating history of electronic development. Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Fastener Lead Errors 196

Fastener lead error, or space deviation between screw threads, is discussed in a 16-page booklet. The text explores the anatomy and mathematics of lead error. It points out the most common causes of faulty lead and the damage such a fault can do. How to spot lead error and how to prevent it is explained. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.

now —
for small
plastic parts

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avoid delays . . .
improve quality . . .
control production . . .

... with the Hull Standard Model 99A completely automatic transfer Molding Press for thermosetting plastics that literally "works while you sleep." Anyone, with minimum instruction, can supervise several presses.

Capacity up to 20,000 parts per week with 4-cavity mold. Utilizes conventional molding powders. No preforms or preheating required. Phenomenally low mold cost. Quick set-up and mold change-over.

Provides closer tolerances and greater strength in thin sections — facilitating miniaturization. Flash and finishing costs are minimized.

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CIRCLE 197 ON READER-SERVICE CARD

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CIRCLE 199 ON READER-SERVICE CARD

Voltage Regulators

200

Bulletin 5.00.2 discusses 12 systems where voltage regulators function. It also describes, with pictures and specs, a number of regulator models. Among these are a dual-mode, and two transistor-magnetic types. With case studies, the 28-page booklet shows how regulators keep the radiation of an infrared calibrating source constant and how they control the voltage, current, or speed in servo systems. Other cases cover electroplating, communications, railroad control, airborne photography, and other uses. The booklet is pocket-sized. Electric Regulator Corp., Pearl St., Norwalk, Conn.

Magnetic Shield for Tubes

201

Co-Netic low level magnetic shields are described in data sheet 132 now available. The sheet is illustrated and gives a detailed description of the shield which fits all 7 and 9 pin tubes, eliminates magnetic interference and prevents magnetic hum in fields of 25 gauss or less. Perfection Mica Co., Magnetic Shield Div., 1322 N. Elston Ave., Chicago 22, Ill.

Rotating Devices

202

This catalog, containing 28 pages, lists many synchros, ac/dc motors, servo motors, inverters, actuators, gear motors, generators, and other components of interest. Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J.

Hairsprings

203

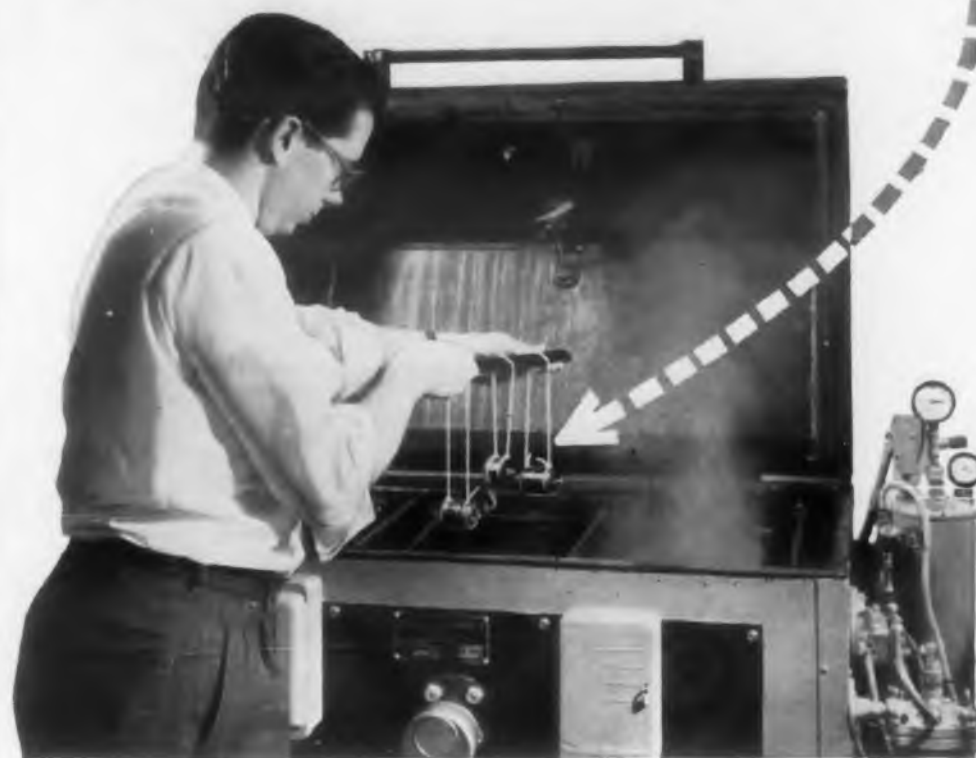
A practical guide for the product engineer called upon to design and specify hairsprings for instruments, gear trains, clocks, and other fine mechanisms is provided by the revised edition of an 8-page booklet just published.

The booklet contains recommendations for the selection of materials to deal with a wide variety of specific operating conditions. It also tells how to specify the various physical requirements of a hairspring and discusses the relative importance to be given to the effect or torque, O.D., cross-section and collect hole size. Formulas are given for ready calculation of torque, stress, and permissible stress concentrations.

Among the materials now commonly used for hairsprings and discussed in the booklet are Ni-Span "C," stainless steel, phosphor bronze, beryllium copper, copper-silicon alloy, nickel silver, silver alloy, and high-carbon steel. Associated Spring Corp., Bristol, Conn.



STIFF DOSE OF SALT



Exposure . . . to the equivalent of a stiff sea spray . . . on a hot, humid day—one more test the G-M Servos take in stride.

Not just a promise—but a tested fact.

G-M Servo Motors are built to deliver the ultimate in performance. The salt spray test shown above is just one of a battery of tortures designed to prove G-M Servos under all extremes of humidity, temperature, altitude, vibration and salt spray.

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4 GOOD REASONS WHY G-M SERVO MOTORS SERVE YOU BEST!

- 1 G-M Servo Motors are available in standard sizes.
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G-M Servo Motors
manufactured by the Components Division of
G-M LABORATORIES INC.
4284 N. Knox Avenue • Chicago 41



Write Now

for information, or send for complete G-M charts and specifications. No obligation, of course.

CIRCLE 204 ON READER-SERVICE CARD

Another Application for FERRITES

ARC selects
FERRAMIC® CORE
 for Automatic Direction Finder



Space saving is illustrated by the fact that the core loop antenna protrudes only 2" outside aircraft skin compared to the 12" exterior structure of older air core loop antennas.

Streamlined loop design saves weight, reduces air drag and increases sensitivity

Aircraft Radio Corp. selected General Ceramics Ferramic "E" Material for their new sub-miniature direction finder because it permitted a new concept of aircraft antenna design. Weight reduction of 80%, less air drag due to elimination of the cumbersome air core loop, and 50% lower cost were

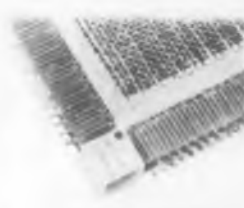
accomplished. Sensitivity was greatly increased. When your application involves magnetic material from 10 kcs. to 20,000 mcs. — ask the General Ceramics engineering advisory service for help in solving your problem. Address inquiries to General Ceramics Corporation, Keasbey, N. J.—Dept. ED.

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FERRAMIC CORES



MAGNETIC MEMORY CORES AND PLANES



PRECISION STEATITES



"ADVAC" HIGH TEMPERATURE SEALS



SOLDERSEAL TERMINALS

CIRCLE 205 ON READER-SERVICE CARD

NEW LITERATURE

Microwave Ferrites

206

"Microwave Ferrite Devices" tells system and instrumentation engineers how to use ferrites. The 8-page paper first outlines physical phenomena in sufficient detail to allow correct use of ferrite components. It then explains the features and uses of existing and feasible devices. Last it describes a hypothetical system composed largely of ferrite parts. Graphs and drawings support the text. Offered as a reprint, the piece was written by Rudolf Henning for the first issue of the Technical Bulletin. Sperry Gyroscope Co., Microwave Electronics Div., Great Neck, N.Y.

Cold Headed Fasteners

207

This catalog describes the design and use of such cold headed specialties as rivets, nails, screws, and other fasteners and small parts. Data includes cost and design advantages and manufacturing possibilities plus information on metals and finishes. John Hassall, Inc., Westbury, N. Y.

Technical Communications, Vol. 1, #1

This magazine is intended as a tool for all those who use creative skills—words, ideas, pictures—to clear a path through today's technology.

It includes topics of interest to the communications specialist whether he works in science, government or industry. The magazine is written and edited exclusively for those who have contact between scientists, research and management, engineer and military men. Technical Communications may be obtained by sending \$1.00 to Professional Publications, Inc., Dept. ED, 266 S. Alexandria, Los Angeles 4, Calif.

Active Infrared System

208

A long range photoelectric control system is described in Bulletin PA579, now available. Long range operation from an invisible infrared beam is made possible by the use of the photoelectric receiver of Firetron, a lead sulfide photoconductor.

The bulletin indicates that the high sensitivity of the system permits extensive coverage—up to 1000 feet—using a single system.

It responds only to its own infrared source and will signal a beam interruption as short as 0.005 sec. Electronics Corp. of America, Photosensitive Div., 77 Broadway, Cambridge, Mass.

silver, silver alloy, and precious metal electrical contacts are included in a brochure now released. The company is the only manufacturer of precision electrical contacts in the East, stocking standards," and prepared to design, develop, and manufacture "special" contacts.

This 4-page folder gives an availability table of special and composite contacts, and thoroughly indicates the design and specification stages in ordering contacts, with recommendations for most economy. A complete chart is included which gives dimensions of all contacts available as standard from stock—contacts which will answer most assembly needs. Contacts Inc., 1100 Silas Deane Hwy., Wethersfield, Conn.

Miniature Blowers and Fans

210

Miniature axial and centrifugal blowers and fans for electronic cooling, ventilating, and exhausting, are shown in a 6-page catalog, released recently. The air moving devices described operate to 120 vdc and 200 vac, and produce up to 115 cfm free air in the largest size. The smallest weighs 4 oz., delivers 9 cfm. The performance curves, MIL specifications, and other technical data are also furnished. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

Accurate Speed Measurement

211

Four methods of measuring speed to one tenth of one per cent accuracy through use of a potentiometer recorder are described in a brochure designated GET-2741 (1, 2, 3, 4).

Included are bulletins which describe application of the following: Differential Speed Recorder (1)—used to measure draw in feet per minute (or similar units) between sections of a paper mill, with similar applications in other industries; Speed Ratio Recorder (4)—for measurement of such processes as "per cent elongation" of steel in a strip mill, "per cent draw" in a paper mill, or per cent of flow in a chemical blending system; Speed Deviation Recorder (2)—used in the textile industry to measure per cent deviation from a predetermined optimum speed. Also used similarly in other industries; Multi-Range Expanded Scale Speed Recorder (3)—for accurate speed measurement over wide ranges in continuous process industries such as paper, rubber, and textile.

Separate bulletins also are available on the instrument—the potentiometer recorder—the tachometer generator used with the recorder. General Electric, Schenectady 5, N. Y.



DUAL RACK INSTALLATION



transistor power supplies

NEWLY DESIGNED FOR TRANSISTOR VOLTAGES

- 3 RANGES—FINE RESOLUTION • TUBELESS
- LOW COST • CONTINUOUSLY VARIABLE

These new T-Nobatrons are the perfect solution to the problem of providing well-regulated voltages for the development and testing of transistor circuits. They provide stable DC output voltages in three ranges, with fine resolution. Excellent transient response for line and load pulses. Simple tubeless construction means greater reliability, lower cost. Also ideal for many other applications in these voltage ranges, such as relay testing and computer circuitry development.

ELECTRICAL CHARACTERISTICS

Model	T50-1.5	T60-5	T120-2.5
AC Input (60 ~, 1 ϕ)	95-130	95-130	95-130
DC Output Voltage (three ranges)	0-10 0-25 0-50	0-10 0-25 0-60	0-25 0-50 0-120
Output Current (amps.)	0-1.5	0-5	0-2.5
Regulation, line: 105-125 V	$\pm 1\%$	$\pm 0.5\%$	$\pm 0.5\%$
For wider input	$\pm 2\%$	$\pm 1.0\%$	$\pm 1\%$
Internal Resistance, typical (ohms)			
low-voltage range	1.2	0.35	1.3
middle range	2.1	0.55	2.0
high range	4.5	1.0	4.0
Ripple (mv)	50 max.	50 max.	50 max.
Time Constant (line)	0.08 sec.	0.08 sec.	0.08 sec.
(load)	0.15 sec.	0.15 sec.	0.15 sec.



MODEL T50-1.5

SORENSEN & COMPANY, INC.

SO. NORWALK • CONN.

In Europe, contact Sorensen-Ardag, Eichstrasse 29, Zurich, Switzerland, for all products including 50 cycle, 220 volt equipment

CIRCLE 212 ON READER-SERVICE CARD

**Here's a versatile
super-ceramic that shrugs
off shock...heat...abrasion**



**Centralab
High Alumina
Ceramic**

Centralab High Alumina ceramic can be fabricated in any shape, form, or size — to exacting tolerances — for applications requiring exceptional strength, greater shock- and heat-resistance.

In addition to its superior electrical characteristics, Centralab High Alumina ceramic is chemically inert and remains stable under radiation bombardments, elevated temperatures, and controlled atmospheres.

Centralab High Alumina ceramic is available in production quantities — in 85% and 95% unmetallized or metallized bodies.

Send your inquiry to Centralab. Our service includes competent engineering assistance by ceramics specialists, and modern facilities geared for prompt deliveries.

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One of America's largest manufacturers of engineered ceramics. Regardless of requirement, Centralab specialists and facilities can produce the High Alumina ceramic-component design you want.

CIRCLE 213 ON READER-SERVICE CARD

X-2358

NEW LITERATURE

Versatile Scaler 214

Recently issued, this 2 page catalog sheet illustrates and describes a versatile scaler which has a resolving time of 0.8 μ sec, permitting counting rates of a million counts per minute. Included are circuit drawing, rear chassis connections, and information on input requirements, resolving time, high voltage range, preset count selection and other technical data. Radiation Instrument Development Lab., 5737 South Halsted St., Chicago 21, Ill.

Fixed Composition Resistors 215

The results of extensive tests on a series of fixed composition resistors are shown with graphs, charts, and text in Catalog Data Bulletin B-1C. The 12-page booklet offers comprehensive data on construction, characteristics, solderability, terminations, heat dissipation, color coding, tolerances, power and voltage ratings, temperature rise, and matched and balanced pairs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Plug In Control

Five-in-one plug-in control unit described in data sheet now available. The handy unit provides five outlets from single receptacle. The sheet is illustrated and includes specifications. Arthur S. L. Pine and Co., 6001 S. Knox Ave., Chicago 29, Ill.

Phasemeter Applications

Sixteen pages of "Application Notes" are now available on the model VM-200 series phase angle voltmeters, and provide set-up diagrams and procedures for the many research, test and production applications of this multi-functional instrument. The instruments have many laboratory, production testing and field applications in communications, control and automation systems, particularly in aircraft and guided missiles. The notes illustrate the instrument's use as a phase-sensitive vector voltmeter and ac vacuum tube voltmeter. Methods are provided for measuring signal magnitude and the quadrature and in-phase components of a signal. Measurements of impedance, reactance, resistance and power factor are described. North Atlantic Industries, Inc., 603 Main St., Westbury, N.Y.

2 PL
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PLASTIC
2 3/8 x 2 3/8

14
CLEAR PLASTIC 3 1/2 x 3

23 CLEAR PLASTIC 4 3/8 x 4 3/8

BD
BEEDE
ELECTRIC METERS

for
SMALL POWER-UNIT PANELS,
INDUSTRIAL TEST UNITS,
COMMUNICATION EQUIPMENT.

Catalog on Request

BEEDE ELECTRICAL INSTRUMENT CO., INC.
PENACOOK, N. H.

CIRCLE 218 ON READER-SERVICE CARD

Silver-Zinc Batteries

219

Plug-In Computer Elements

221

Factors which led to the choice of silver-zinc batteries for helicopter use are discussed in a bulletin called "Why the Silver-Zinc Storage Battery?" The bulletin describes tests carried out on silver-zinc, lead-acid and nickel cadmium batteries, and analyzes the performance data thus obtained. Yardney Electric Corp., 40-50 Leonard St., New York 13, N.Y.

Bulletin C-24 is an 8-page technical manual on transistorized, plug-in computer elements and their applications. Liberally illustrated with circuit diagrams, the text analyzes the computer elements and the basic circuits that combine to construct them. Separate attention is given to logical gating circuits, logical control circuits, binary decimal counters, and accessory units. The manual has a section on transistorized regulated power supplies for operating the elements, and one devoted to interconnection pointers. Ransom Research, 323 W. 7th St., San Pedro, Calif.

Rubber Products

220

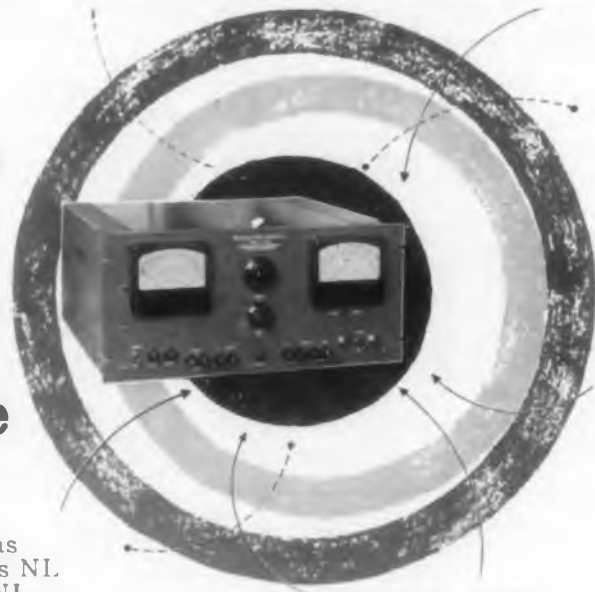
Facilities for the custom manufacture of rubber parts are the illustrated topic of a recent 12-page catalog. Prime emphasis is placed on the production of special molded rubber parts, silicone rubber parts, custom built rubber covered rolls, and rubber bonded-to-metal parts. Other features of the catalog include punched products, gaskets, natural and synthetic rubber compound identification tables adopted by the S.A.E. and A.S.T.M., descriptions of natural rubber and synthetics, and a guide to ordering rubber products. The Williams-Bowman Rubber Co., 1945 S. 54th Ave., Cicero 50, Ill.

