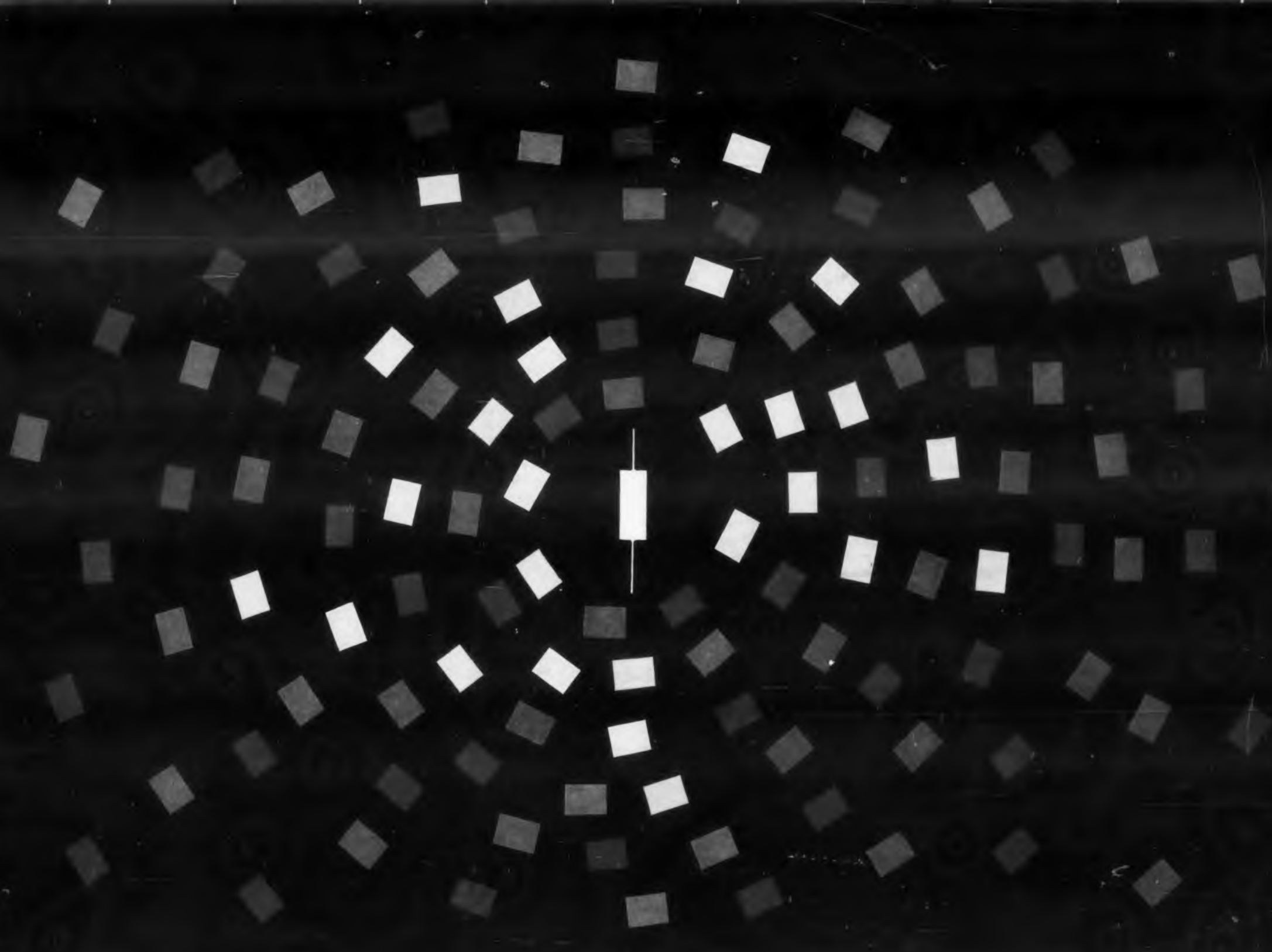


DEC 15 1953
ELECTRONIC DESIGN
OCTOBER 14, 1953



Improved Resistor Withstands More HEAT and HUMIDITY ... p. 62

At Canadian General Electric Company, Limited:



OLD

Previous, asphalt-impregnated transformers, made by Canadian General Electric, Limited. Insulation strength was limited.



NEW

Streamlined transformers, molded with Epon resins, have superior insulation, dielectric strength; accuracy, performance are greatly improved.



Following curing period, the mold is quickly unbolted and the Epon resin-potted transformer removed.



Cutaway view of new instrument transformer clearly shows the complete penetration of Epon resins.

Epon[®] Resins improve performance, streamline appearance of instrument transformers

When Canadian General Electric Company, Limited, Toronto, Canada, decided to produce a new line of instrument transformers, they were faced with several critical problems: how to ensure performance, reliability, and appearance . . . all on a mass-production basis.

They solved all their problems with Epon resins.