Numerical Positioning Control

222

Bulletin GEA-6594 describes a complete industrial system for automatic point to point positioning of machines and machine tools. With illustrations, the 8-page booklet discusses the benefits and typical applications of the system. It explains theory and operation of numerical positioning. General Electric Co., Schenectady 5, N.Y.

high-current d c power supply has fast response



Model 3 - 1.5MB

This regulated 1½-ampere unit has a recovery time of 0.4 milliseconds NL to FL...0.25 milliseconds FL to NL. It is used with computers, and quick-response laboratory and production testing applications. Model 3-1.5MB is in production, and moderately priced. Write for literature.

specifications

OUTPUT VOLTAGES

0-300 VDC @ 1500 Ma, continuously variable without switching. This output is floating. Bias voltage: 0-145/155 VDC @ 5 Ma max., continuously variable. External output: 6.3 VAC @ 10 amps, center tapped.

REGULATION:

For 300-volt/1500 Ma output: 100 MV change NL to FL. For line voltage of 105 to 125 VAC (at 300-volt/1500 Ma output): 0.15% change in output voltage.

RIPPLE

For 300-volt/1500 Ma output, ripple and internal noise are below 3 Mv RMS.

dressen-barnes

DRESSEN-BARNES CORP., 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 223 ON READER-SERVICE CARD

a new measure



in Celco



precision

TOROIDAL COMPONENTS



Whether it's a complex 10 winding magnetic amplifier or a simple choke . . . at Celco each toroid is precision-made. New core materials are used in Toroidal magnetic amplifiers, reactors and transformers to achieve maximum performance.

At Celco, the proper matching of cores, winding, handling, impregnation, encapsulation and electrical history of the final assembly is carefully controlled to maintain the original design characteristics.

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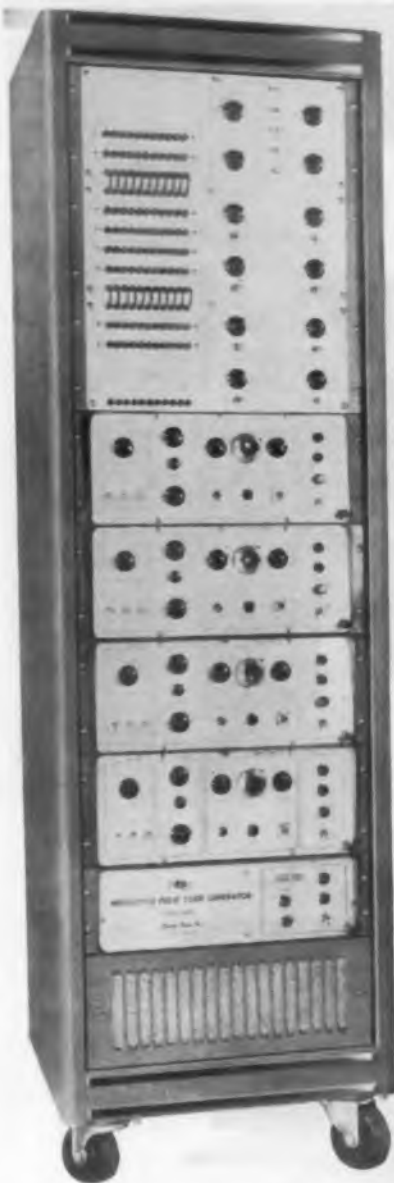
CIRCLE 224 ON READER-SERVICE CARD

Electro-Pulse presents

the 5100 SERIES PULSE CODE GENERATORS and Magnetic Core Testing Equipment

HIGH CURRENT ...

MEGACYCLE OPERATION



- Ten-Interval Pulse Code
- Five-Interval Controllable Repeat
- Variable Width and Delay Pulses
- Amplitude Variable to 5 Amp. per Channel—500 Mil. Avg. Current
- Independently Coded Channels
- Mixed Output—4 Channels Pos. and Neg.

Model 5100A
Four-Channel Pulse Code Generator

Designed for: Magnetic Memory Core Testing — Switch Core Testing — Magnetic Material Pulse Response Studies — Pulse Code Transmission System Design and Test — Multi-pulse Circuit Development.

The Electro-Pulse 5100 Series Pulse Code Generator has been developed to meet an increasing demand for higher clock rates and higher output currents necessary in data handling and related fields.

The flexible coding system is based on 10 intervals with controllable repeat of five intervals. Each channel Control Unit optionally selects (independently for each interval) a pulse or no pulse.

Four direct channels and two delayed channels feed four output amplifiers to form any required positive or negative code patterns, pulse current amplitudes, or waveforms with variable rise times.

Write for Complete Data: our Bulletin 5100/ED

Model 3450B
MEGACYCLE PULSE GENERATOR

- 2 mc to 200 cps
- Continuously variable pulse width and delay to 100 μ s in 3 ranges
- Simultaneous pos. & neg. pulses



The 5100A Series and the Model 3450B are latest additions to the Electro-Pulse instrumentation line. Others: Precision Pulse Generators, Variable Pulse Generators, Time Delay Generators, Pulse Oscillators, Voltage and Current Calibrators, and Electronic Counters.

Representatives in Major Cities

EP Electro-Pulse, Inc.

11861 TEALE ST., CULVER CITY, CALIF. • Phone: EXmont 8-6764 or TExas 0-8006

CIRCLE 225 ON READER-SERVICE CARD

NEW LITERATURE

Hardware Catalog 226

To help simplify the work of engineers, buyers, and cost estimators, a 138-page catalog containing price, stock and delivery information on stainless steel and nylon fastenings is now available. The features of this catalog include net prices for all quantity brackets and all sizes. No computation is necessary. Set-up charges and net prices are given on non-stock items, enabling a buyer, engineer or cost estimator to obtain this information without having to contact the supplier. Anti-Corrosive Metal Products Co., Inc., Castleton-on-Hudson, N.Y.

Long Scale Panel Meters 227

A long scale panel instrument bulletin has recently been issued. For specialty applications, the instruments described come in sizes from 2-1/2 to 5-1/2 in. for a wide range of current and voltage indications as well as tachometry and temperature applications. Weston Electrical Instrument Corp., Newark 12, N.J.

Production Services 228

A 6-page brochure describing the range of engineering services available for the producers of industrial and consumer goods, and ordnance is now available. The services envelop the major creative departments—product engineering design and development, production engineering, graphic arts and plant services. Production Services Corp., 81 Market Square, Newington 11, Conn.

H F Pulse Generator 229

A high frequency pulse generator is described in a technical bulletin which is now available.

Designed for applications involving high speed switching circuits, the 1050 produces half sine wave pulses in four overlapping frequency bands from 1.6 to 10.4 mc. Controls have been conveniently located on the front panel for the selection of five different widths of the output pulse and for amplitude control and polarity reversal.

The bulletin on the generator provides complete specifications both electrical and physical. Burroughs Corp., Electronic Instruments Div., 1209 Vine Street, Philadelphia 7, Pa.

TRUE DIFFUSED JUNCTION SILICON DIODES FOR HEAVY-DUTY POWER RECTIFICATION

THERMOSEN TYPE NO.	MAX. FWD. D.C. CURRENT*	PEAK INVERSE VOLTS	LEAKAGE MA.
P2505	25 AMPS	50	< 5
P2510	25 AMPS	100	< 5
P2520	25 AMPS	200	< 5
P2540	25 AMPS	400	< 5

*6" x 6" heat sink



ACTUAL SIZE

THERMOSEN offers for the first time the superior uniformity and reliability of true diffused junction silicon power diodes. These small, rugged, efficient devices are the best answer yet to your heavy-duty power rectification problems. Conservatively rated, hermetically sealed (guaranteed to 175°C), with an ambient temperature range of -65°C to +150°C, these diodes are reliable long-life components for new or replacement designs.

Thermosen has the experienced staff and complete facilities to develop and manufacture special electronic or semi-conductor diodes to your most exacting specifications.

THERMOSEN, INC. 375 FAIRFIELD AVE. • STAMFORD, CONN.

CIRCLE 230 ON READER-SERVICE CARD

Rotary Equipment

231

An engineering catalog, Bulletin 5721, covers rotary electrical and electronic equipment. It illustrates more than seventy different types of miniature blowers, gear motors, motor generator sets, fans, and blowers. Engineering drawings, performance curves and other detailed information are provided. A section of the catalog also details specified electronics equipment such as voltage regulated power supplies, transistorized voltage regulators, and stroboscopes. Western Gear Corp., P.O. Box 182, Lynwood, Calif.

Punched Card Reader

232

A static punched card reader designed for use with industrial processing and control systems is described in specification Bulletin AR-72 now available. It states that the card reader accepts an IBM or any other standard punched card having as many as 80 vertical columns with 12 punching positions in each column. The reader is equipped with Cannon connectors for connection to associated control equipment. The Peerless Electric Co., Electronics Div., Warren, Ohio.

Small Rugged Carbon Pots

233

Catalog Data Bulletin A-4a is devoted to 15/16 in. rugged carbon potentiometers. The 4-page text offers comprehensive data on construction, materials, identification, dimensions, shafts, bushings, hardware, switches, torque, and resistance tapers. Detailed graphs and drawings are used for illustration. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Packaged Power

234

Form F-111 is an 8-page illustrated folder concerned with packaged electric power systems for mobile communications equipment. Three 2-hp engine-driven electric plants are discussed; one for battery charging with ac power, a second for high battery charging output, and a third for battery charging only. An easy-to-follow chart cites the uses and advantages of each system. The booklet also describes a cooling system which permits the installation of generating sets in compartments or locations where adequate cooling presents a problem. D. W. Onan & Sons Inc., Minneapolis 14, Minn.



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leaders in the field of high
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Values:

18 to 1000 uufd

Tolerances:

±20%, ±10%, ±5% and ±2%
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Temperature Coefficient:

Substantially zero — with spread of
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Max. Ambient Temperature:

150° Centigrade

Power Factor at 1 mc:

better than 0.001

Manufactured in England and Canada

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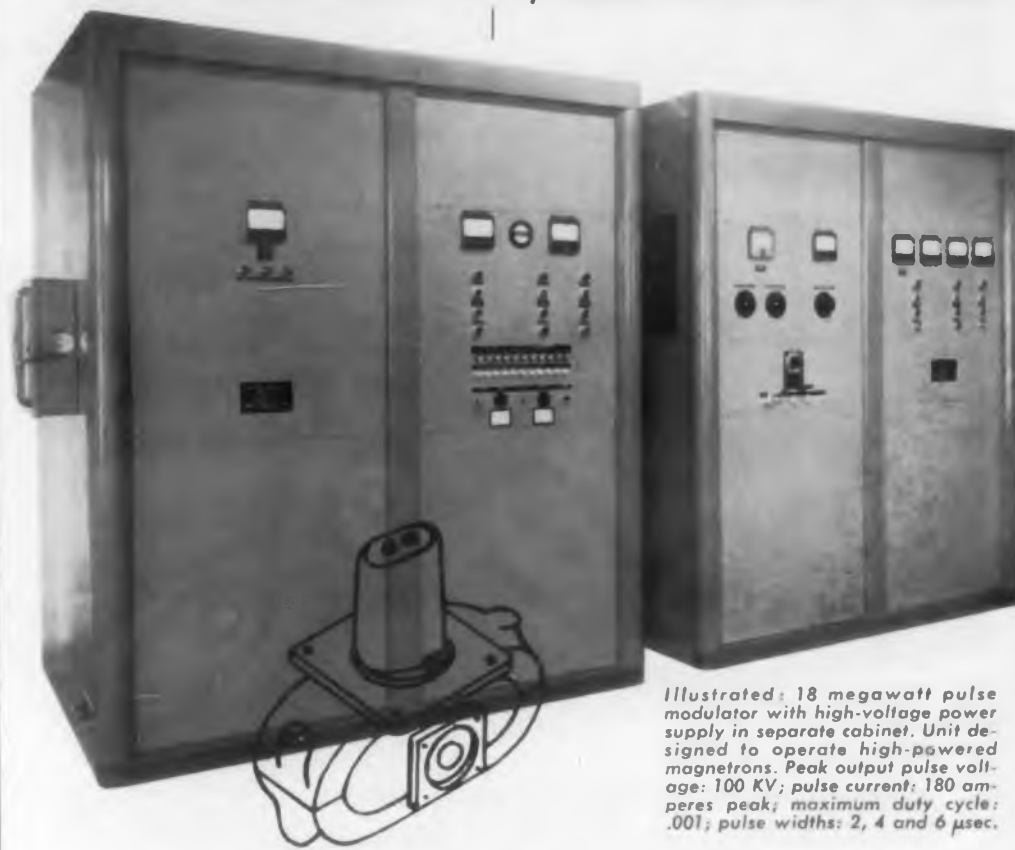
3355 Edgecliff Terrace, Cleveland 11, Ohio

CIRCLE 235 ON READER-SERVICE CARD

Testing

MAGNETRONS KLYSTRONS CARCINOTRONS

● OTHER MICROWAVE TUBES, COMPONENTS OR SYSTEMS?



Illustrated: 18 megawatt pulse modulator with high-voltage power supply in separate cabinet. Unit designed to operate high-powered magnetrons. Peak output pulse voltage: 100 KV; pulse current: 180 amperes peak; maximum duty cycle: .001; pulse widths: 2, 4 and 6 usec.

Come to Manson for the widest selection of standard *Pulse Modulators* and *High-Voltage Power Supplies* covering all useful power levels. From kilowatts to tens of megawatts, Manson has precision-engineered designs for operation and test of magnetrons, klystrons, traveling wave tubes, backward wave oscillators, lighthouse tubes, pulse transformers, waveguide components and related devices. The wide range of standard models is readily adaptable to meet individual specifications.

HIGH POWER PULSE MODULATORS:

Hard- and soft-tube types from 16 kw. to 30 megawatts peak power output, and higher. Average output powers as high as 60 kilowatts. Typical operating features include: continuously adjustable voltage control; discrete or variable pulse widths; internally- and externally-controllable repetition frequencies; auxiliary synchronized outputs; pulse-shape monitoring circuits; and interlocking and overload protection.

HIGH VOLTAGE POWER SUPPLIES:

High-voltage DC and AC types, single- or multiple-output, regulations and stabilities to 0.01%. Standard and custom designs to satisfy your specific tube testing or production problems: highly-regulated supplies uniquely suited for TWT test and operation; unregulated high-power supplies for systems testing; and complete power sources for controlling all aspects of tube production.

Write today for complete details on our full line of high-power pulse-test equipment and high-voltage power supplies, including applications and performance data.

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STAMFORD, CONN.

Manson offers to engineers and technicians a rewarding present and attractive future in Connecticut.
CIRCLE 236 ON READER-SERVICE CARD

NEW HIGH CURRENT VOLTAGE and CURRENT REGULATION with LIMITING! (in a single unit)



Oregon
Electronics MODEL
CV-15-50

for TRANSISTOR ENGINEERING

For the first time you can have a power supply that will protect transistors from overload... both voltage and current! Set for maximum voltage on the limiter control and the output power will be interrupted **before** the limit is exceeded. (An audible or visual alarm can also be used). When used for regulated voltage supply, the system becomes a current limiting circuit.

SPECIFICATIONS

INPUT: Nominal 117V, 50-60 cycles.

OUTPUT: Voltage regulated ranges—0-5; 0-15; 0-50; 0-150 volts and Current regulated ranges of 0-15; 0-50; 0-150; 0-500 milliamperes. Output floating or either positive or negative grounded.

REGULATION: Voltage—better than 0.05%. Current—better than 0.2%.

RIPPLE: Voltage—Less than 2mv peak-peak. Current—Less than 2mv peak-peak across 100 ohm load.

LIMITER: Provides visual and audible alarm or visual and cutout as selected. Same ranges as output. Adjustable by means of panel control.

MODULATION & EXTENDED CONTROL: Plugging jacks provide for external modulation or adjustment of current regulated output and extended or remote adjustment of voltage output.

METER: Dual range 5-15 and multipliers.

PANEL: Anodized aluminum—natural or satin black. Standard rack width, 7" high.

CABINET: Heavy gauge steel finished in silver grey smooth baked enamel.

Oregon
Electronics

Write for complete information

2105 S. E. SIXTH AVE.
PORTLAND 14, OREGON
BEI mont 6-9292

MANUFACTURERS OF SPECIAL ELECTRONIC EQUIPMENT

CIRCLE 237 ON READER-SERVICE CARD

NEW LITERATURE

Capacitors

238

Four engineering bulletins on capacitors have just been released. They describe sub-miniature electrolytic capacitors (T E-250), flat and round miniature Mylar dielectric capacitors (R M-325), and two different types of Mylar metallized capacitors (R M-300 and R M-375 respectively). The bulletins employ charts and graphs to demonstrate performance characteristics in temperature ranges, voltage ratings, capacitance stability, and various test specifications. Astron Corp., 255 Grant Ave., East Newark, N.J.

Step-Function Speed Reducer

239

Two step-function speed reducer models, an 8-speed and a 10-speed, are presented in Bulletin 262. The 2-page sheet contains drawings and photographs, a brief description, and a list of specifications. It also shows the range of speed ratios for each model. Inco Co., Div. of Barry Controls Inc., Hollis St., Groton, Mass.

Side Indicator Panel Meter

240

An engineering data sheet carrying a description of the Model 1135 side indicator panel meter, and including full electrical and other specifications, has been made available by the manufacturer. Designed to replace conventional 3-1/2 in. meters on all installations where panel space and weight must be saved without sacrificing accuracy, dependability or readability, the Model 1135 side indicators have a scale length equivalent to that of full-sized conventional meters but occupy only 1/4 of the panel area. As pointed out on the Engineering Data Sheet, initial accuracy of the Model 1135 is held to ± 2 per cent of full scale deflection for dc ranges and ± 5 per cent for ac.

The data sheet carries full mounting dimensions and data. Provision has been made for either horizontal or vertical mounting. In addition, these meters are suitable for dual, "back-to-back," mounting arrangements to facilitate comparative readings. Included also in the data sheet is a complete listing of standard ranges, and maximum resistances. Numerous special variations, non-standard ranges and resistances, and other modifications can be supplied on order. International Instruments Inc., P.O. Box 2954, New Haven 15, Conn.

NEW, LOW FREQUENCY RELIABILITY IN MIDGET, GLASS-ENCLOSED CRYSTAL



Precision components of the new RHG-DP crystals are enclosed and hermetically sealed in glass holders to assure maximum internal cleanliness and most reliable evacuation. The result is a series of sturdy, miniature, low frequency units having excellent long-term stability and higher Q.

TYPICAL VALUES FOR 2 KC UNIT*

Frequency range	1 to 15 kc
Holder	T5 1/2 glass bulb — Noval Base
Temperature range	— 55 to +100°C
Frequency tolerance	$\pm 0.15\%$
Effective resistance	75,000 ohms max.
Aging 8 hours—100°C	$\pm 0.001\%$ max.
Meets MIL specifications for vibration stability	

*Reeves-Hoffman manufactures a broad line of crystals in the range from 1 to 1000 kc.

REEVES-
HOFFMAN

WRITE FOR BULLETIN RHG-DP

DIVISION OF
DYNAMICS CORPORATION OF AMERICA
CARLISLE, PENNSYLVANIA

CIRCLE 241 ON READER-SERVICE CARD

Transistor A/D Converter 242

This all transistor analog-to-digital converter is described in this 4-page brochure available. This high speed ADC was originally developed for use in the extremely reliable model 112 data handling system. This high accuracy analog-to-digital converter is virtually maintenance-free as a result of its all solid state circuitry. The illustrated brochure contains complete specifications and utilizes basic circuit diagrams and sketches to explain operation. Beckman Instruments Inc., 325 N. Muller Ave., Anaheim, Calif.

Indicator Lights 243

The newly designed indicator lights described in Form L-159 incorporate the tiny NE Neon Glow Lamp NE-2D. Photographs and diagrammatic drawings are shown of several popular styles of sub-miniature indicator lights made especially for the NE-2D lamp.

A feature of this brochure is the descriptive data given on the NE-2D neon glow lamp. The lamp measures 7/8 x 1/4 in. overall and has a newly improved T-2 bulb

with a formed tip and a midjet flange base. Drawing as little as 0.0002 amp, the NE-2D consumes about 0.04 w of power and produces practically no heat. It has a life span of approximately 25,000 hours. Required ballast can be had in the form of a 1/3 w resistor or in another component of the circuit. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y.

Temperature Control 244

This illustrated 4-page, two-color brochure on a variety of temperature control equipment features Blue M Power-O-Matic Industrial Batch Ovens. The ovens have fully automatic proportional wattage control and temperature range to 600 deg F. with a capacity from 16 to 96 cubic feet.

Also included in the brochure are mechanical convection ovens with temperature to 1200 deg F meeting Air Force Specifications MIL-H-6088A; and industrial and laboratory furnaces to 2600 deg F.

The bulletin includes complete construction details, prices, sizes of unit available and voltages. Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.

PULSE DELAY GENERATOR MODEL 1000-A



THE MODEL 1000A IS A PRECISION INSTRUMENT WHICH PRODUCES A PULSE VARIABLE IN DELAY FROM AN EXTERNAL OR INTERNAL TRIGGER. THE DELAY RANGE IS 1.0 TO 999.9 MICROSECONDS IN 0.1 MICROSECOND INCREMENTS. THE ACCURACY IS 0.01% AND THE JITTER LESS THAN 0.005 MICROSECONDS.

OTHER MODELS ARE AVAILABLE WITH THE SAME ACCURACY AND DELAYS OUT TO 10,000 MICROSECONDS.

ACCURACY

$\pm 0.01\%$ or 0.05 usec.

STABILITY

less than 0.005 usec. jitter & 0.005% change in delay with change in prf

VERSATILITY

single or paired pulse output & delayed scope trigger in advance of delayed pulse
EXTERNALLY TRIGGERED

ORBITRAN COMPANY

LAKESIDE CALIFORNIA

CIRCLE 245 ON READER-SERVICE CARD



HONEST JOHN artillery rocket depends on G-E electric heating blanket (inset) to bring missile to uniform operating temperature before launching.

HONEST JOHN FIRING SHOWS HOW . . .

General Electric Specialty Heating Maintains Propellant Temperature

Successful launch—and flight—of the Honest John depends upon exact propellant temperature at the moment of firing. A General Electric heating and insulating blanket—which shrouds missile from nose to nozzle—provides and maintains that temperature!

Proper operation of many types of land and airborne equipment, especially at low temperatures, often depends on controlled heat in the right places at the right time. Experienced G-E heating engineers, backed by complete facilities, have already solved thermal conditioning problems on applications ranging from complete missiles and airborne systems to tiny test instruments.

LET US ANALYZE YOUR HEATING PROBLEM. Whether you need a custom-

made prototype, or quantity production, investigate G-E "one stop" service for specialty heating products tailored to your specific needs.

FOR MORE INFORMATION contact your General Electric Aviation and Defense Industries Sales Office or send coupon.

General Electric Company
Section H220-11, Schenectady 5, N. Y.
Please send bulletin GEA-6285A, G-E Specialty Heating Equipment
... for immediate project
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Name
Position
Company
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Progress Is Our Most Important Product

GENERAL ELECTRIC

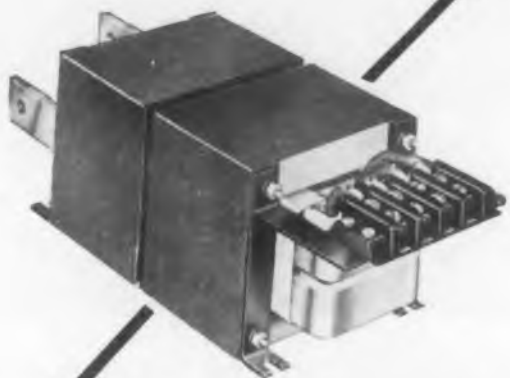
CIRCLE 246 ON READER-SERVICE CARD

Voltage Stabilizers



Input
190/208/230
volts $\pm 10\%$
Output
54 to 77 volts,
10 amp.

or Filament Transformers



Input 200/220/240
volts; Output 6.3
volts, 600 amps.

Acme  **Electric**

WILL DESIGN TO YOUR PERFORMANCE REQUIREMENTS

When performance and dependability are the most significantly important factors in your requirements, your best source of supply is Acme Electric. Send your prints and outline of application performance for confidential review and quotation.

ACME ELECTRIC CORPORATION
901 WATER STREET • CUBA, NEW YORK

Acme  **Electric**
TRANSFORMERS

CIRCLE 247 ON READER-SERVICE CARD

NEW LITERATURE

Electron Tubes

248

Electronic tubes, for industry and communications are described in two-color brochure No. 2210, now available. The brochure gives the general specifications, tube type, description, characteristics, ratings and operating conditions of 10 power triodes, the operation of many rectifiers and clipper diodes, and the various frequency ranges and bands of TR tubes. It also includes the characteristics, maximum ratings, and typical operating conditions of several power triodes for pulse operation. Central Electronic Mfg., Inc., Denville, N. J.

Screw Machine Products

249

Typical screw machine work in a variety of tough alloys including stainless steels, Inconel, nickel, and titanium, are shown in a screw machine products brochure now available. Fabrication operations and techniques required for each of the eight illustrated items are described as well as dimensions and tolerances. Both cold-headed and screw machine products are included. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, N. Y.

Fine Frequency Measurement

250

Illustrated and discussed in a four page technical data bulletin is the Model 7700 Microsensitive Frequency Measuring System for detecting and measuring virtually all types of radiated signals in the range 0.54-30.5 megacycles. The bulletin covers description, design, operation, applications, and accessory equipment. A simplified block diagram depicts the components and relationships of a Collins wide-range communications receiver, a translator unit and 7 digit direct readout events per unit time meter, incorporated in the compact system (24 in. high, 19 in. wide, 17 in. deep, 100 lb.) Complete specifications are also included. Beckman/Berkeley, 2200 Wright Ave., Richmond 3, Calif.

Electronic Components

251

Electrical and electronic components with detailed specifications and actual size illustrations are described in catalog 600 now available. The products include many varieties of solder terminals, terminal boards, hardware, insulated terminals, coil forms, shielded coil forms, coils, and capacitors. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

FREE BOOKLET



Self-locking fastener miniaturization for avionic applications

This new 36-page brochure reports on ESNA's progress and present status in the field of "reduced dimension" self-locking nuts. Cost problems, high temperature performance, product reliability and installation techniques are discussed. Detailed drawings are shown for the newest miniature hex, clinch and anchor nut designs most commonly required for electronic equipment, missiles, computers and many types of electrical assemblies. Write Dept. N44-157.

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Digital Recording

256

The three-color, six page brochure, designated SA-81, describes a tape punch, print punch, scanning printer, printer-perforator combinations, time data printer, printing timer, printing input keyboard, and standard data printer machines.

This electronic equipment is widely used for production testing, weighing applications, laboratory instrumentation, computer data read-out and input, data-reduction systems, process control logging systems, and office, industrial and merchandising automation. Clary Corp., 408 Junipero St., San Gabriel, Calif.

Collector Rings

257

A line of custom built collector rings is briefly described in this bulletin. Two types of collector rings—the cylindrical style and the annular style—are illustrated and the bulletin shows how to prepare data for estimating. B. A. Wesche Electric Co., 9027 Shell Rd., Cincinnati 36, Ohio.

Wire and Cable Manual

The second edition of a 393-page technical guide on wire and cable is now out. Some parts of it are all new. Others have new information and illustrations. The index has been improved and simplified. The revision shows technical advances and changes in wires and cables and reflects changes in industry standards, regulations, and practices. Particular emphasis has been placed on the newest materials and methods in the field.

The manual has eight sections: Wire and Cable Technical Tables; Wire and Power Cable Engineering Calculations and Data; Communication Frequency Data and Calculations; National Electrical Code Data; Properties of Metals; General Technical Information; Conversion Tables; and Cable Installation Practices. A 23-page index follows this.

The cable installation section, all new, covers arc-proofing, bending radii, cable installation, splicing instructions, and other information. The Wire and Cable Technical Tables now have data on aluminum conductors as well as copper. Information on new sheath, insulation, and conductor materials has also been added. The latest code changes and new tables bring the National Electrical Code section up to date. The Wire and Power Cable Engineering Calculations and Data provide an engineering guide to cable design, selection, and operation.

For a copy of the "Manual of Technical Information," send to the Rome Cable Corp., Dept. ED, Rome N.Y. The price is \$4.50 plus 12¢ for postage.

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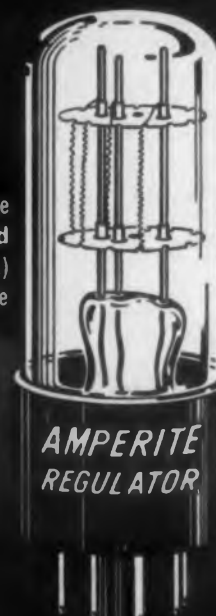


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PROBLEM? Send for Bulletin No. TR-81

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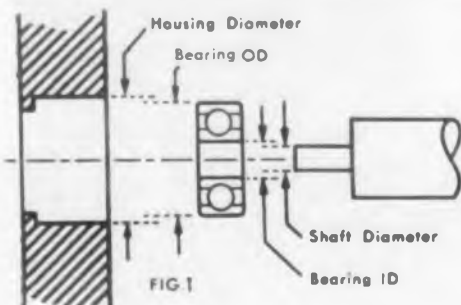
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MICRO-BEARING ABSTRACTS

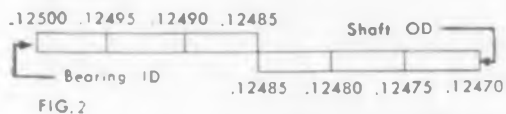
by A. N. DANIELS, President
New Hampshire Ball Bearings, Inc.

BEARING FITS AND FITTING PRACTICES

As shown in Fig. 1, the fitting of Micro-Bearings, like the fitting of larger ball bearings, chiefly involves the clearances between the inside diameter of the housing and the outside diameter of the bearing; the bore of the bearing and the shaft diameter.



The achievement of the desired fit by dimensioning is illustrated in Fig. 2. The bearing ID is represented by the top blocks and the shaft OD is represented by the lower blocks. Such a block diagram could also be applied to housings and bearing outside diameters. In this block diagram, it will be noted, the bearing ID is represented by a .00015 tolerance with a similar tolerance for the shaft. A resulting fit of line to line to .0003 loose is shown.

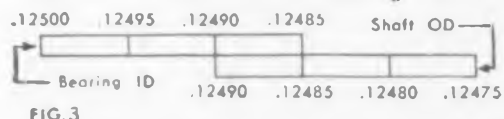


An interference fit not tighter than line to line is suggested for the following reasons:

1. Difficulty in assembly.
2. Difficulty in disassembly. This is often more hazardous than the assembly operation and may result in total bearing destruction.
3. Reduction in radial play.
4. Danger of bearing ring conforming to possible poor geometry of mating shaft or housing.

TOLERANCE DISTRIBUTION

The maximum .0003 loose condition shown in Fig. 2 may be excessive in some applications. The fitting problem then resolves itself to reducing this extreme, and yet maintain the maximum tight fit of line to line. The looseness may be reduced by redimensioning the shaft to .12490/.12475 as shown in the block diagram, Fig. 3.



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District Offices: Pasadena, Calif.; Park Ridge, Ill.; and Great Neck, N. Y.

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If the frequency distributions of shaft and bearing ID sizes were statistically normal, the modal fit of all parts would be 0.0001 loose. Accordingly, an insignificant percentage of parts would be mated to the extreme values, and for practical purposes could be ignored.

With regard to bearings' outside diameters and bores, however, normality of the distribution curve cannot be assumed. During the grinding operation, the "most metal tendency" tends to skew the frequency distributions for bearing ID's and OD's in the direction of most metal.

In grinding and finishing shafts and housings, similarly skewed distributions occur.

Operating on a modified probability distribution of tolerance is possible if the volume of parts is sizeable. But the approximate distribution of shaft and housing sizes must be verified if this method is to be used.

MATERIALS and SURFACE FINISHES

The ease of assembly is also affected by materials and finishes. The following factors must be considered:

1. The galling characteristics, hardness and ductility of the materials involved.
2. Finish lay patterns produced by various tools and techniques used.
3. R M S surface finish values achieved.
4. Geometry of shafts and housings as regards out-of-roundness, taper, etc.

The possible combinations of these elements in any single application are so numerous that their gross effect can only be ascertained by trial and error, or by a detailed study of operations on individual applications. A more complete discussion of fitting practices, including sizing methods and coding, is found in our design handbook.

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Ferrite Core for ADF Antenna

MANUFACTURERS of airborne communications and navigation equipment have continuously sought ways to increase instrument sensitivity which is of vital importance to the safety of the aircraft, particularly where weak signals must be picked up.

The Concept

One manufacturer of such equipment, Aircraft Radio Corporation, Boonton, N. J., set out to design a compact, sub-miniature automatic direction finder that was light, yet more sensitive than comparable larger units of previous designs. Standard loop antennas in ADF systems used an "air coil", a form around which wire was coiled. These loops and their housings extended some 12 in. from the airframe, adding to the air drag and requiring a sizeable hole for attachment.

Investigations showed that a coil of several widely spaced turns of wire wound on a flat ferrite core would result in the most effective type of loop.

Ferrite Core Reduces Air Drag

It was found that Ferramic E material, supplied by General Ceramics Corporation, Keasbey, N.J., with its high permeability and low losses, would be most applicable.

How It Works

The ferrite core, because of its high permeability, concentrates the magnetic field within the loop coil. As a result, the sensitivity of the ferrite loop is equal to that of air core loops that are many times larger. The advantages obtained include the following:



Wire wound ferrite core (shown being wound) replaces "air coil" to give more compact unit with greater sensitivity.



Loop antenna assembly of direction finder showing ferrite core mounted in housing.

■ Protrusion of the loop antenna assembly, including the streamlined housing, is only 2 in. on the outside of the plane's surface, as compared to 12 in. with the old style "air coil". This affords a great reduction in air drag. In addition, the assembly requires a smaller opening in the skin of the aircraft.

■ Weight of the loop antenna is only 3-1/2 lb; yet it is a rugged component with its core, wiring, "hardware" (adjustable heavy screws to compensate for variations in the electrical field because of the metal surrounding it), hermetic seal and other items. This is less than one-half the weight of older directional sensing devices for the automatic direction finders.

■ Cost of the loop antenna with ferrite core is 50 per cent less than that of the older types.



Assembling ferrite core to loop of new sub-miniature, automatic direction finder.

NEWS ABOUT SILICON DEVICES



NEW SILICON DIODE, rated at 500-ma output current and 330-volt rms input voltage, is an example of the growing development in the design of components for use in TV-power supplies.

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Silicon-equipped sets are relatively free of a decline in B+ voltage. Silicon diodes are up to 99% efficient in units operated at 60 cps—reverse leakage is as low as a few microamperes. Both rectifiers and transistors of silicon have temperature ratings far higher than those of other semiconducting materials... can operate continuously at -65° to 200°C .

Note to device manufacturers: You can produce silicon transistors, rectifiers and diodes of the highest quality with Du Pont Hyperpure Silicon. It's now available in three grades for maximum efficiency and ease of use... having a purity range of 3 to 11 atoms of boron per billion. Technical information is available on crystal growing from Du Pont... pioneer producer of semiconductor-grade silicon.



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IDEAS FOR DESIGN

Low-Cost Transistor Modulator

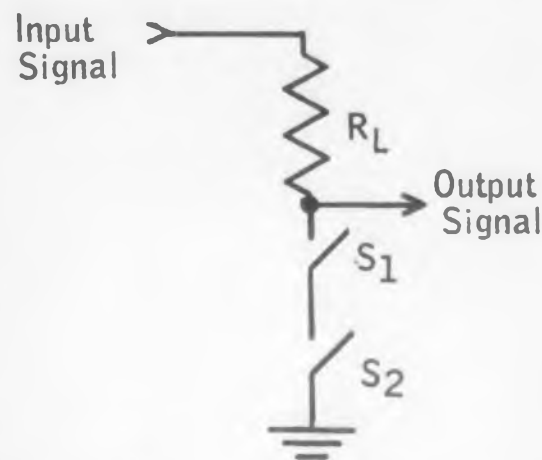


Fig. 1. Simplified equivalent circuit for phase sensitive transistor modulator.

Space and economy considerations necessitated the design of a phase sensitive two transistor modulator with as few components as possible, preferably eliminating the use of diodes.