Result: these handsome new transformers, completely impregnated with Epon resins, have high insulation and dielectric strength, good impact resistance, ex-

cellent heat dissipation, and increased ability to withstand creepage. Cracking and oxidation are virtually eliminated.

If potting, laminating, sealing or encapsulation play an important role in your operations, be sure to investigate Epon resins. They may be able to solve a production problem for you. For assistance and technical information, write to your nearest Shell Chemical office listed below.

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IN CANADA Chemical Division, Shell Oil Company of Canada, Limited, Toronto

Central District
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Chicago 48, Illinois

East Central Division
1578 Union Commerce Bld
Cleveland 14, Ohio

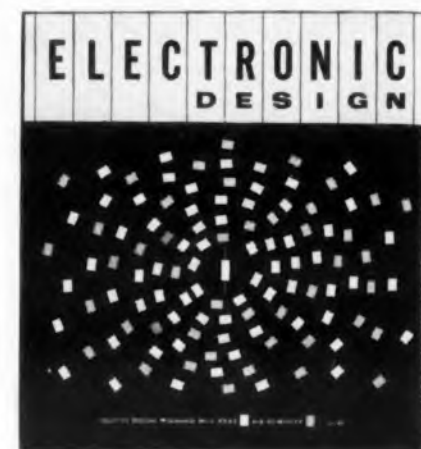
Eastern District
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New York 20, New York

Western Division
10642 Downey Ave.
Downey, California



CIRCLE 1 ON READER-SERVICE CARD

HIGHLIGHTS OF ISSUE



Improved Resistor Withstands More Heat and Humidity 62

A deposited carbon resistor that withstands more heat and humidity was developed by using a new manufacturing process and a new deposited carbon alloy. Our artist has placed the cover product in a symbolic environment of heat and humidity. Red stands for heat; gray, humidity. The intensity of the color signifies the resistor's capability of withstanding increased environmental conditions.

Achieving Stable High-Fre- quency Design With the Mesa Transistor 34

Deliberate interstage mismatch results in transistor unilateralization even in wideband applications. Design procedure for the 2N700 Mesa transistor is outlined.

How To Choose A Servo Gear Ratio 50

With graphs and formulas, this article shows how to choose a servo gear ratio that requires minimum driving torque. It also discusses the effects of drag and acceleration requirements. An example is provided that illustrates the equations given.

Making The Most Of Flat Cables: Part 1 56

In this first of two articles, three major subjects are covered: (1) some of the stripping methods now used with flat cables; (2) the types of stripping and their applications; and (3) the importance of strain reliefs. The article is profusely illustrated with photographs.

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Proper camera and oscilloscope setting to give the best exposure for trace recording K. P. Taschioglou, H. P. Munsberg

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Unusual receiver for good signal-to-noise ratio without phase shift

How To Choose A Servo Gear Ratio 50
Choosing a gear ratio that requires minimum driving torque is shown with graphs and formulas R. H. Parvin

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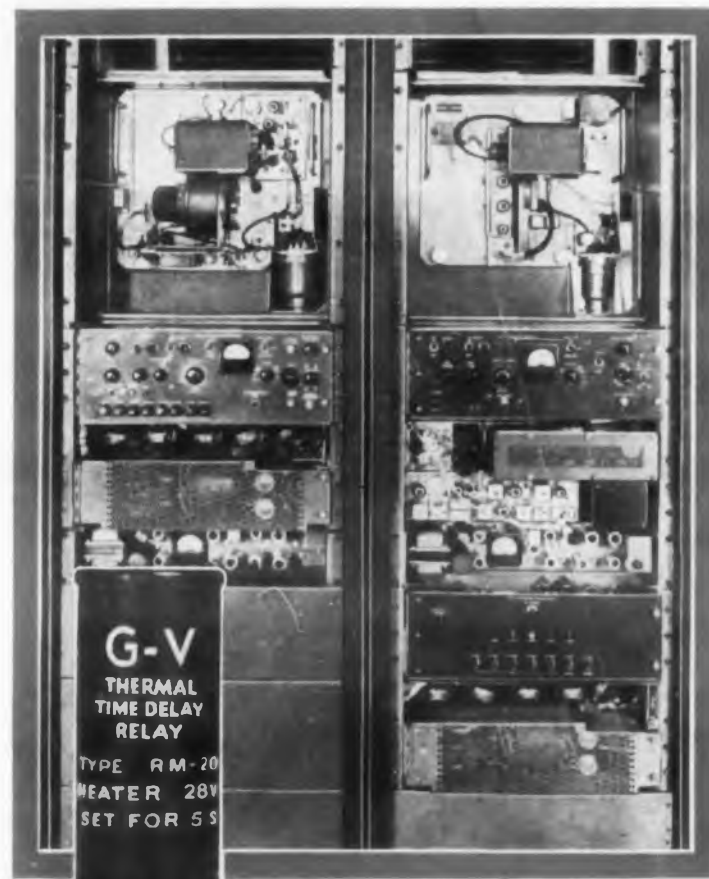
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G-V thermal time delay relays...
 protect cathodes in RCA's
 TV microwave relay system

When the industry required a portable microwave repeater station that behaved like a permanently installed, unattended unit, RCA developed its Television Microwave Relay Station, Type TVM-1A. In it, to protect the unit's cathodes, RCA design engineers rely on G-V thermal time delay relays to delay the application of plate voltage.