The solution of the problem is to use two transistor switches in tandem, each switch being sensitive to the opposite phase, Fig. 1. Depending upon the phase of the input signal either S_1 or S_2 open and close at the carrier frequency, either allowing the input signal to pass through, or shorting it to ground through resistor R_L . The phase of the input signal "locks" or closes one switch, allowing the other switch to control the chopping of the input signal. The transistor version of this type of circuit, using symmetrical npn and pnp type transistors is shown in Fig. 2.

Large signal analysis of a transistor reveals that reverse collector voltage on a transistor will

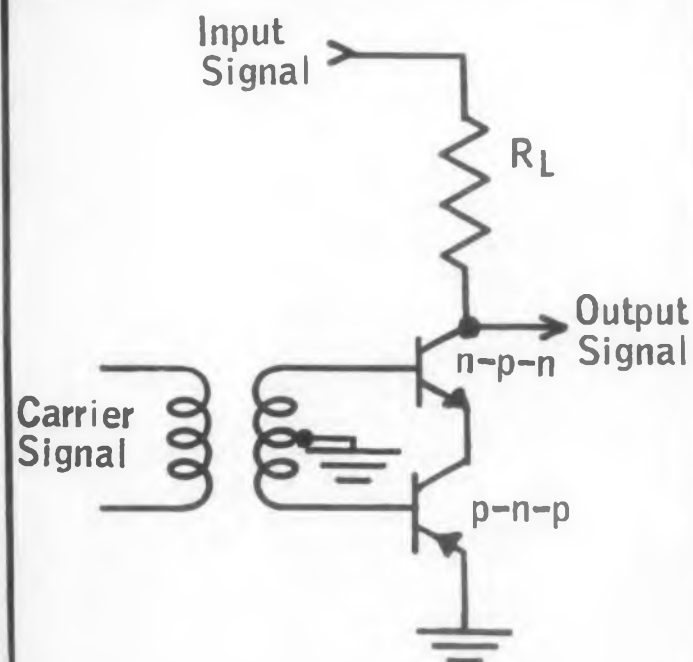


Fig. 2. Modulator circuit employing n-p-n and p-n-p transistors.

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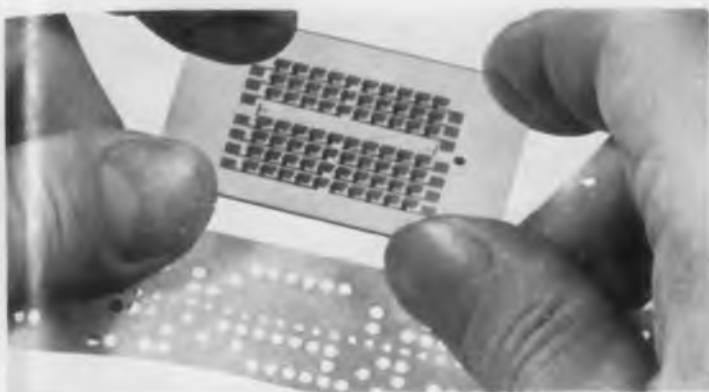
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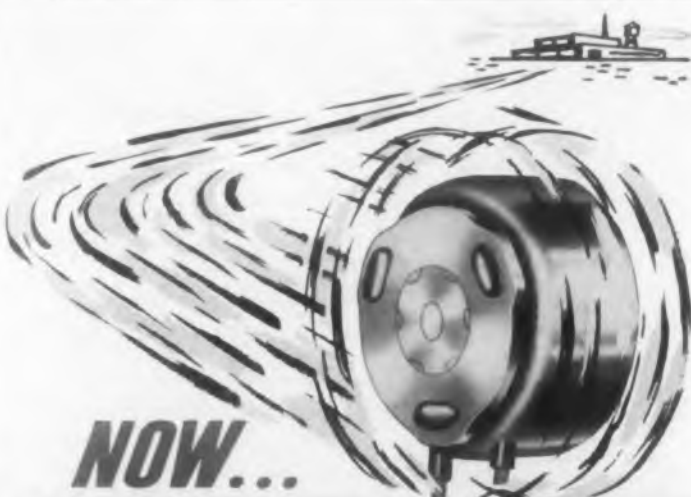
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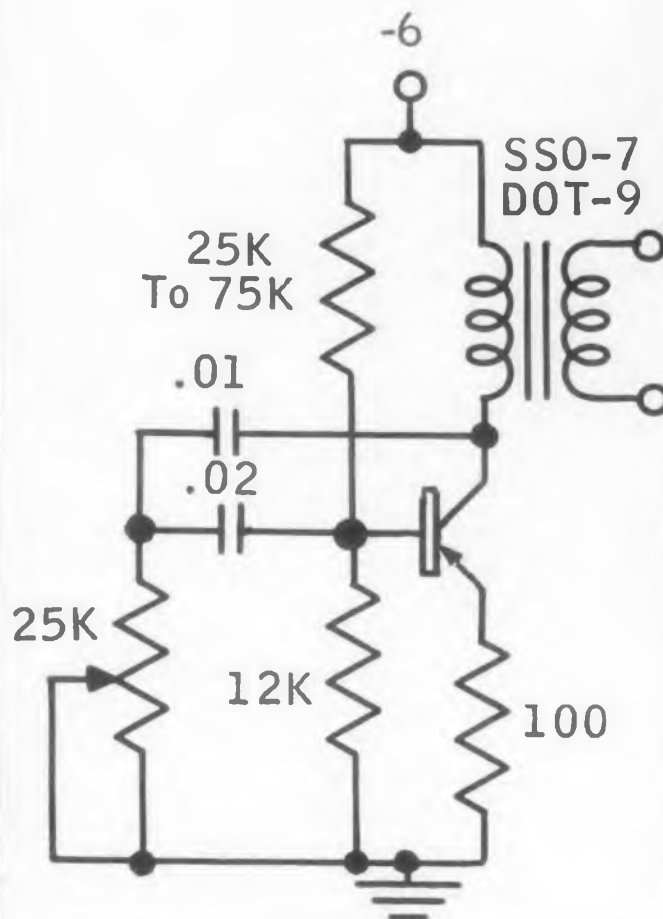
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cause it to be in the saturation, or "switch closed" state, thus allowing the other transistor to be the controlling element.

Since the carrier is being fed into the base, only a very small carrier voltage is required to drive the transistor either into saturation or cut-off. This results in only a very small "carrier leakage" voltage appearing at the output in the presence of zero input signal.

Rob Roy, Sr., Develop. Engr., Control Instrument Co., 67-35th St., Brooklyn, N.Y.

Simple Tone Generator



400 cycle Oscillator

Need for a simple low frequency tone generator using transistors for low power consumption and miniaturization, having a low output impedance, led to the design shown.

By inserting a transistor interstage transformer in the collector circuit rather than a resistor, a high voltage gain results without undesirable per cent drop. A two mesh feedback network for phase shifting and a low-impedance signal takeoff winding only are necessary.

A potentiometer may be used in the first feedback mesh giving a 3:1 frequency change. Proper capacitor selection will give a tone anywhere in the audio range.

Harold P. Shamrock, Robertshaw Fulton Controls, 401 N. Manchester, Anaheim, Calif.

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Shock	50 Gs for 11 milliseconds.
Vibration	5-75 cps at maximum excursion of 1/8-inch, 75-2000 cps at 20 Gs acceleration.
Dielectric Strength	.....	Sea level—1000 volts rms between terminals and frame, and between adjacent circuits; 750 volts rms between contacts of a set. At 80,000 ft., 350 volts rms.
Insulation Resistance	.....	1000 megohms minimum at 125° C.
Coils	Coils up to 10,000 ohms available for a wide range of voltages or currents.
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Pickup Time	3.5 milliseconds nominal.
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Contact Rating	3 amps resistive at 28 volts d-c or 115 volts a-c; also for low-level applications.
Contact Resistance	.....	0.050 ohm maximum.
Contact Life	.....	500,000 operations minimum at 2 amps; 100,000 operations minimum at 3 amps.
Enclosure	Hermetically sealed, filled with dry nitrogen at 1 atmosphere pressure.
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Terminals	Printed circuit; solder; plug-in (matching socket available). Variations of printed-circuit terminal length on 1/10-inch grid spacing available.
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IDEAS FOR DESIGN

Push-Pull Driver Stage

Termination of transistorized audio amplifiers with a push-pull arrangement is very common. One of its disadvantages—the need for two opposite polarity input signals—calls for a particular requirement from the driver stage. Two conventional ways of securing the phase reversal of the two inputs are shown in Fig. 1.

The disadvantages of Fig. 1 (a) are: high cost, narrow bandpass, and in some applications heavy weight and sizeable physical dimensions. The disadvantages of Fig. 1 (b) are: no voltage amplification in the driver stage, and a need for comparatively larger amplification from stages preceding the driver.

Suggested Circuit

The driver stage in Fig. 2 is suggested as one that combines the advantages of the conventional



Fig. 1. Conventional driver stages for getting phase reversal using transistors.

circuits, without all of their disadvantages.

In Fig. 2 the driver transistor furnishes its full amplified signal current into the first transistor of the push-pull pair (TR-2). The output of TR-2 is mainly dissipated in the load (loud-speaker as shown). A small part (1/10 approximately) of this stage output current is routed into the input of the second transistor (TR-3). This signal has the right phase to enable proper operation. The frequency response of the circuit is determined by proper combination of R_1 , C , and R_2 . The bigger the C the broader the band-pass.

In a sense, the TR-3 stage is connected in a circuit that resembles a Hartley oscillator. In the

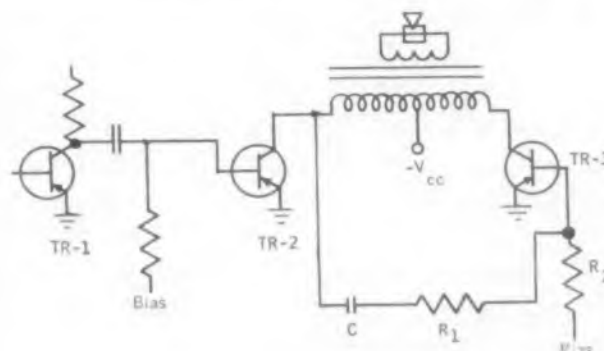


Fig. 2. Suggested circuit showing simplified driver and push-pull output stage.



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REPORT BRIEFS

Electronic Reliability in Military Applications

This report constitutes the second general summarization of the findings of Aeronautical Radio, Inc. (ARINC) in its investigation of electronic reliability in military applications. The work has been performed over a period of six years under successive tri-service contracts. A major purpose of this report is to explain to the extent now possible, failure mechanisms producing unreliability in electron tubes and electronic equipments. The discussion of these mechanisms is based upon data which has been collected through field observation and laboratory studies, and analyzed in relation to both established physical laws and recently advanced hypotheses. Liberal use is made of the published work of other organizations cooperating in the reliability improvement effort. Utilizing these several sources of information, the report draws general inferences concerning the causes of unreliability, and suggests design methods, operating practices, and maintenance procedures that will contribute to higher reliability. *Electronic Reliability in Military Applications. General Report No. 2, Order publication 102 from Aeronautical Radio, Inc., Reliability Research Dept., 1700 K Street, N. W., Washington 6, D. C.*

Jamming "Type A" Presentations

This investigation was concerned only with jamming of the "type A" presentation and only with the effectiveness of such jamming in the absence of the overloading of the receiver. The efficiency of any particular type of jamming signal may be conveniently expressed in terms of the J/S ratio, the ratio of the jamming power to the signal power such that the pip is detectable just 50 per cent of the time. The J/S ratio was determined for each given set of parameters by taking the mean of 5 observations by each of two observers. Sine wave AN jamming was found to be ineffective under these conditions. Noise AM jamming is effective. DINA jamming is effective. The effectiveness of both noise and DINA jamming varies with changes in characteristics of the radar system. *Jamming of the "Type A" Presentation with Sine Wave AM, Noise AM, and with DINA, by Donald W. Taylor and D. A. Peterson, Harvard University, Radio Research Laboratory, Cambridge, Mass., Sept. 1943, 45 pp. microfilm \$3.30, photocopy \$7.80. Order PB 124627 from Library of Congress, Washington 25, D. C.*

ELECTRONIC DESIGN • January 22, 1958

Equal-Ripple Bandpass Amplifiers

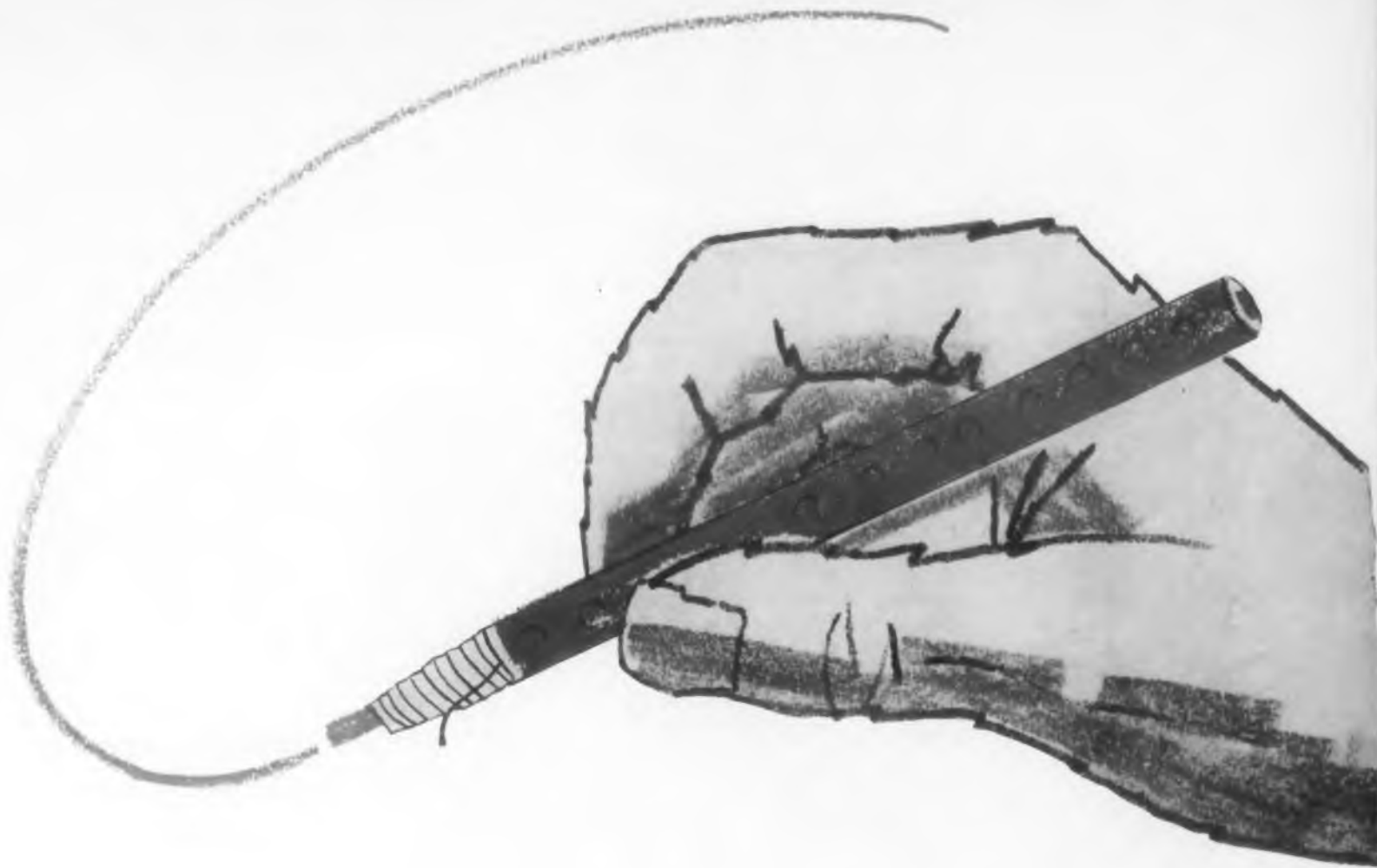
This report pertains specifically to the design of electrical communication bandpass amplifiers. The generalized formulation of the problem on the frequency plane permits, however, application to any linear system. Design charts are given for typical interstage coupling circuit and bandwidth situations. The method of solution via conformal transformation is fully explained. Appendices A-F contain the mathematical details. *Equal-ripple Bandpass Amplifiers*, by Deforest L. Trautman and John A. Aseltine, California University, Dept. of Engineering, Los Angeles, Calif., Aug. 1951, 74 pp, microfilm \$4.50, Enlarged Print \$13.80. Order PB 128371 from Library of Congress, Washington 25, D. C.

Microwave Transhorizon Communication

Microwave signals were transmitted over paths ranging from 60 to 120 statute miles by means of radio scattering. The transmitters and receivers used were adapted from MPN-1 or CPN-4 equipment on S- and X-bands. One-half microsecond pulses were transmitted at a repetition rate of 2040 cycles using transmitter powers of 50 and 10 watts average respectively on S- and X-bands. The receivers amplified and recorded the fundamental repetition rate frequency in a narrow band amplifier to increase sensitivity. Two of the paths and the equipment are described in detail in Final Report Part I. *Microwave Transhorizon Communication*, Cornell University, School of Electrical Engineering, Ithaca, N. Y., Sept. 1955, 47 pp, microfilm \$3.30, photocopy \$7.80. Order PB 125027 from Library of Congress, Washington 25, D. C.

Investigation of ANA Bonding Specification

Covers the effects of all the parameters which are present in a bond. Test setups were established to simulate actual installations where the vulnerability of the receivers was affected by the geometric pattern of the objects being bonded together. Further recommendations are submitted to incorporate an electrical-performance test in bonding specifications, with the test setup given in detail and the specified minimum r-f impedance requirements determined by actual simulated aircraft conditions. Additional data is presented regarding the necessity of grounding metallic objects which are near unshielded transmitter-antenna leads. *Investigation of ANA Specification No. AN-B-10a "Bonding; Electrical (for Aircraft)" and Proposed Revision Thereto*. No. AN-B-10b, U. S. Naval Air Development Center, Johnsville, Pa., July 1950, 60 pp, microfilm \$3.60, photocopy \$9.30. Order PB 128494 from Library of Congress, Washington 25, D. C.



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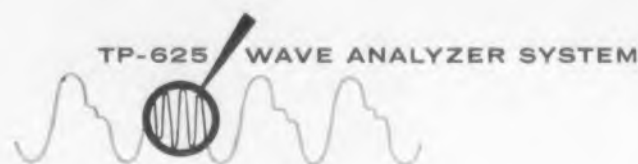
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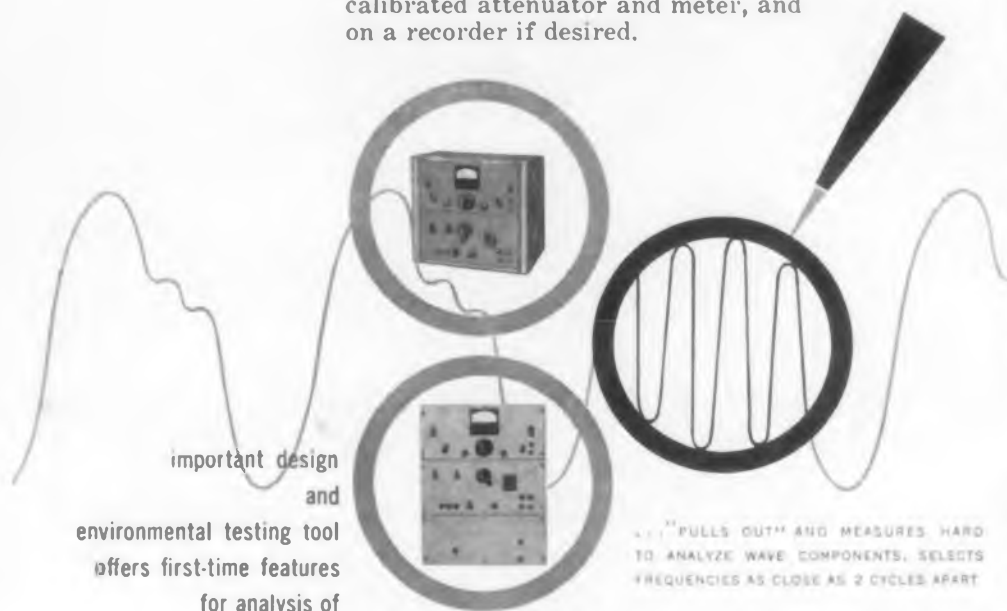
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REPORT BRIEFS

Ferroelectric Materials Survey

This report is based on a survey of literature on ferroelectric materials with emphasis on those which might possibly be used at high temperatures. Data on high temperature properties were most carefully collected because of the increasing demand for high-temperature electronic components. Wherever crystallization conditions were known, they also were briefly described. *Ferroelectric Materials Survey with Particular Interest in Their Possible Use at High Temperatures*, Charles F. Pulvari, Catholic University of America, Electrical Engineering Dept., Washington, D. C., Feb. 1957, 74 pp., \$2.00. Order PB 121949 from OTS, U. S. Dept. of Commerce, Washington, D. C.

Bounds to Entropy of Television Signals

This research is an application of statistical communication theory to television transmission. An upper bound to the entropy per symbol is obtained by two independent methods. It is shown that this quantity not only provides an insight into the nature of pictures but furnishes a theoretical limit to the efficiency of picture-coding methods. Based on a thesis, Massachusetts Institute of Technology. *Bounds to the Entropy of Television Signals*, by Jack Capon, Massachusetts Institute of Technology, Research Laboratory of Electronics, Cambridge, Mass., May 1955, 54 pp, microfilm \$3.60, photocopy \$9.30. Order PB 124210 from Library of Congress, Washington 25, D. C.

Miniaturized Pulse Connectors

The development of a miniaturized, silicone rubber insulated, pulse connector is described. Designs for three types of connectors are given. The development of a semiconducting silicone rubber to be used in high-temperature miniaturized pulse connectors is discussed. Tests to determine the performance characteristics of the connector assemblies and their components are reviewed in detail. Except for the effects of immersion in gasoline, connectors were developed which met or exceeded all electrical and mechanical properties of the associated cable. *Miniaturized Pulse Connectors*, by J. H. Gesell, Federal Telecommunication Laboratories, Inc., Nutley, N. J., Dec. 1956, 49 pp, \$1.25. Order PB 131048 from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.

attention idea men



Because an electronic design engineer must have hundreds of ideas to draw upon for each individual design decision, the editorial staff of *ELECTRONIC DESIGN* is continually trying to add to this storehouse of ideas. We are, therefore always interested in material based on your own experience which would be of immediate practical use to electronic design, development and research engineers. It is not difficult to write an article for *ELECTRONIC DESIGN* if you know what to write about and how we like to have our stories written. To simplify the preparation of an article, we have drawn up a brief guide for authors. Send for your copy today.

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**Static High Frequency Generator and
Magnetic Amplifier**

Early developments in the field of static fre-
quency multipliers are described and early
theories extended to include high permeability,
square loop core material now commercially
available. Shunt and series-fed shock circuits are
analyzed, with particular attention given to the
relationships between circuit power efficiency and
firing angle, and input supply amplitude and
circuit parameters. Development of a series-type
shock circuit is described and data are given for
an engineering model. A second part of the re-
port is concerned with a study of switching cir-
cuits using a combination of transistors and mag-
netic cores. Among these are parallel type in-
verters, shunt reactance switches, combination
parallel inversion and shunt reactance switching
circuits, and combined inversion-conversion cir-
cuits. Development of magnetic amplifiers for
use with the Moog hydraulic valve and each type
of multiplier also is discussed. *Static High Fre-
quency Generator and Magnetic Amplifier, M.
Frank and J. R. Walker, Wayne Engineering In-
stitute, Feb. 1957, 202 pp., \$5.50. Order PB
131240 from OTS, U. S. Dept. of Commerce,
Washington, D. C.*

Attenuation in Interdigital Circuitry

This work was concerned with experimental
observations of unilateral attenuation in an in-
terdigital type circuit as used in traveling-wave
magnetrons. Attenuation was obtained by means
of ferrite samples of various geometries placed
inside the circuit. The samples were saturated
magnetically by the magnetic field used in
crossed-field tubes for beam focusing. Working
from a condensed theory of the interdigital cir-
cuit, positions of circularly polarized magnetic
fields were found. The ferrite was placed at those
positions for most unilateral effect. Major atten-
tion was given to attenuation due to ferrite
spheres. They were shown to be impractical for
unilateral attenuation unless very high fre-
quencies or special easily-saturated ferrites are
used. A ferramic rod with an estimated front-to-
back attenuation ratio of 5 produced attenuation
of 24 db, the maximum obtained. The report con-
cludes that practical application of the results to
crossed-field tubes would depend on the disturb-
ance of the focusing field by the presence of the
ferrite. *Unilateral Attenuation in the Interdigital
Circuit, L. K. S. Haas, University of California,
May 1957, 70 pp. \$1.75. Order PB 131257 from
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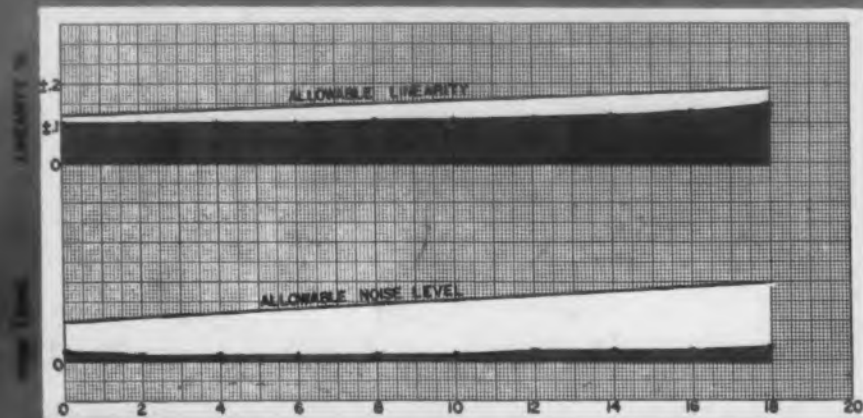
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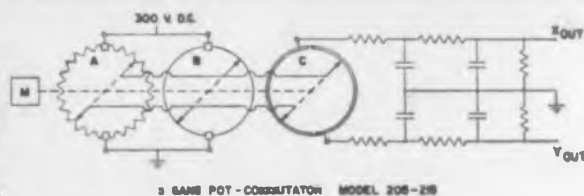
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The continuity of the resistance element does not depend upon a single hair-line wire. Failure of the potentiometer therefore does not occur suddenly, but any deterioration of performance is gradual. This fail-safe characteristic enhances reliability, and insures against catastrophic system failure at critical times.



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PATENTS

Direct Current Amplifier

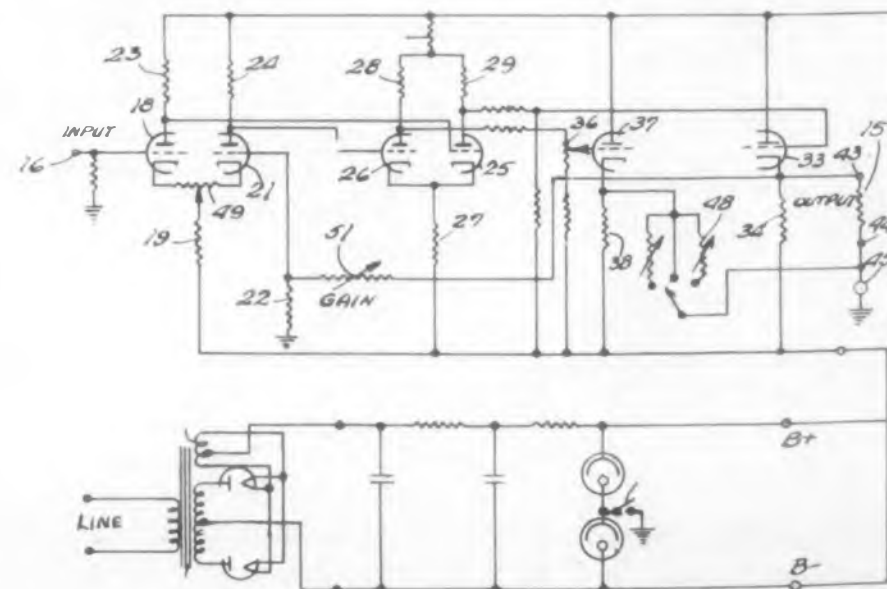
Patent No. 2,796,468. D. C. McDonald.
(Assigned to Cook Electric Company)

In direct current amplifiers having several stages, the output of one stage is directly connected to the input of the next stage. As a consequence any change in the voltage of the power supply such as arising from varying load will be amplified. Even though variations may be small at the first stage, the amplification of these potential variations will appear in the output of an order of magnitude approximating that of the signal. An automatically compensating power supply will correct for variations, however, such supply sources become relatively complex and results in a more expensive source of power. The circuit illustrated is unaffected by such voltage variations and in addition provides a circuit having improved stability. As a consequence the power supply may be a simplified and less expensive unit. Direct current amplifiers find extensive use in amplifying the record on magnetic tape. Such recordings may be of various data which are subsequently taken off of the tape with a reproducing head, amplified and then recorded on visual records. The amplifier circuit of the patent is intended to serve in this sort of apparatus.

The input signal is applied at the terminal 16 and to the grid of a tube 18 which, with a second tube 21 or the other section of a dual tube, forms the first stage of the amplifier. This first stage uses a common cathode resistor 19

for both tubes and the control grid of the tube 21 is grounded through a resistor 22. Resistors 23 and 24 of equal value are used in the plate circuit of each of the pair of tubes. If a positive potential is applied to the grid of the tube 18, increased current flows through the tube and cathode resistor 19, the effect of which is to increase the bias of the associated tube 21 and reduce current flow through this tube. As a result, the current flow from the power supply to the first stage is constant irrespective of the input signal. The second stage of the amplifier includes a pair of tubes 25 and 26, or a dual tube, with the amplified signal voltage at the plate of each of the first pair being applied to the control grid of its respective tube of the second stage of the amplifier. The plate resistors 28 and 29 for each tube are equal. This second stage also uses a single cathode resistor 27 for both tubes, so that in this stage also the power drawn from the power supply is balanced or constant irrespective of the signal.

The plate potential of each of the tubes forming the second stage is applied to the control grid of its respective power amplifier tube 33 and 37. The cathode of the tube 33 is connected with an output terminal 43 and the cathode of the tube 37 is connected with the output terminal 44, the resistor 15 between the terminals representing the load. A feed back circuit including resistor 51 may be provided from the cathode of tube 33 to the grid of tube 21. Since each stage of the balanced ampli-



draws constant current, there will be no variations in the potential of the supply due to varying loads. Similarly variations due to tube drift and variations in temperature are also balanced which improves the stability of the circuit.

But three adjustments are needed to set the amplifier into proper operating condition. The first and second adjustment is made without a signal applied to the input. The first adjustment is with respect to the rheostat 49 between the cathodes of the tubes of the first stage. This rheostat is adjusted until there is a zero potential at the output terminal 43. The rheostat 36 is then adjusted to set the grid bias on the tube 37 so that the cathode of this tube has ground potential. Between the cathode of tube 37 and the output terminal 44 is a variable resistance or resistive network which is adjusted to match the resistance of the load 15. In order to adjust or select the proper matching resistive value, an output signal is applied and resistor 48 is adjusted so that zero current appears on the meter at the jack 45.

The patent also discloses two additional circuits which operate fundamen-

tally in the manner described. The amplifier has a flat frequency response up to about 30,000 c.p.s.

Bipolar Output Carrier Magnetic Amplifier

Patent No. 2,808,520. John Presper Eckert, Jr. (Assigned to Sperry Rand Corporation)

The magnetic amplifier uses a single output winding on the magnetic core. A carrier frequency source is coupled to one end of the output winding. An input winding on the core controls the flow of energy from the carrier source through the output winding. A circuit consisting of two independent branches is connected to the other end of the output winding so that energy from the source is selectively coupled simultaneously via the output winding to both of the branches. One of the branches has circuit elements for shifting the potential level of signals therein relative to signals in the other branch to effect signals of different relative polarities in the two output branches.

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PATENTS

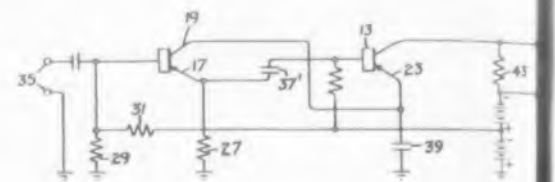
Transistor Amplifiers

Patent No. 2,794,076. Richard F. Shea.
(Assigned to General Electric Company)

Multiple stage power amplifiers using transistors have been found unstable because of a shifting of the operating point particularly under varying temperature conditions. Variation of the collector current when the emitter current is zero has been a prime cause of this instability. Different transistors exhibit varying degrees of this same instability so that the replacement of a transistor for one in a circuit has not been easily achieved. Correction of the instability in transistor amplifiers has been achieved, however, the corrections made result in a substantial loss in the efficiency of the amplifier. The circuit of the figure achieves substantial stabilization of the operating point with but minor loss in efficiency. The amplifier also achieves stabilization with the first stage operating at a relatively low voltage level with the subsequent stages operating at higher voltage levels to secure a high

power output. The operation of the first stage at a low voltage level is advantageous with respect to the noise factor. In the circuit, the first stage provides a constant current source for the second stage of the amplifier with both stages contributing to the power gain.

The circuit is clear from the figure in which the transistors may be of the junction type and the input signal is applied to the input terminals 35. It will



be noted that the collector 19 of the first stage is connected with the emitter 23 of the second stage and both of these electrodes are grounded through the by-pass condenser 39. The stabilizing elements include the resistor 27 for the emitter 17 and the series resistors 29 and

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...serving as a voltage divider and connected in the manner shown. The voltage developed across the resistor 27 in the first stage is applied to the base electrode of the second stage through a coupling capacitor 37'. The amplified output potential appears across the resistor 43. The patent gives a complete mathematical analysis of the circuit.

A circuit, having components of the values given in the disclosure, produced a power output greater than 200 milliwatts feeding into a 5,000 ohm a.c. load at an efficiency of about 35% for the entire amplifier. The gain was 35 db with each stage contributing approximately equal gains. At the 50 cycle and 10,000 cycle frequencies, response was noted as being down approximately 6 db.

Several other two stage circuits are illustrated and described which differ somewhat from the circuit of the figure herein. The essential features for achieving stabilization are as in the circuit above. A push-pull transistor amplifier circuit is shown which embodies the principles of the illustrated circuit.

Servomotor Control System

Patent No. 2,807,764. Homer A. Engle. (Assigned to Viking Industries, Inc.)

The control system utilizes a pair of gas tubes the anodes of which are connected with an ac motor to be driven in a direction determined by the conduction through the tubes. An operating potential is applied between the motor and the cathodes of the gas tubes. A saturable reactor is provided for each tube with its winding between the cathode and anode of its respective gas tube. A control signal is applied to one of the gas tubes to bias it to conduction which determines the direction of rotation of the motor. The generator of the control signal may be a bridge which is coupled to the motor armature in such manner as to unbalance the bridge. This provides a signal having a polarity determined by the direction of the unbalance. The control signal is applied to the tubes through a transformer having a primary winding across which the bridge is connected. The secondary winding is connected between the control grids of the gas tubes.

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TW/TX-24-1936 SGS fused Teflon tape or extruded Teflon insulated stranded silver-plated copper conductor, braided silver-plated copper shield, with braided fiber glass Silicone impregnated covering over-all.

TW/TX-24-1936 SGT fused Teflon tape or extruded Teflon insulated stranded silver-plated copper conductor, braided silver-plated copper shield, with Teflon saturated fiber glass braid over-all.



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TW/TX-30-738 SNN fused Teflon tape or extruded Teflon insulated stranded silver-plated copper conductor, braided tin-coated copper shield with Nylon fiber braid Nylon lacquered jacket over-all.