In both industrial and military equipment, G-V thermal relays are providing long, dependable, proven service in time delay applications, voltage and current sensing functions and circuit protection.

Write for extensive application data and catalog material.

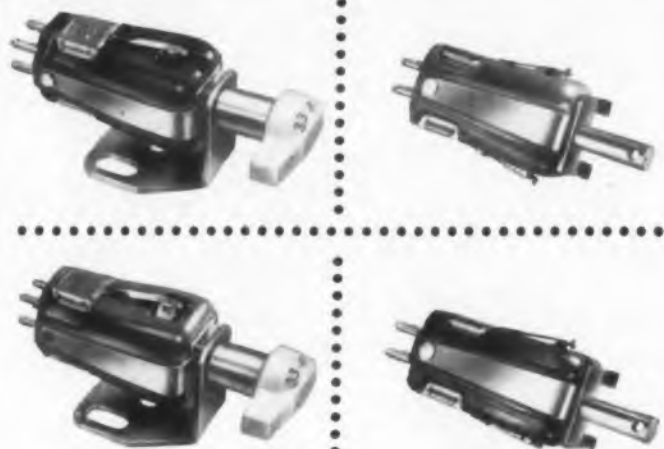
G-V CONTROLS INC.
 LIVINGSTON, NEW JERSEY



CIRCLE 2 ON READER-SERVICE CARD

NOW CBS ELECTRONICS BRINGS DESIGN ENGINEERS COMPLETE LINE OF FINE STEREO CARTRIDGES

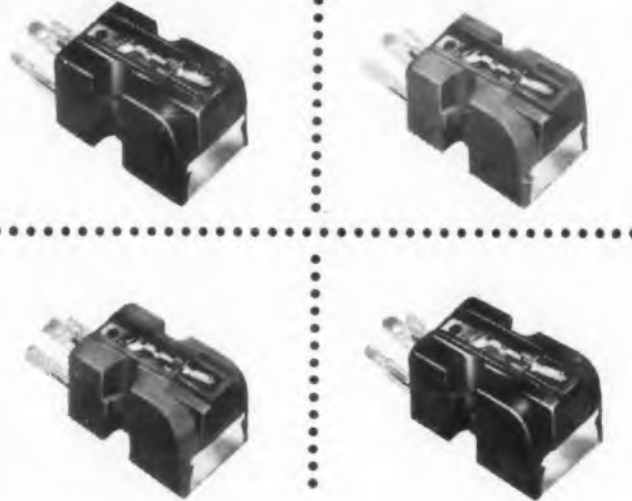
CBS Electronics now makes it possible for you to purchase CBS-Ronette, the world's most popular cartridge, and Columbia CD, the ultimate in stereo cartridges, from one dependable source of major audio components.



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CARTRIDGE**

Made by the world's largest manufacturer of original equipment cartridges — stereo and monaural — the CBS-Ronette features proven, uniform dependability at low cost. Compliance and output voltage can be designed to your specifications. CBS-Ronette tone arms and microphones are also available.

Look to CBS Electronics, electronic manufacturing division of the CBS family, for the finest in stereo cartridges and audio tubes. Sales and engineering service are available from convenient regional offices. Call your nearest CBS Electronics office for technical data, price and delivery information today!



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CIRCLE 3 ON READER-SERVICE CARD

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ELECTRONIC DESIGN is published bi-weekly by Hayden Publishing Company, Inc., 830 Third Avenue, New York 22, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer; and David B. Landis Secretary. Printed at Hildreth Press, Bristol, Conn. Accepted as controlled circulation at Bristol, Conn. Additional entry, New York, N. Y. Copyright 1959 Hayden Publishing Company, Inc., 36,150 copies this issue.



The Bettmann Archive

ELECTRONIC DESIGN
NEWS

Soviet Electronic Design Decentralizing

FLAWS IN the Soviet electronic R & D setup are leading to decentralized designing, a major change for the U.S.S.R.'s electronic industry.

Reasons for the decentralization reflect a large part of the Soviet electronics picture.

Design Center Is Moscow

Until recently, electronic equipment, non-military especially, was designed centrally, in the Moscow laboratories of the State Committee on Radio and Electronics. This work falls into two general types.

The first is conducted by extremely able, well-trained academicians with complete freedom to choose their projects and requisition equipment. Theoretical work dominates but often turns practical when made part of specific product development.

Practical work is the second type—turning theoretical designs into breadboard models, models into preproduction units, and speculation into test data.

Theoretical work is reviewed by a product planning group, which decides whether a project will be followed up. When the decision is yes, a design is prepared for bench models and the product is assigned to a specific plant—with quotas.

Though the academicians are of outstanding quality and capable of top work, to the visiting Americans the other "designers" seemed equivalent to U.S. technicians.

This, coupled with the lack of plant experience by either academicians or technicians often result in designs that are not suited to production. In the past, the equipment was produced anyway, caus-

ing production difficulties, waste and poor performance. Needless cost and low reliability were the two worst results.

Now, plants assigned to manufacture specific products change designs sent from Moscow if they feel improvements can be made. Some plants, with a reputation for modifying all designs that come their way, have, in effect, an in-plant design staff with production experience.

These production engineers, as well as the

central designers, have complete and prompt access to the latest foreign publications, an added impetus to local design. (Committee members were uniformly impressed with the speed with which the Soviet electronic industry became thoroughly aware of the newest American developments.)

Another cause of Soviet design decentralization is the competition developing among individual production plants. In some types of consumer electronics, particularly radio and TV sets, supply is greater than demand. The plants are starting to do what they can to earn a reputation for quality work and to keep their production lines going. Local redesigning to avoid production difficulties and to increase reliability is part of this effort.

A third reason for the drift from Moscow is the government's current policy of general economic decentralization and strengthening of the country's 104 economic divisions.

District planners are trying to draw as much work as possible into their areas, and to minimize supply-demand imbalances. Manufacture of new products and promotion of increased consumption of products already manufactured locally are two ways this is being done. To help, time-payment purchases and advertising are being instituted.

Designers Badly Handicapped

Soviet designers, whether in Moscow or in distant plants, work under handicaps that would discourage their American counterparts. Some of restricting influences on design are:

- The narrow range of available parts. This is a result of stringent State part standardization and is the most limiting condition.

This article . . .

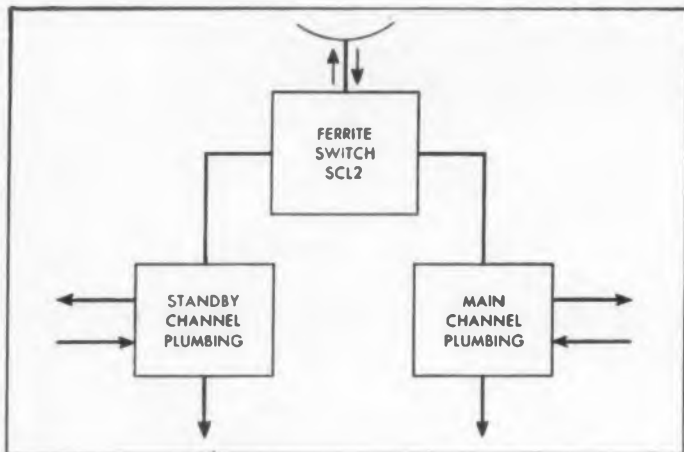
. . . is a result of interviews conducted by ELECTRONIC DESIGN with members of a six-man electronic industry team that recently returned from an 8000-mile, three-week visit to the Soviet Union.

The group, which was sponsored by the State Department and the Electronics Industries Association prepared a confidential report and gave a brief review of the trip at the last quarterly meeting of the EIA.

Chairman of the team was Ray Ellis, of Raytheon. The other members were semiconductor specialists Conrad Zierdt of GE; Julian Sprague, of Sprague Electric; telephone expert Imre Molnar, of General Telephone Labs; economist Frank Mansfield, of Sylvania; and Charles Marsden of NBS.

In three weeks the group visited 16 Soviet establishments and talked with 120 top electronics men.

THREE-POSITION FERRITE SWITCH FOR C-BAND



TYPICAL MICROWAVE CIRCUIT in which Raytheon ferrite switch is now being used. Switch has three positions: antenna to main channel; antenna to standby channel; antenna to both channels simultaneously.



FERRITE SWITCH SCL2

FERRITE SWITCH IS ACTIVATED when fault is detected in sensing unit. Receiver fault causes switch to transfer to intermediate position for comparison of main and standby. Normal baseband receiver noise and pilot tone allow switch to complete switchover.

TYPICAL SPECIFICATIONS

SCL2	
Frequency range (mc)	6,575-6,875
Isolation, minimum	20db
Isolation, maximum	30db
Insertion loss, minimum	0.5db
Insertion loss, maximum	0.8db
Power, average	10 watts
Power, peak	1 kw
VSWR, minimum	1.02
VSWR, maximum	1.28
Type of switch	SPDT reciprocal
Coil current	400 ma
Coil resistance	60 ohms
Length	8 in.
Waveguide	RG-50/U*

*Mates with

ADVANCED SWITCHOVER PROTECTION PERMITS MORE RAPID AND FLEXIBLE OPERATION THAN EVER BEFORE

A completely new ferrite switch has just been introduced by Raytheon. The device, which is controlled by a specially designed switchover unit, provides fool-proof switchover protection. It has three positions, connecting:

1. antenna to main channel
2. antenna to standby channel
3. antenna to both channels simultaneously

In the third position, the received signal is divided equally between the arms feeding the main and standby receivers.