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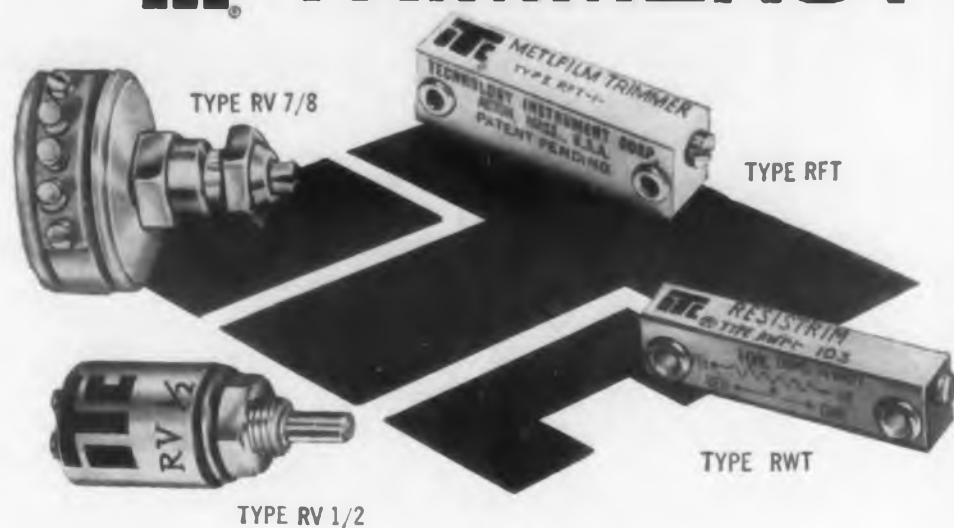
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Books

Introduction to Transistor Circuits

E. H. Cooke-Yarborough, Interscience Publishers, Inc., 250 Fifth Ave., New York, N.Y. 154 pgs, \$2.75.

This book is based on a series of lectures given at University College, London by the author. More than half of the work is concerned with the non-linear properties of transistors. The author recognizes that the development of a circuit is often easier and quicker if done by experimentation, rather than by detailed calculations. He has no objection to this procedure, if the experimenter has at least a qualitative understanding of the involvements. A subsequent analysis of the circuit should be made.

In order to give the engineer a mental picture of the behavior of these circuits,

representations of the flow of electrons and holes in transistors, and the flow of current in the associated circuitry are presented rather than the more abstracts of concepts of circuit theory.

Subjects covered include transistor action, low frequency amplification, pulse circuits and transistor applications.

Electronic Designers' Handbook

Robert W. Landee, McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y. 1200 pages, \$16.50.

This handbook presents fundamentals and data to aid in the design of all types of electronic equipment. It is intended to provide adequate technical discussions, and basic design procedures for the solution of many problems. The text is

Sensitive RF Voltmeter to 500 Megacycles



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- Low level comparison measurements of signal sources and attenuators

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made as clear as possible by including design examples which illustrate the application of the material to specific problems. The degree to which frequently used circuits and practices have been integrated into the material should contribute to the value of the handbook. Theoretical and technical discussions and explanations are presented, and graphical and tabular data needed in everyday design considerations are conveniently arranged in a logical manner.

Ionization and Breakdown in Gases

F. Llewellyn-Jones, John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N.Y. 176 pages, \$3.50.

The aim of this book is to give a brief account of the fundamental physics of the electrical breakdown of gases. It is

primarily intended for the postgraduate research worker. An attempt is made to assess how much of the subject is amenable to systematic treatment. It also indicates the areas of study which require more experimental data.

The book gives an understanding of the fundamental principles of the motions of electrons and ions in gases. It also provides a physical picture of the processes which bring about the phenomenon of the electric spark.

The macroscopic phenomenon of drift, current growth, emission of light, and chemical changes may be quantitatively related to the atomic processes by the dynamic theory of gases. This theory may be applied to charged and uncharged particles alike. A knowledge of elementary classical statistical mechanics is assumed on the part of the reader.



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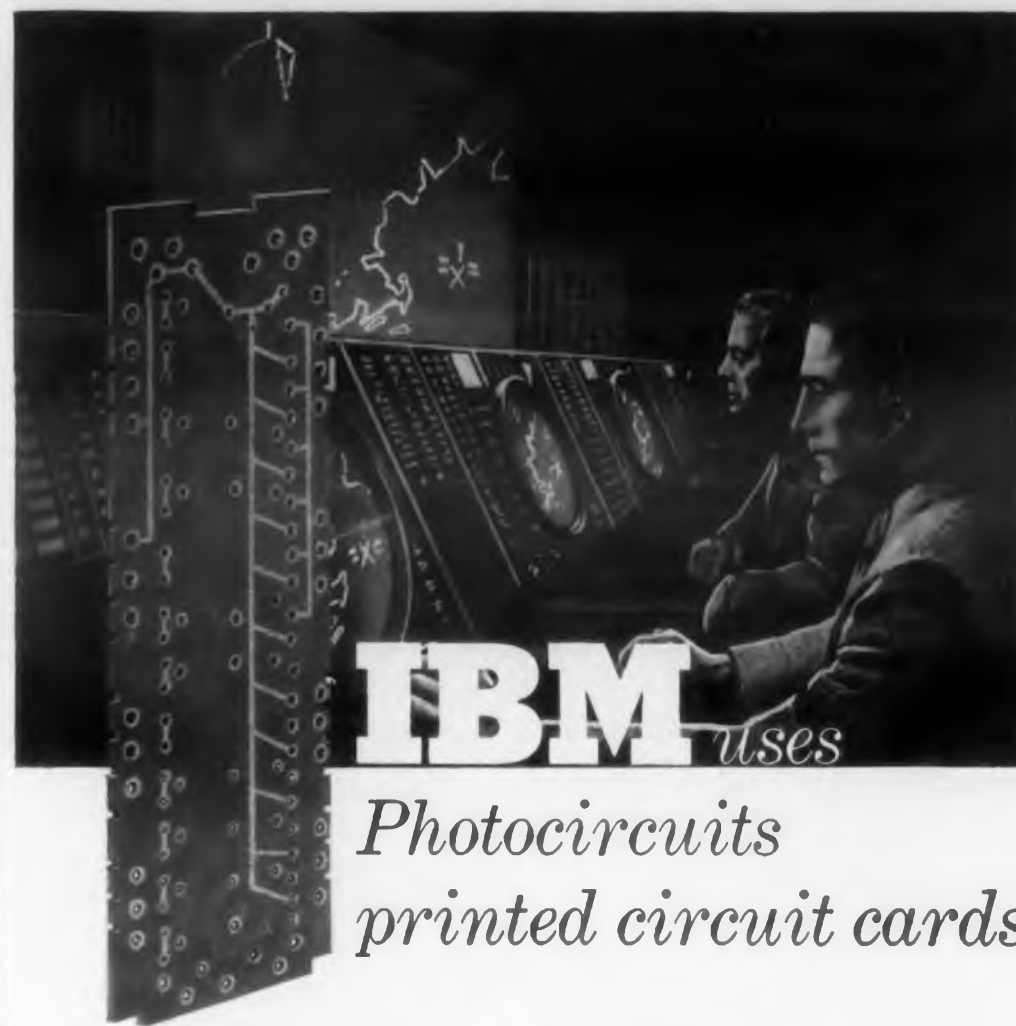
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What the Russians Are Writing and Saying

J. George Adashko



цепями, что было достигнуто путём (медная проволока, уменьшение взаим
задачей являлось тщательного конт
ности исходных полуфабрикатов



THE DAY OF RADIO

The A. S. Popov Scientific-Technical Society for Radio Engineering and Electric Communication (Soviet counterpart of the IRE) held its regular All-Union Scientific Session, devoted to the "Day of Radio," in Moscow, May 20-25, 1957. Some 2000 scientific and engineering workers, representing research institutes, higher institutions of learning, plants, and enterprises from Russia's largest cities took part in the sessions.

Also participating were foreign specialists—representatives from Bulgaria, Hungary, East Germany, China, Poland, and Czechoslovakia, as well as representatives of the IRE.

In addition to introductory and general speeches, special addresses to the conference were made on "Ways of Technical Development of Electric Communication in the U.S.S.R.," "Miniaturized Parts for Mass-Production," "Semiconductors Produced by the Russian Industry, Prospects of their Improvement, and Proposed Expansion in Assortment," "Electric Telescopy," and "Application of Radio Methods for the Study of Pathological Phenomena in Organisms."

Considerable emphasis was placed on the 10-Bev synchrophasotron produced in the U.S.S.R. by the Academy of Sciences, the largest in the world so far. Considerable discussion was devoted to its electronic features.

The session consisted of 12 sections: information theory, antenna devices, semiconductors, receiving and transmitting devices, wired communication, television, radio technology, electronics (electron physics), radio measurements, radio broadcasting, electroacoustics and sound recording, general radio engineering and radio wave propagation. More than 175 papers were delivered and discussed. We are listing the high points of some of the sessions to acquaint our readers with topics getting foremost attention in the Soviet Union.

SESSION ON INFORMATION THEORY

One of the newer developments appeared in a paper by L. A. Khal'fin representing an attempt at building a general theory for geophysical methods of investigation, based on information theory. For this purpose, the fundamental problems of geophysical methods of research were posed as problems in information theory.

In a second paper by L. A. Khal'fin, he considered a theory of signals, based on the definition of a signal as a finite function of time. The problems considered are of primary significance for the formulation of the initial premises of theories of information.

A paper by K. A. Meshkovski dealt with a comparison of the noise rejection and efficiencies of certain communication systems in which the signal is received as a whole, with fluctuating noise in the communication channel.

A paper by L. M. Fink considered the possible gain resulting from the use of a multi-position system of a frequency-sharing radio telegraph, using realizable apparatus. Multi-position systems of telegraphy retain the same speed of information transmission, but make it possible to prolong the duration of the message. On the basis of a preliminary calculation, it was shown that the increase in the number of positions from two to eight hardly expands the bandwidth.

In his paper "Properties of Oscillations with Limited Spectrum" D. V. Ageev attempted to

prove that the limitation of the frequency spectrum of oscillations does not limit the waveform of oscillation during a finite time interval.

L. N. Teplov devoted his paper to the ratio of signal to fluctuating noise in linear integration. An estimate was made of the effectiveness of integration of a signal and fluctuating noise in high-frequency and low frequency radio-receiving channels. Emphasis was placed on the promising features of the method of integral reception in radio-telegraph communication apparatus, particularly if the received oscillations are integrated before they reach the detector.

A paper by B. A. Varshaver demonstrated the use of Shannon's results combined with Kotel'nikov's "maximum-possible noise-rejection" theory to determine the carrying capacity in the case of binary transmission at various manipulation methods.

A paper by M. S. Pinsker considered the problem of estimating the carrying capacity of a channel and the speed of information.

A paper by B. S. Fleishman and G. B. Linkovski was devoted to the estimate of the maximum possible value of entropy of unknown distribution, represented by several moments.

In a paper by B. A. Varshaver, dealing with the theory of transmission of discrete signals subject to fluctuating noise, it was indicated that under certain conditions it is possible to obtain approximately the same results by changing over to a more complicated code which increases the duration of the transmission of an individual symbol.

A paper "Potential Noise Rejection of Certain New Methods of Transmission of Telegraph Signals" by N. T. Petrovich considered how transmitted telegraph symbols can be received only by comparison of the given message with other messages, transmitted during other time intervals or on other carrier frequencies.

A paper by V. M. Shtein called "Quantization Noise of a Group Signal in Frequency Sharing of Channels" showed that in pulse-code modulation of a large number of telephone channels it is necessary to have from 128 to 256 quantization steps. The effect of the loading of the group channel on the quantization noise was considered.

A paper by G. K. Kerapin was devoted to a problem of great importance in communication engineering, that of restoring portions of signals that are damaged by noise and lost in the transmitter.

SESSION ON SEMICONDUCTORS

I. Adirovich and A. Iu. Gordonov devoted their paper to a theoretical investigation of the electronic processes in transistors and showed that the emitter-collector transfer coefficient is

INDUSTRO TRANSISTOR



PNP

Germanium Alloy-Junction Transistor Specifications

INDUSTRO TRANSISTOR TYPE	MAX. RATINGS @ 25° C			TYPICAL CHARACTERISTICS @ 25° C										Application	
	VCE Max. (Volts)	Dissipation Coefficient		** Beta @ 270 Cycles	Rise Time (μsec)		Storage Time (μsec)	Fall Time (μsec)	F _{cb} (mc)	C _c (μf)	D.C. Current Gain		I _{CBO} (μa)		
		In Air °C/mw	With Ht. Sink °C/mw		Avg.	Max.					Conditions	Gain			
COMPUTER TYPES															
2N315	— 20	0.4	0.18						5	12	I _c =100ma V _{CE} =.15V	20	1	Switching	
2N316	— 20	0.4	0.18						12	12	I _c =200ma V _{CE} =.2V	30	1	High Speed Switching	
2N317	— 20	0.4	0.18						20	12	I _c =400ma V _{CE} =.2V	30	1	High Speed Switching	
2N398	—105	0.36	0.15							35			6	High Voltage Switching	
2N404	— 25	0.4	0.18						4	12	I _B (ma) V _{CE} (volts)		1	Medium Speed Switching	
2N425	— 20	0.4	0.18		0.5	1.0	0.25	0.3	4	12	1	.25	30	1	Medium Speed Switching
											10	.35	18		
2N426	— 18	0.4	0.18		0.5	0.55	0.25	0.3	6	12	1	.25	40	1	Medium Speed Switching
											10	.35	24		
2N427	— 15	0.4	0.18		0.4	0.44	0.25	0.3	11	12	1	.25	55	1	High Speed Switching
											10	.35	30		
2N428	— 12	0.4	0.18		0.1	0.33	0.25	0.3	17	12	1	.25	80	1	High Speed Switching
											10	.35	40		
TR-10	— 50	0.36	0.15	22									25 @ 50 V	1	Slow Speed Switching
TR-19	— 25	0.36	0.15	80					1.5	35			6	1	Slow Speed Switching
TR-87	— 25	0.36	0.15	38					0.5	35			6	1	Slow Speed Switching
TR-88	— 25	0.36	0.15	80					1.0	35			6	1	Slow Speed Switching
TR-269	— 25	0.4	0.18	40					4	20 max.			1	1	Medium Speed Switching
TR-760	— 15	0.4	0.18	40					5	14			1	1	Medium Speed Switching
TR-761	— 15	0.4	0.18	75					10	14			1	1	High Speed Switching
TR-762	— 6	0.4	0.18	100					20	14			1	1	High Speed Switching
TR-763	— 6	0.4	0.18	120					30	14			1	1	High Speed Switching
TR-764	— 20	0.4	0.18	200					25	14			1	1	High Speed Switching

The Industro Transistor Corporation is now delivering PNP Germanium Alloy-Junction transistors for computer, entertainment and industrial applications, meeting transistor requirements for prototype and production orders. More than 200 transistor types can be supplied in addition to those listed on these pages.

(Note: NPN Germanium Alloy-Junction transistors will be available in late 1958.)

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RUSSIAN TRANSLATIONS

the fundamental parameter of a transistor and determines its ability to amplify signals in any circuit.

A paper by Iu. K. Barsukov, "Transient Blocking Process in Junction Germanium Diodes Type DG-Ts" investigated the dependence of the activity of the first stage of the transient process on the value of the forward current before the start of the process and the inverse current during the first stage of the process.

Iu. A. Volkov and I. P. Stepanenko considered several properties of diode semiconductor amplifiers. They indicated that diode amplifiers can find their widest use in digital computers and in amplifiers of periodic pulses in general. The diode amplifier can serve as a basis for a wide class of trigger circuits.

A paper by T. M. Agakhanian and L. N. Patrikeev, "Determination of The Limiting Frequency of the Current Transfer Coefficient of a Junction Transistor" showed that the limiting frequency of the transistor can be determined from the frequency characteristics of the current gain in a grounded-emitter circuit by using suitable recalculation.

S. M. Gerasimov devoted his paper to an analysis of the calculation of the energy and the electric parameters of a self-excited uhf generator with allowance for the correlation of the phase in the feedback loop. The calculation results were compared with experimental ones.

A. I. Borisov discussed in his paper the parameters that characterize the fundamental nonlinear properties of junction transistors and established the connection between these parameters and the nonlinear distortion coefficients of junction-transistor amplifiers for all three transistor connection methods.

A paper by B. V. Kol'tsov was devoted to a telemechanical dispatcher-control system for coal mines using transistors. The system is based on the principle of pulse-phase channel sharing. The synchronism and phasing of the transmitting and receiving devices are automatically insured when they are fed from the same power system.

A. A. Rizkin showed in his lecture that transistor circuits are subject to internal feedback, which lowers the stability and the limiting frequency of any transistor stage. The lecture noted that the regeneration method is applicable to circuits containing neutralization.

Sh. I. Barilko considered the possibility of employing a grounded-collector transistor as a regulating element in a stabilizer; this circuit, as is known, is distinguished for low output impedance, which depends on the impedance of the

signal source, and for high stability.

B. N. Kononov proposed a method for eliminating the saturated mode of junction transistors in pulse circuits using nonlinear feedback, which at a certain collector potential level reduces sharply the gain of the stage and consequently, the dependence of the transistor on the saturating current.

A paper by G. S. Tsykin considered the properties of dc inversion circuits suitable for the supply of vacuum tube apparatus. On the basis of an analysis of the existing circuits, he proposed a new converter circuit, gave its analysis, and proposed methods for its engineering calculations.

A paper by A. G. Muradian and I. K. Zamiatina derived equations for the instability of parameters of amplifiers without feedback. Simple ex-

amples were used to illustrate the possible instability of practical circuits. The instability of individual circuits was compared.

In his lecture "Low-Power Nonlinear Semiconductor Resistances," V. V. Pasyukov noted that the technology of the manufacture of nonlinear resistors for different specified parameters is quite simple, does not require complicated and expensive equipment, and makes it possible to automatize the manufacturing processes in mass production of resistors. Characteristics of resistor specimens developed for telephone engineering are not inferior to the parameters of American specimens obtained from actual apparatus.

L. K. Chirkin considered in his paper the various fields of application of nonlinear semiconductor resistances, for example, in telephony,

AUTOMATION AND TELEMCHANICS

(Contents of *Avtomatika i Telemekhanika* No. 6, 1957)

SERVOMECHANISMS

Optimum Transients in Saturating Systems, E. A. Rozenman.

Like the article by A. M. Hopkin (*Trans. AIEE*, vol. 70, No. 1, 1951), this article is a phase-plane approach to the compensation of saturating servomechanisms and deals with the form of the shortest transient in a system in which the power is limited by heating. It is shown that the optimum current characteristic of the drive motor is nearly linear if the time constant of the heating is high.

Electric Angle Errors and Residual Voltages in Inductive Computing Elements, Iu. M. Pul'er (15 pp, 9 figs).

Equations are derived for the angular errors, for the electrical (amplitude and phase) errors, and for the residual voltages of sine-cosine resolvers and similar induction elements as functions of air-gap irregularities and of the losses in the steel, taking into account the technology used in the manufacture of such elements. An estimate is made of the residual voltage in induction tachometer generators, resulting from variations in rotor thickness. The mathematical methods employed are suitable for a more general analysis of the influence of structural and technological errors in the mechanical system and of the influence of the characteristics of the magnetic materials on the electrical errors.

CIRCUIT THEORY

Determination of Coefficients of Transfer Functions of Linearized Links and Automatic-Regulation Systems, M. P. Simoiu, (15 pp, 4 figs, 5 tables).

A method is proposed wherein the coefficients

of the transfer functions are determined from experimental transient curves of linearized elements and systems. The author shows by means of an illustrative example, how this method can be used to approximate complicated transfer functions by means of simple ones.

TELEMETRY

Noise Rejection of Frequency-Modulation Systems, V. A. Kashirin, (7 pp, 2 figs).

Comparison of the maximum possible noise rejection of frequency-sharing and time-sharing multi-channel telemetering systems in which the fluctuating noise level is low.

MAGNETIC AMPLIFIERS

Concerning the Problem of Matching a "Second Harmonic" Magnetic Amplifier to the Load, V. N. Mikhailovski, Iu. I. Spektor (9 pp, 6 figs).

The effect of the nature of the load on the stability of the magnetic amplifier is evaluated and the regions of unstable operation are determined. Relationships are derived by which the magnetic amplifier can be matched to an active load, so as to obtain maximum power sensitivity for selected excitation conditions. The dependence of the sensitivity on the power of such a magnetic amplifier feeding an active load, on the amplitude of the exciting field is determined for optimum matching.

Magnetic Amplifier Circuits with Proportional and Derivative Feedback, L. A. Grigorian (14 pp, 14 figs, 1 table).

A detailed design procedure is outlined for the determination of the parameters of magnetic amplifiers with rigid and flexible feedback. Equations are derived for the circuit parameters for a general type of amplifier, as well as for one containing an ideal magnetic circuit.

automation, and radio engineering. In particular, the use of nonlinear resistances in trigger circuits makes it possible to obtain a large slope of the pulse front and to eliminate negative overshoot.

SESSION ON RADIO WAVE PROPAGATION

In a paper by A. V. Prosin "On the Maximum Permissible Frequency Band that can be Transmitted in Beyond the Horizon Tropospheric UHF Propagation," he introduced the concept of the transient characteristic of the troposphere and defined this characteristic for the transmission of a step sinusoidal voltage for directional and non-directional antennas.

A paper by V. S. Shapiro considered the temporal and spatial variations of true and effective heights of the ionosphere and proposed a method for their calculation.

A paper by Iu. K. Kalinin and E. L. Feinberg considered the theory of propagation of a ground wave along a flat surface, and generalized the theory directly to the case of a spherical earth, thus obtaining formulas in closed form for a piecewise-homogeneous terrain. Analysis of these equations shows that the general idea concerning the propagation of a ground wave over spherical surface differs qualitatively from the picture of the propagation over a flat earth.

A paper by A. A. Grigor'eva gave the results of the measurements of the coefficient of absorption of short radio waves in the ionosphere in a vertical propagation. The dependence of the variation of the absorption coefficient during the days in various seasons of the year and on the state of the ionosphere were established.

A paper by K. M. Kosikov considered the difficulties occurring in the estimate of the conditions of propagation of radio waves over long-range communication lines using ionospheric data. Notice was taken of the great practical significance of the results obtained with inclined-return probing by means of pulses and sharply directed high-power radiation.

A paper by N. M. Boenkova disclosed certain novel conclusions about the general behavior of the ionosphere during the time of solar eclipses observed on June 30, 1954 and February 25, 1952 at the ionospheric stations of the Soviet Union.

V. E. Kashprovski devoted his paper to the location of the coordinates of thunderstorms at great distances. He gave results of work on the creation of a Russian system for the determination of coordinates of thunderstorms, effective over great distances and suitable for providing data for hydrometeorological service.

ELECTRONIC DESIGN will continue its report on this Russian conference in the next issue. More complete reports on individual papers of interest to electronic design engineers will be presented in subsequent issues.

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WL5877	2.5	10.8	1500	1500	40	3.2	5 1/2"	1 1/4"
WL5878	2.5	21	1500	1500	80	6.4	6 1/2"	2 3/16"

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Determination of Transistor Lead-in Resistances

IN THE early development of transistors it was discovered that the effect of the contact resistance at the base cannot be neglected even if only an "order of magnitude" agreement between theory and performance is expected. For certain applications, particularly in pulse circuitry the lead-in (contact) resistance at the other electrodes cannot be neglected although these values may be "small." The series resistances associated with the base and with the emitter in the common base connection can be determined from low frequency measurement of the "h-parameters."

The equivalent circuit of the transistor (see figure) separates the intrinsic semiconductor properties from the lead effects. It is recalled that the h parameters are defined through equations

$$v_1 = h_{11}i_1 + h_{12}v_2 \quad (1)$$

$$i_2 = h_{21}i_1 + h_{22}v_2 \quad (2)$$

Combining the intrinsic properties of transistors with the lead resistance given in the figure, it can be shown that at extremely low frequencies the h parameters are related to the desired lead resistances through the equations

$$h_{11} = R_e + r_e + R_b(1 - \alpha_0) \quad (3)$$

$$h_{12} = \mu + R_b G_o (I_e = 0) \quad (4)$$

$$h_{22} = -G_o (I_e = 0) \quad (5)$$

where $r_e = kT/eI_e$, the emitter resistance (k is the Boltzmann constant, e the charge on an electron and T the absolute temperature)

$\mu = \frac{kT}{ew} \frac{\partial w}{\partial v_{be}}$, the voltage feedback parameter (w is the thickness of the base layer)

(α_0 is the short circuit current amplification factor)

With the aid of equations 3, 4 and 5, the measurement of the low frequency h parameters permits computation of the desired parameters. This

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Cross section shows **molded insulating jacket**—the same construction as used for all A-B hot molded resistors.

Here's a new 1/4-watt, insulated composition resistor in a truly small size . . . ONLY ONE QUARTER OF AN INCH LONG . . . that provides the same superlative performance, reliability, and uniformity which have made the Allen-Bradley hot molded resistor preferred the world over.

Although exceptionally small, Allen-Bradley Type CB hot molded resistors are rated for "continuous operation" at 70°C ambient temperatures. The hot molded construction of this Type CB resistor makes impregnation unnecessary . . . it also provides the most reliable protection against extended periods of high humidity, as encountered in practical applications. Available in all RETMA resistance values from 47 ohms to 22 megohms. Tolerances: 5%, 10%, and 20%.

Where space is at a premium . . . and where failures would be disastrous . . . you owe it to yourself to investigate this new addition to the Allen-Bradley quality line. Please write today for complete specifications. Samples available for your tests.

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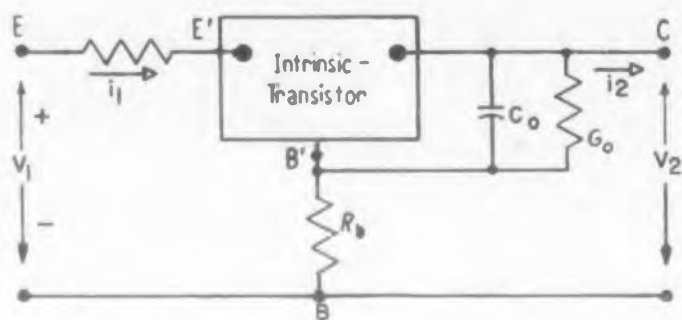
OTHER HOT MOLDED RESISTORS IN THE A-B FAMILY

Allen-Bradley fixed, molded resistors rated at 70°C ambient are available in standard RETMA values from 2.7 ohms to 22 megohms in 1/2 and 1-watt sizes . . . and from 10 ohms in the 2-watt size. In 5%, 10%, and 20% tolerances.

Allen-Bradley solid-molded resistors are packaged for either automatic or manual assembly. A-B carton packaging prevents bent or tangled leads. Pressure sensitive tape used to hold resistors in place on reels—for most economical assembly.

ALLEN-BRADLEY
HOT-MOLDED COMPOSITION RESISTORS

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Equivalent circuit of a junction transistor in the common base circuit consisting of intrinsic transistor and the following equivalent elements:

- R_e —Emitter lead-in resistance,
- R_b —Base lead-in resistance,
- C_o —Collector-barrier layer-capacitance,
- G_{io} —Collector-barrier-layer surface conductance.

method gives favorable agreement with the high-precision technique devised by L. J. Giacoletto (*R.C.A. Rev.* 15 (1954) pp 506-562) who used bridge methods. (Abstracted from an article by W. Guggenbuehl and W. Wunderlin *Archiv der Elektrischen Uebertragung*, Vol. 11, No. 9, September, 1957, pp 355-358.)

Magnetrons for Industrial Processes

ALTHOUGH the early development of the magnetron has centered around the application of the tube in radars, the application of magnetrons to industrial processes has, since the war, received considerable attention. In the field of dielectric heating magnetrons are particularly suitable as a source of microwave energy.

Characteristics of magnetrons which may be desirable in radar applications are not necessarily desirable in industrial applications. For example, in the latter applications the steady state characteristics, stability and efficiency are of interest while in radar applications the pulsed conditions determine quality. Power supplies for industrial types are comparatively small (up to 10 kv as compared to 50 kv in radars).

The original article describes three industrial type magnetrons of German manufacture. These are designed to operate at 2.4 kmc and work into 75 ohm cables. The power output ratings of the three tubes are 100, 200 and 2000 watts. Two German firms are currently manufacturing industrial type magnetrons. (Abstracted from an article by W. Schmidt *Elektronische Rundschau*, Vol. 1, No. 10, Oct. 1957, pp 306-309.)



**New G-E Indicator Lamp "lives" 10,000 hours
... resists shock and vibration
... needs no transformer**

The light output of the new General Electric Glow Lamp, NE-79 is easily sufficient to illuminate the legend in a cover glass or lenses in a diversified array of indicators. Made for use on 105-125 volt circuits, in series with a 1 watt 7500 ohm resistor, no transformer is needed. Since the bulb is only $\frac{1}{8}$ " in diameter it fits pilot assemblies which go into a $1\frac{1}{2}$ " mounting hole.

The NE-79 has inherent resistance to both shock and vibration and, since it is equipped with a double contact bayonet base, it cannot shake loose in the socket. For further information on the NE-79 glow lamp write to General Electric Company, Miniature Lamp Department ED-18, Nela Park, Cleveland 12, Ohio.

Other General Electric Glow Lamps have electrical characteristics that let them serve as relaxation oscillator, leakage indicators, switches, voltage regulators, or voltage indicators.

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German Abstracts

Nonlinear Distortion in Transistor Amplifiers

E. Brenner

IF THE characteristic curves which relate input voltage to load current in an amplifier are assumed to be only slightly curved then the input-output relationship can be approximated by the second degree polynomial

$$i = I_0 + a_1 v + a_2 v^2 \quad (1)$$

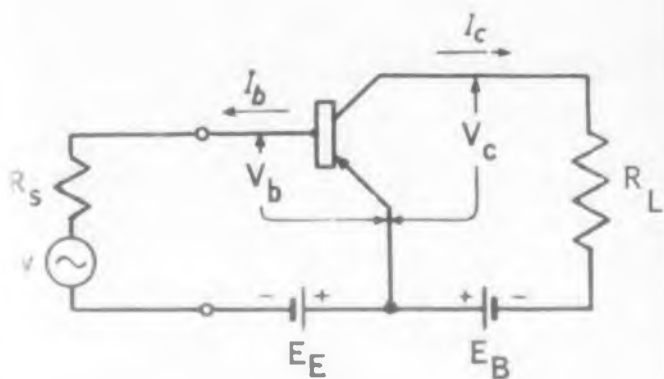
The distortion factor which is associated with this input-output relationship can be defined as

$$K = a_2 V / 2a_1 \quad (2)$$

where sinusoidal conditions are assumed so that V is the amplitude of the input voltage. While in vacuum tubes the nonlinearity of the transfer characteristics accounts for all the distortion, in the transistor amplifier there are several causes of nonlinear distortion. In the design of transistor amplifiers one has particular interest in the effect of the quiescent point and the output impedance of the source. Referring to the common emitter connection shown in the figure, with R_L set to zero, the distortion arises from the nonlinearity of the input resistance and from the short circuit current amplification. The relationship between base current and emitter to base voltage, taking into account the base-resistance is given by the exponential law

$$I_b / I_0 = e^{(V_b - I_b r_b) / V_T} \quad (3)$$

ELECTRONIC DESIGN • January 22, 1958



Common emitter amplifier. Distortion arises from the nonlinearity of the input resistance and from the short circuit current amplification.

where V_T is the voltage equivalent of temperature ($V_T = kT/e$).

The current amplification factor, b , can be assumed to decrease linearly with emitter current, so that $b = b_0 - BI_e$. The constant B in power transistors has the order of magnitude between 2 and 5 per ma; assuming emitter and collector current virtually equal one can approximate the collector current-base current relationship through

$$I_c \approx b_0 I_b - b_0 B I_b^2 / 2 \quad (4)$$

Equations (3) and (4) describe principal causes of nonlinear distortion. On the basis of these equations it can be shown that the distortion factor K is related to collector current swing by either

$$K = \frac{\Delta I_c}{4 I_c + r_b I_c^2 / b V_T} \quad \text{for } R_s \text{ zero}$$

$$K \approx B \Delta I_c / 4 b_0 \quad \text{for } R \text{ infinite (current source)}$$

It can also be shown that for finite source resistance the optimum value is given by $I_c \approx V_T b^2 / B I_e^2$.

Abstracted from an article by G. Meyer-Ewertz and K. Felle, *Elektronische Rundschau*, Vol. 11, No. 10, October 1957, pp 297-301.)



To keep 75,000-watt Klystron tubes operating efficiently, Eitel-McCullough specifies Monsanto's OS-45 coolant-dielectric, pumpable from -65° to 400° F.

The extreme operating conditions encountered in advanced troposcatter communications systems, such as DEW Line and White Alice, often require special materials for cooling the Klystron transmitting tubes. A recent application of the Eimac amplifier Klystrons specified Monsanto OS-45 as the coolant-dielectric for use in these tubes.

Engineers at Eitel-McCullough, Inc., manufacturer of Eimac power Klystrons, found that OS-45 has excellent dielectric properties and that it is one of the few dielectrics that would do the job required.

When you design or miniaturize electronic equipment, consider Monsanto OS-45. You can get help-

ful facts from Technical Bulletin O-123. Write for it or mail in the coupon below, today.

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Beginning January 8th, *Electronic Design* will reach your desk 26 times a year. This increase in publishing frequency from 24 to 26 issues may not seem important at first glance, but here are some of the advantages to the reader:

- More timely presentation of new products, materials, and processes.
- Better coverage of important electronic events, conventions, meetings, etc.
- More balanced editorial—some departments will be expanded.
- Improved delivery schedules, more efficient production and handling—copies will reach you faster.

Studies conducted among *Electronic Design* readers have shown an unusually heavy "habit readership". 26 time scheduling should help to regularize this reading routine even more. Next year you can expect *Electronic Design*—more timely and more complete than ever before—on a regular basis, every other Wednesday.



New York

Chicago

Los Angeles

Abstract

Safer Solvent Replaces Carbon Tetrachloride

A NEW SOLVENT, Methyl Chloroform has been approved for use as a cleaner for electrical and electronic equipment by the U. S. Navy Bureau of Ships. This solution is recommended for use as a replacement for the more dangerous carbon tetrachloride.

Serious accidents have resulted from the improper use, storage and handling of carbon tetrachloride (CCl_4). An underlying factor is the familiarity with which this solvent is regarded because of its past indiscriminate use. Despite the familiarity, carbon tet is recognized as being definitely toxic. For repeated exposure, 25 parts of the solvent to a million parts of air is generally regarded as the maximum safe concentration that can be tolerated by personnel.

In view of the deficiencies of carbon tet, a test program was instituted by the U. S. Navy to find a safer cleaning solvent. The solvent, selected as a result of the test program is inhibited 1,1,1-trichloroethane of methyl chloroform. This solvent is definitely less toxic than carbon tetrachloride, as 500 parts of the solvent to a million parts of air is regarded as the maximum safe concentration that

can be tolerated by personnel, yet it retains the evaporation rate and cleaning properties of CCl_4 .

Methyl chloroform, like carbon tet, is nonflammable. However, in order to remove its corrosive effects on aluminum, an inhibitor has been added. After 90 per cent of the solvent has evaporated, the residue contains a large portion of this flammable inhibitor. Therefore, methyl chloroform should not be used to clean oxygen equipment.

Application

The solvent may be applied by brushing, wiping, or spraying. Methyl chloroform, like carbon tetrachloride, will attack electrical insulating materials, particularly the air dried varnishes.

This solvent is less toxic than CCl_4 ; however, all container labels should state: "Caution—use with adequate ventilation. Avoid prolonged or repeated breathing of vapor. Avoid prolonged or repeated contact with skin. Do not take internally." *Abstracted from New Solvent Replaces Carbon Tetrachloride by J. M. Adams, Bureau of Ships Journal, Sept., 1957.*

Design for Reliability

OBTAINING high reliability in electronic equipment requires a special effort by the design engineer. Significant results in obtaining this reliability have been obtained through the vigorous pursuit of three basic "ground rules."

■ **Use proven parts and tubes with adequate derating for higher reliability.** Electronic components can usually be recommended and selected by their ability to perform under certain conditions. These recommendations, together with their parameter variations, should be based upon past experience and extensive testing. The most reliable parts,

available in production quantities from more than one source, should be selected and controlled by adequate drawings and specifications. Realistic deratings and parameter variations should be determined under operating conditions or high reliability for these parts. Close cooperation with parts manufacturers should be encouraged to advance the growth of parts reliability through feedback of test and failure information. The testing and evaluating of new products should be accomplished as soon as it is practical, and this information should be made available to the design engineer.

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- *Amplifier for Servo Motors*—for control motors or indicator motors
- *Voltage Regulation*



Honeywell *stud-mounted* 2N539 transistors make this 48-watt, 14 ounce D. C. Power Converter more compact than any other.

WHERE miniaturization is vital, yet high power is still required, Honeywell's complete line of power transistors is your best answer.

Honeywell *stud-mounted* transistors combine smaller size per power output with greater flexibility and interchangeability.

They offer a *narrow* span of characteristics—along with superior electrical performance and high uniform power gain over a wide range of collector current values.

Honeywell power transistors are hermetically sealed by *welding*—so you can build ruggedness and durability into your equipment. You get long life along with outstanding performance.