This allows an actual comparison of the two receiver signals before switching and eliminates the need for complex and unreliable signal injection systems.

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write to the address below stating your particular area of interest.

RAYTHEON COMPANY
SPECIAL MICROWAVE DEVICES
WALTHAM 54, MASSACHUSETTS



Excellence in Electronics

NEWS

■ Parts are often of ancient style. Soviet part designs were frequently frozen at illogical points along the march of technology.

■ Parts are overdesigned in the least desirable ways. They seem designed to resist twisting, bending and other stresses unlikely in their environments. They are often bulky, heavy and wasteful of material.

■ Parts and components have low reliability. For the Soviets, reliability efforts mean over designing in the first place, then adjusting the manufacturing formula when components are returned for repairs. In one component plant visited, finished units were not tested. In another, no parts were given life tests. In none of the plants toured was there a snow-white operation resembling those in this country. The impurity problem is compounded by low-quality materials in general electronic use and the complete absence of plant maintenance programs, at least in the facilities visited. Resistors, however, are good, even though one plant was using a production process identical in every detail with one used by IRC twenty years ago.

But under a current drive steps are being taken to raise the low reliability of Soviet products. Reliability is so low, one team member said, 70 per cent of consumer products need repairs during their six-month warranty. Heavy in-line testing is being instituted and very little printed circuitry is being used.

■ The absence of an electronic service industry means equipment goes back to the factory for repairs, though burned-out crt's are not rebuilt. The government service organization was described as completely inadequate. And because of poor servicing, designers are under pressure from plant managers to provide designs that will not mar the reputations of the plants nor those of the plant managers, who keep their positions by producing to expectations.

■ The most unpredictable design influence is the Soviet state and its bureaucracy. Large-scale work in color TV underway for some time in the U.S.S.R. is now relatively marking time while a choice is being made between the centrally designed three-color dot-sequential system using a shadow-mask tube and a similar system designed by a Leningrad group. The choice will not be made until after tests are conducted on complete installations of both systems in both cities.

Another example of bureaucracy, Soviet style, is the attention being focused on early-model surface-barrier transistors, now considered outdated in the West. They are being produced in quantity in the U.S.S.R. Why? Once, in a routine report on a Philadelphia conference paper, specific reliability figures happened to be mentioned

for two of many transistor types being discussed. The early surface-barrier type had the better of the two figures, and that was enough for the Soviet planners.

■ Another important design factor is the relatively late Soviet technological start. For instance, there are not enough microwave and coaxial links for both civilian and military use. TV and telephone designers must design for a present net of only 1500 miles of operating connections. By 1965 there will be only 45,000 miles—if goals are met. There are 200,000 miles of such links in the U.S.

Other Observations Revealing

■ Engineers engaged in direct design work in the Soviet Union publish very little. Most papers are produced by academicians reporting theoretical developments. One Russian commented on the vast amount of design material published in the U.S., wondering how engineers here are able to choose among promising ideas.

■ The group visited 16 facilities carefully screened to reveal nothing of military interest. The plants were of old design and were inefficient. The touring group concluded that American electronic workers were two-and-a-half to three times more productive than Soviet workers and earned four times as much, with fringe benefits included.

■ Not a single computer was seen, nor were there any evidences of computer availability to designers and production engineers, apart from the fact that the Soviet's large transistor output could not be accounted for by requirements of the industries observed.

■ There is a long lag in electronics between development of a new idea and its exploitation. Quality of electronic research is of high quality and great depth. The design academy is able to reproduce fairly rapidly samples of new devices from descriptions, when ordered to by the planners. But because the technology of engineering and production is roughly five years behind that of the U.S., new developments find their way relatively slowly into the Soviet economy.

■ Most designs are outright copies of Western designs. Some are developed, as mentioned, from descriptions, some from examination of purchased equipment, and some, the U.S. observers surmise, are made from parts and equipment obtained "informally."

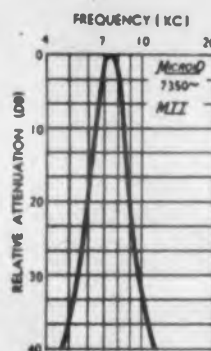
■ In the 16 establishments visited, only two production processes were of any interest to the Americans: a subminiature-tube operation and a process for making telephone relay springs.