For complete information on the Honeywell transistor line, write or phone your nearest Honeywell representative.

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MURdock 8-9000
P.O. Box 161

CHICAGO
IRving 8-9266
7350 N. Lincoln Ave.

BOSTON
ALgonquin 4-8730
1230 Soldier Field Rd.

MINNEAPOLIS
FEderal 2-5225
2749 4th Ave. So.

LOS ANGELES
RAmond 3-6611 or
PArkview 8-7311
6620 Telegraph Rd.

Note these new specifications—developed with
the design engineer in mind

	2N538*	2N539*	2N540*
Input Resistance	24—48 ohms	27—54 ohms	30—60 ohms
Power Conductance	17.5—52 mhos	35—105 mhos	71—213 mhos
Current Gain, Median	30	40	60

(At a collector current of 2 amps.)

*EIA registration numbers have replaced
the former H5, H6, and H7 designations.

Honeywell



First in Controls

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The designer should allow for realistic variations in parts and tubes, thus using a statistical approach to circuit design. By collecting information on the variations to be expected in parts parameters under operating conditions and manufacturing tolerances, the designer can calculate the over-all variability of his design. For maximum reliability and producibility, the designer might try to design the equipment to perform properly with all parts at their maximum tolerance limits, and in such a direction as to produce greatest deviation in nominal performance. However, this attempt might fail; because, even the best and highest precision parts will not have sufficiently small tolerances to adequately satisfy design limits, or the circuit will be hopelessly complicated. A statistical knowledge of component reliability, derived by component evaluation and testing, would allow an engineer to design circuitry in which known tolerance variations could cancel or counteract one another. Complex circuits have been successfully investigated by Motorola, Inc., to determine if they had adequate safety margins to meet their required tolerances. This approach has avoided production of unreliable equipment and has saved valuable time in the breadboarding and testing of circuits which are incapable of consistently performing within required limits.

Test prototype equipment thoroughly, and accurately analyze results for corrective action. Although good initial designs will greatly reduce the number of changes occurring during development and production, they cannot remove the need for extensive equipment testing throughout an entire development program, if high reliability is to result. During this testing, careful attention must be given to causes of failure, and periodic failure graphs should be made to predict reliability of later models. A specific engineer on each project might be assigned to collect and analyze the future data necessary for reliability improvement. Reports of equipment or component failure should be forwarded to the reliability and components group for examination and recording. *Abstracted from A Reliability Handbook for Guided Missile Electronics Designers by F. E. Deste, Motorola, Inc., a paper presented at WESCON, August, 1957.*



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Over 15,000 engineers have chuckled their way through "Murder in the Model Shop". Now in its second big printing, this free 48-page pocket book tells in true Mickey Spillane style how an "engineer-private eye" solves actual servosystem and instrument design problems with SERVOBOARD[®] Electromechanical Assembly Kits. Appendix includes descriptions of servo components and kits, Servoscope[®] servosystem analyzer, and Servomation[®] building blocks. For your copy write to:

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STANDARDS AND SPECS

Sherman H. Hubelbank

Nebulous Drawing Titles

Drawing titles are too often confusing labels rather than proper identification tags. If a standard nomenclature system is followed, they can be valuable indexes. But consistency, or standardization, is practiced too little. Even in a single firm, drawings of similar items often have dissimilar names. This lack of method results in a babel where titles are misleading or meaningless to all but their authors.

Granted a title should not violate a spec and should not outrank other details set forth in a drawing. But it can, if it is precise, instantly orient the reader and so speed his understanding of a picture and its attendant reading matter.

Standards for titles have made some gains in the past few years. ANA Bulletin 411 has given direction to manufacturers. With this bulletin, the Department of Defense proposes to identify and catalog all end items and components procured under its jurisdiction. The bulletin directs contractors to use Handbook H6-1 of the Federal Item Identification Guides as a drawing title authority. The handbook can be used to approve terminology and construction, or to formulate new terminology where none exists.

Besides conforming to the Federal cataloging system, the practice affords several other advantages, especially where machine tabulating systems are employed. Where titles can be punched into cards along with relevant data such as part number, drawing size, vendor, and material, such supplementary information can be quickly found and reproduced in whatever form is needed. Time saved helps the system pay its way. An alpha-numerical file prepared from the punched cards keeps the significant features of any item handy. Designers wanting a product that meets fixed specs can instantly pick out all the cards in a given category.

Where standard titles are filed, the alphabet will automatically group them in categories. This makes it easy to analyze a group and its member items for comparative frequency and trend. The system has another advantage. Because duplicate, similar, or obsolescent items can be quickly spotted, it helps rid records and stock bins of unnecessary items. These short cuts are denied to organizations where rigid nomenclature standards are not maintained. *Abstracted from Nebulous Names Make Nuisances by G. H. Carle, Standards Engineering, Oct.-Nov. 1957.*



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Company Standardization Programs and Practices

Over one hundred companies and several hundred trade associations were recently surveyed by the National Industrial Conference Board, 460 Park Ave., New York, N. Y., concerning company programs and practices in industrial standardization. Few companies formulate all their own standards. National standards, formulated by national groups, are the basis of most of the standards for most of the companies.

In companies that have formalized their standards work, the staff of standards departments usually include engineers, subprofessional personnel such as draftsmen, and other personnel doing clerical and stenographic work. In some large departments, personnel with experience in purchasing, shop management, quality control, safety, or other activities that are the objects of standardization are included to handle their specialties. Committee work plays an important role in the standards work of many companies. Practices range from assigning to committees the exclusive jurisdiction over standards matters, to using committees only in consultative or advisory capacities.

The duties most often assigned to the standards organizations are the following: assisting in the formation of company standards policies; developing procedures for the formulation of standards; surveying and reporting on internal company standards practices; serving as a source of information to company management on standards topics; functioning as the standards coordinating group; representing the company in its external standards relationships; and acting as effective exponents of standardization.

The accessibility of the standards is of prime importance according to the results of the survey. Professor J. Rogers of the Univ. of California, who made the survey for the NICB, found that such factors as the method of indexing and numbering, titles of standards, appearance of the printed standards, use of illustrations, provision for supplementation, and extent of distribution deserve prime attention.

The study, entitled Studies in Business Policy, No. 85, found that objections to the creation of standards often stem from the preconception that the end result may be a deadly identity of product. Actually, it is noted that manufacturing standardization permits longer runs, simpler tooling, faster production, and better control of quality, and permits industry to offer a richly varied array of goods. The use of standard tools, materials, and components does not automatically require that final products be of limited variety and reduced to a common level of quality or mediocrity of design.

MICROWAVE NEWS AND SPECIAL TUBE from SYLVANIA

MINIATURE COUNTER TUBES...



Sylvania adds a miniature 100 KC counter tube to the line

New 100 KC counter tube, type 7155, is introduced by Sylvania for smaller, lighter counting devices

High-speed counter tube with three output cathodes in a T 5 1/2 envelope is now available from Sylvania. The new tube, type 7155, is of particular value in equipment design where size and weight are important factors. This latest addition to the counter tube line follows by less than a year Sylvania's development of the first 100 KC counter tube.

Type 7155 operates with the reliability, accuracy and simple circuitry typical of all Sylvania counter tubes. As with the other

high-speed tubes in the line, types 6909 and 6910, the new counter tube can be used singly or cascaded in multiple stage counting for laboratory or industrial applications.

RATINGS (Absolute Values)

Total Anode Current	0.7 Ma	Min.
	1.2 Ma	Max.
Voltage Between Electrodes (Other than Anode)	140 Volts	Max.
Supply Voltage (Anode to Cathode)	425 Volts	Min.
Input Frequency	100,000 P.P.A.	Max.

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COAXIAL TR TUBES...

Sylvania develops new TR construction—
a coaxial tube for low frequencies



New coaxial TR tube saves space and weight at low frequencies

TR tubes in coaxial construction for low frequency radar and countermeasure equipment are now in production at Sylvania. Typical of the new tubes available is the TR860, a 9-inch diameter type designed for very high power. It utilizes one of the largest ceramic-to-metal seals in existence.

The new coaxial construction is based on four years of research and development work by Sylvania. One of its major advantages over conventional rectangular TR's at low frequencies is the great saving in space and weight it makes possible. In addition, the new coaxial tubes are much more rugged than conventional types because of smaller window and seal areas.

CIRCLE 309 ON READER-SERVICE CARD

NEW MICROWAVE CRYSTAL DIODES...

Double-ended construction adds new convenience to S and X band crystal diodes



Sylvania's new dual duty microwave crystal diodes utilize detachable spring-grip base

New Sylvania microwave crystal diodes in the S and X bands can now serve as either forward or reverse diodes. A detachable spring-grip base can be slipped on either end for forward or reverse use.

The dual diodes eliminate the need to specify reverse types and simplify ordering and stocking.

Designations for the new double-ended diodes are 1N416B, C, D and E for 1N21 types and 1N415B, C, D and E for the 1N23 series.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N.Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

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SYLVANIA

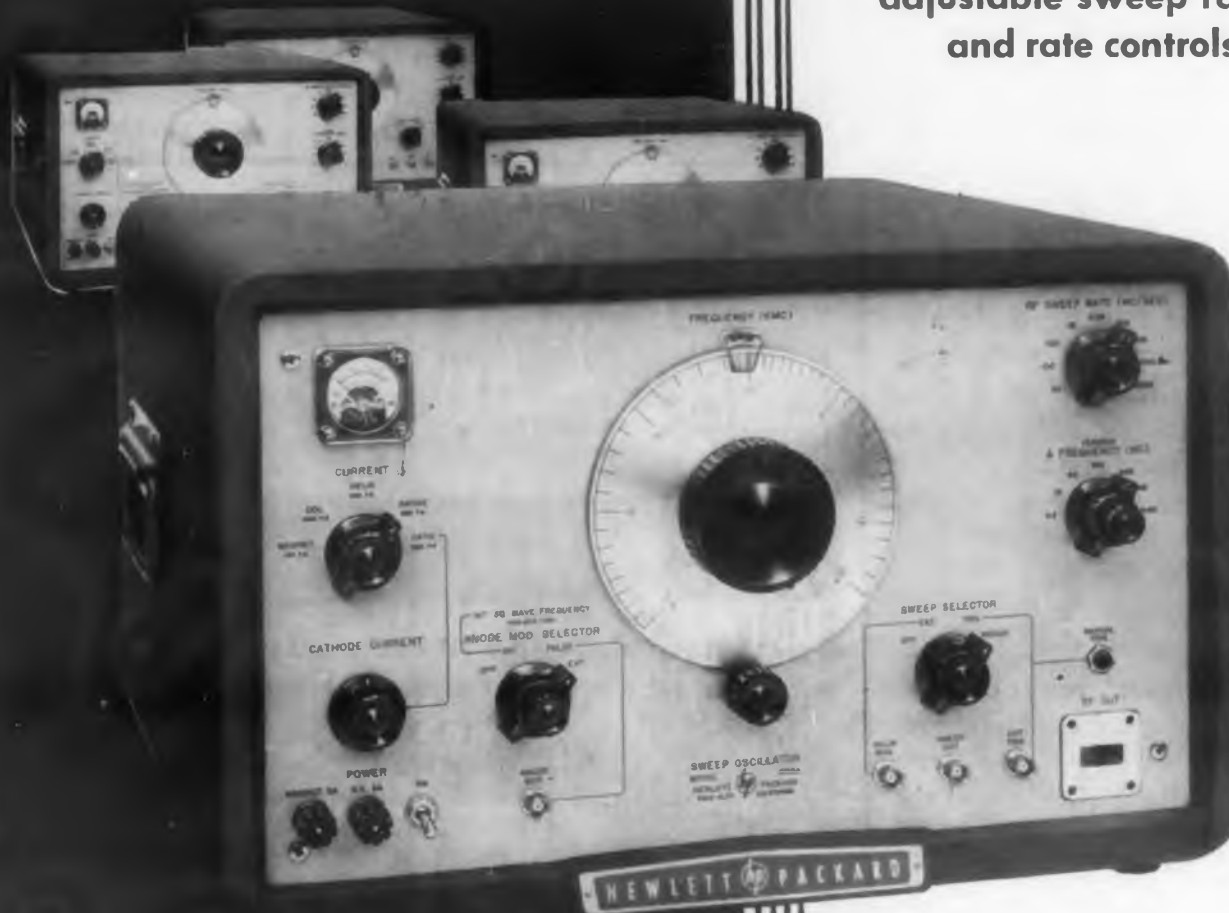
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January 22, 1958

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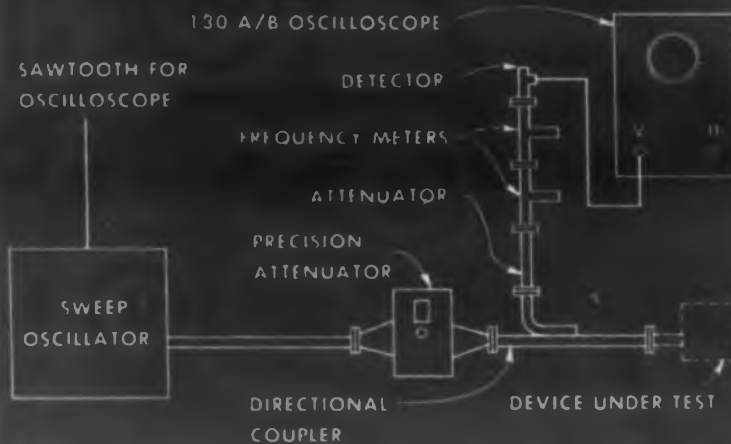
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4 new microwave sweep oscillators



*speed, simplify
measurements
3.95 to 18.0 KMC*

Covers full band, or any part
Use with 'scope or recorder
All electronic; no mechanical sweep
Direct reading, independently
adjustable sweep range
and rate controls



◀ Figure 1. Arrangement for high speed microwave measurement to provide rapid visual display with -hp- 130A/B oscilloscope. Can be used for G, J, X and P bands.

hp Dependable, quality

CIRCLE 301 ON READER-SERVICE CARD

Hewlett-Packard 684 series Sweep Oscillators are new measuring tools deliberately designed to give you simpler, faster microwave measurements. Four models are provided, covering the G band (3.95 to 5.85 KMC), J band (5.30 to 8.20 KMC), X band (8.20 to 12.40 KMC) and P band (12.40 to 18.00 KMC).

These new instruments make possible microwave investigations and evaluations with a convenience previously associated only with lower frequency measurements. The 684 series oscillators provide a wide range of sweep speeds so that measurements of reflection, attenuation, gain etc., can be displayed on an oscilloscope or recorded in permanent form on X-Y or strip-chart recorders.

Electronic Sweeping

Specifically, the new oscillators provide either a CW or swept rf output throughout their individual bands. The instruments employ new backward wave oscillator tubes whose frequency is shifted by varying an applied potential. Thus, troublesome mechanical stops and tuning plungers are eliminated. Sweep range is continuously adjustable and independently variable; sweep rate is selected separately, and either can be changed without interrupting operation. The full band width can be covered in time segments ranging from 140 seconds (very slow for mechanical recorder operation) to 0.014 seconds (high speed for clear, non-flickering oscilloscope presentation).

Linear Frequency Change

The swept rf output from the 684 series oscillator is linear with time, and a linear sawtooth voltage is provided concurrent with each rf sweep to supply a linear time base for an oscilloscope or recorder. In addition, for convenience in recording and other operations, rf sweeps can be triggered electrically externally and single sweeps can be triggered by a front panel push button. The rf output can also be internally AM'd from 400 to 1,200 cps and externally AM'd or FM'd over a wide range of frequencies.

Rapid Visual Presentation

The variety of sweep rates and band widths available from the new oscillators insures convenience and accuracy for reflection and transmission coefficient measurements and many other production line and laboratory tests. For maximum speed, an oscilloscope such as -hp- 130A/B may be used as indicated in the diagram on opposite page. For maximum information and a permanent record, an X-Y or strip chart recorder may be used.

Complete details of a rapid visual method using an oscilloscope or a maximum-data, permanent record method using a recorder may be obtained from your -hp- field engineer. Detailed discussions of these methods are also contained in the -hp- Journal, Vol. 8, No. 6, and Vol. 9, No. 1-2, available on request.

TYPICAL SPECIFICATIONS

Below are specifications for -hp- 686A Sweep Oscillator, 8.2 to 12.4 KMC. Specifications for -hp- 684A (G band), 685A (J band), and 687A (P band) are similar except for frequency range.

Types of Outputs: Swept Frequency, CW, FM, AM.

Single Frequency Operation

Frequency: Continuously adjustable 8.2 to 12.4 KMC.

Power Output: At least 10 milliwatts into matched waveguide load. Continuously adjustable to zero.

Swept Frequency Operation

Sweep: Recurrent; externally triggered; also manually triggered single sweep. Rf sweep linear with time.

Power Output: At least 10 MW into matched waveguide load. Output variations less than 3 db over any 250 MC range; less than 6 db over entire 8.2-12.4 KMC range.

Sweep Range: Adjustable in 7 steps 4.4 MC to 4.4 KMC.

Sweep Rate-of-Change: Decade steps from 32 MC/sec. to 320 KMC/sec.

Sweep Time: Determined by sweep range and rate; from 0.014 to 140 seconds over full-band.

Sweep Output: +20 to +30-volt-peak sawtooth provided at a front-panel connector concurrent with each rf sweep.

Modulation

Internal Amplitude: Square wave modulation continuously adjustable from 400 to 1200 cps; peak rf output power equals cw level.

External Amplitude: Direct coupled to 300 KC; 20 volt swing reduces rf output level from rated cw output to zero.

External Pulse: +10 volts or more, 5 millisecond maximum duration.

External Frequency: FM and external sweep voltages.

General

Input Connectors, Impedances: BNC; above 10,000 ohms.

Output Connector: Waveguide cover flange; SWR less than 2:1.

Power Requirements: 115/230 volts 50/60 cps ac; approximately 475 watts.

Price: -hp- 684A (3.95-5.85 KMC) \$2,265.00
-hp- 685A (5.30-8.20 KMC) \$2,265.00
-hp- 686A (8.20-12.40 KMC) \$2,615.00
-hp- 687A (12.40-18.00 KMC) \$3,115.00

(Prices above are f.o.b. factory for cabinet models. Rack mount instruments \$15.00 less.)

Data subject to change without notice.

HEWLETT-PACKARD COMPANY

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ELECTRONIC
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