■ Soviet design and production methods were judged to cost consumers 40 per cent more than necessary. And quality, in general, was about 25 per cent less than that usual in the U. S. ■ ■

SPACE SHRINKERS

MICROIDS AND MONKEYS— Burnell & Co. welcomes the assistance of their simian friends in the task of gathering data vital to space shrinking. By shrinking toroids, filters and related networks for guidance and communication systems, Burnell helps space vehicles carry bigger payloads — more instrumentation, animals — eventually man. Typical of our accomplishments is the **MTT MICROID**® telemetering band pass filter. Significantly, the combined weight of 23 **MICROIDS**— plus the monkey — is less than the single non-miniaturized telemetering band pass filter pictured here. **MICROID** band width is 15% at 3 db + 60% —40% at 40 db. Frequency coverage is from .4 kcs to 70 kcs.

Sizes	
Channels 1-6	2x27/32x1/2
Channels 7-10	1-5/16x11/16x11/16
Channels 11-18	15/16x19/32x1/2
Alternates A-E	15/16x19/32x1/2



Write for Filter Bulletin MTT 23.

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CIRCLE 5 ON READER-SERVICE CARD



HIGH ACCURACY

PRECISION DC AC DIFFERENTIAL VOLTMETER

MODEL 803



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- Eight Search and four Null ranges

AT YOUR FINGERTIPS

Precise measurements of either DC or AC voltages with this field proven jf instrument.

Use the 803 as an AC Differential Voltmeter, DC Potentiometer or DC/AC VTVM.

3 INSTRUMENTS IN ONE

DC

Accuracy: .05% from .1 volt to 500 volts
Input Voltage Ranges: 500-50-5-.5v
Null Ranges: 10-1-.1-.01v
Input Resistance: Infinite at Null
Resolution: .005v at 500v to .00005v at .1v

AC

Accuracy: .2% from .5 volt to 500 volts from 30 CPS to 5 KC
Input Voltage Ranges: 500-50-5v
Null Ranges: 10-1-.1-.01v
Input Impedance: 1 Meg. shunted by approx. 25 mmf
Resolution: .005v at 500v to .00005v at .1v

Cabinet Size: 9 3/4" x 13" x 17" — Net Weight: Cabinet Model—30 pounds

Price: \$845.00 F.O.B. Seattle, Washington

For complete details on the Model 803 or other John Fluke instruments write direct or contact our engineering representative in your area.

john fluke



MANUFACTURING CO., INC.

1111 W. NICKERSON ST., SEATTLE 99, WASH.

CIRCLE 6 ON READER-SERVICE CARD

NEWS

Meteor-Burst System



Automatic message-handling equipment helped the NBS meteor burst communications system achieve an error rate of only 0.004 per cent at 30 wpm during a three-week period of good atmospheric conditions.

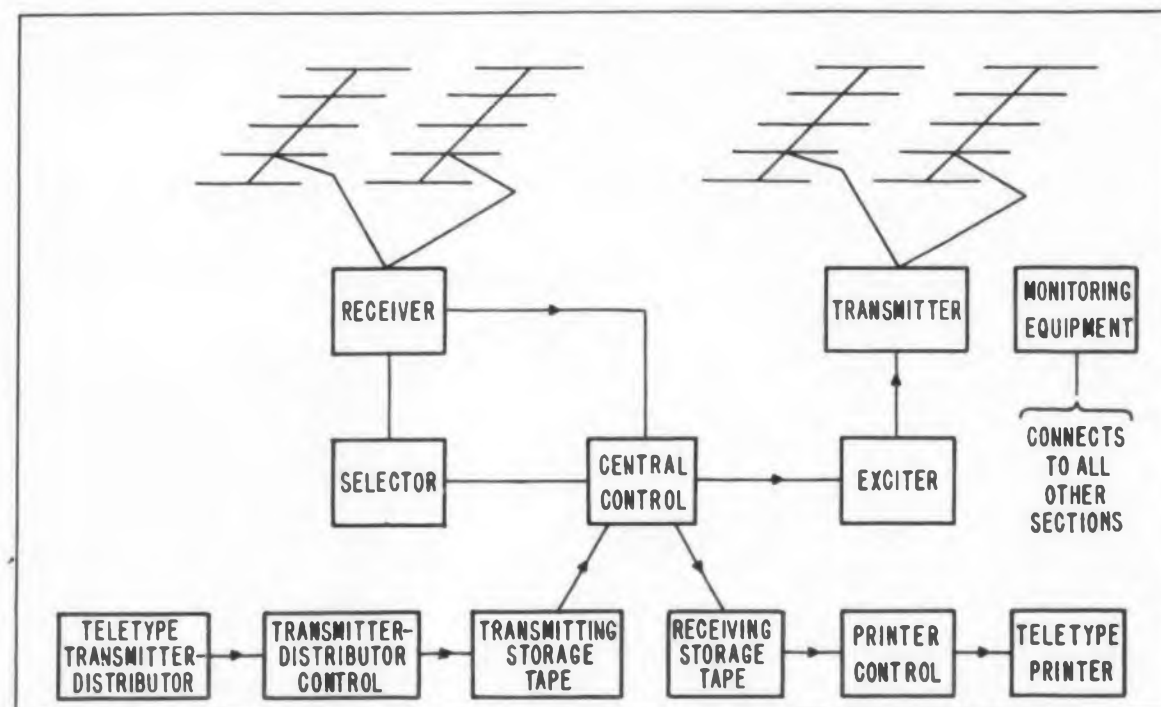
Transmits at 4800 WPM

AN EXPERIMENTAL meteor-burst communication system developed by the National Bureau of Standards has sent messages at speeds up to 4800 wpm with error rates as low as 0.004 per cent.

The system is part of an Air Force sponsored project to determine the feasibility of long-distance vhf communication

based on reflections from meteor trails. Results so far indicate that intermittent meteor-burst communication can compete effectively with other long-distance systems, and that they are relatively free from ionospheric disturbances that affect long-distance hf communication.

The system's control equipment deter-



System uses commercial transmitters and twin arrays of Yagi antennas.

mines when conditions are acceptable for transmission of messages. This decision is based on (1) the amplitude-versus-time characteristics of the received signal, (2) the modulation of the received signal, (3) the availability of storage space for incoming messages, and (4) the availability of messages for transmission. In order to measure attenuation on the two oppositely directed radio paths, the transmitters at both stations are kept in continuous service.

Trails Detected in Milliseconds

With both transmitters on the air, the system can detect the presence of a suitably located meteor trail within a few thousandths of a second. When either station "hears" a signal reflected by a meteor trail, it shifts its transmitting frequency, thus indicating to the other its readiness to transmit messages. After both stations have received this signal, message transmission is initiated.

Should either terminal run out of magnetic tape or should the signal strength fall too low, the two stations "converse" with each other and agree to stop transmission temporarily.

At the end of a meteor burst, signal fading or obvious error in received messages causes the system to stop transmitting, and the transmitters return to their original frequency. Under normal conditions, the command to start and stop and associated events are so timed that no messages are lost.

The experimental meteor burst system was designed for a study of two-way communications over paths from 400 to 1200 miles in length.

The system's receivers are double-conversion superheterodynes. Each contains an FM detector for messages and an AM detector to measure a signal strength. With each change in speed-up ratio, the transmitter frequency shift is changed. Then it becomes necessary to match this change by a change in the electromechanical filter in the receiver. This filter sets the receiver pass

NOW PHILCO OFFERS BOTH



HIGH FREQUENCY SILICON TRANSISTORS

For High Temperature Application

TYPES:

2N495
2N496
2N1118
2N1119

2N1199
2N1267
2N1268
2N1269

2N1270
2N1271
2N1272

Immediately available off-the-shelf, in quantities of 1 to 99, from your local Philco Industrial Semiconductor Distributor.

- LOW SATURATION RESISTANCE
- LOW COLLECTOR CAPACITANCE
- UNIFORM CHARACTERISTICS
- HIGH RELIABILITY

For reliable performance in military and commercial circuits subject to high environmental temperatures, Philco now offers a full range of high frequency switching and amplifying silicon transistors . . . in both PNP and NPN types (SAT* and SADT**).

In high speed circuits, the switching types provide the lowest saturation resistance at high junction temperatures . . . permitting up to 5 mc pulse rates using saturated configurations and up to 30 mc pulse rates with non-saturating techniques.

The excellent high frequency response of the amplifier types permits the practical design of communications systems at frequencies up to 60 mc.

For complete data and application information, write Dept. ED-1059.

*Trademark Philco Corp. for Surface Alloy Transistor.

**Trademark Philco Corp. for Surface Alloy Diffused-base Transistors.

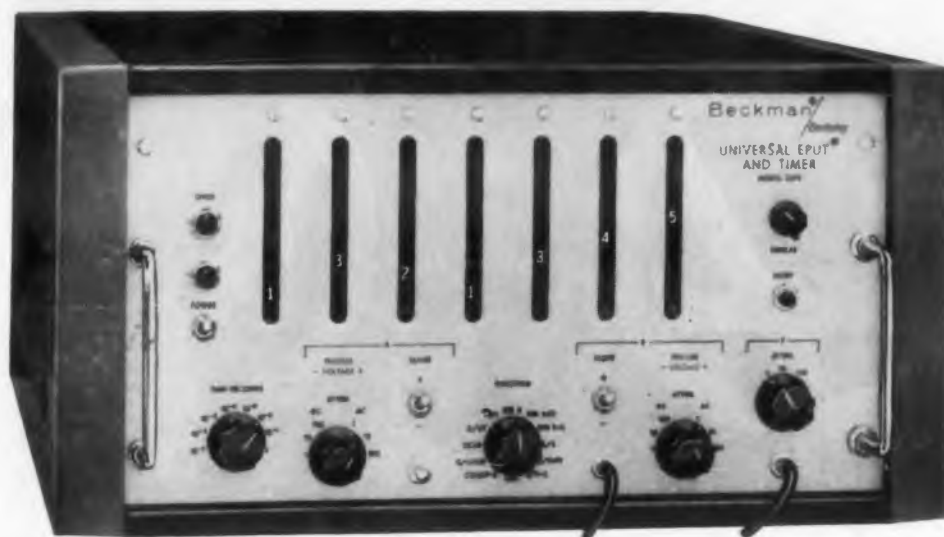
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LANSDALE TUBE COMPANY DIVISION • LANSDALE, PENNSYLVANIA



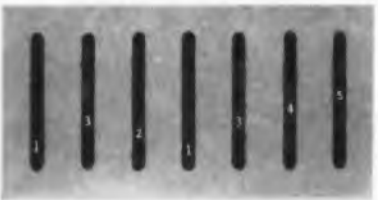
CIRCLE 7 ON READER-SERVICE CARD ►

10 Mc Counter displays microwave frequencies



to transfer oscillator

Coupled to a computing transfer oscillator, this counter will display the 13, 213.45Mc reading shown...one more instance of the unique utility of Model 7370.



SPEEDY, PRECISE METHOD

1. Operator tunes transfer oscillator in the conventional way—finds two adjacent fundamentals having harmonics that zero-beat with the unknown frequency.
2. Reads harmonic number appearing on built-in automatic calculator.
3. Sets digital switches to harmonic number.
4. Reads microwave frequency as it appears on the face of the counter. The entire procedure takes less than one-fifth the time ordinarily required.

SPECIFICATIONS

Model 7370 used with transfer oscillator (Model 7580)	
Frequency measuring range	dc to 15KMc
Types of signals accommodated	CW, AM, FM, pulsed r-f
Sensitivity	100 mv rms
Input impedance	50 ohms
Accuracy	up to $\pm 3p$ in 10^7
Fundamental range of trans. osc.	75 to 150 Mc & 7.5 to 15 Mc
Harmonics available	up to 100th
Stability of fundamental	.0001% per min

Model 7370 alone	
Frequency counting range	dc to 10Mc
Sensitivity	selectable: 0.1v, 1v & 10v
Input impedance	10M ohms
Stability of time standard	3 parts in 10^7 per week
Additional functions	Measures period, phase & frequency ratio.
	Times interval between independent signals.

Prices

Model 7370 Universal EPUT® & Timer	\$1975
Model 7580 Computing Transfer Oscillator	\$1650

Write for detailed technical bulletins

Beckman®

Berkeley Division
2200 Wright Avenue, Richmond 3, California
a division of Beckman Instruments, Inc.

NEWS

band to correspond to the modulation. Another filter, between the antenna and the receiver, rejects signals from the system's adjacent transmitter—an unavoidable source of disturbance because of its proximity to the receiver. With this filter (a quarter-wavelength resonant-line tuned circuit), it is possible to operate with only 480 kc difference between receiver and transmitter frequencies.

The transmitters, commercial units intended for base-station use in mobile communication service, are operated at 49 mc with a power output of 2 kw. Frequency control is by a direct current-coupled, frequency-modulated exciter. The deviation of the transmitter is adjustable so as to provide shifts of 800, 2000, 3700, and 5000 cps at the output frequency.

The antenna system is composed of two arrays, each consisting of two five-element Yagi antennas. To reduce the effect of a strong local transmitter on the sensitive receiving system, one array is always used for receiving, the other for transmitting. Also, contrary to the usual convention, the two antennas of each pair are fed out of phase to produce a split-beam pattern with a null on the great circle connecting the stations. This arrangement made it possible to aim the signals at directions most suited to the meteor burst path, inasmuch as most meteoric propagation takes place on either side of the great circle path. The antenna design is based on meteoric ionization at an elevation of 110 kilometers.

Performance Varies With Conditions

Because of the complexity and high-speed operation of the system, automatic monitoring devices were used to analyze its performance. This was found to vary considerably with equipment settings and atmospheric conditions. The characteristics of the signals received during the experiment indicate that it is advantageous to operate intermittently at transmission speeds higher than the average signalling rate.

From the data on speed-up ratios, it appears that the system operates most effectively at 2400 wpm (40 times normal teletype speed). With this speed and a suitable operating threshold setting, a daily average of 40 wpm may be expected at a character error rate of 0.35 per cent. Higher transmission rates should give better results if improved control systems and rapid-access storage facilities can be substituted. At lower transmission rates, noise interference is a greater factor because the signals have to remain error-free for a longer period for transmissions to be successfully ended. This results in an increase in the probability of error.

What Meteor-Burst Systems Mean to Designers

Meteor-burst systems require a new approach to message handling and control. The systems must operate intermittently at very high speed, and must go into operation automatically when a suitable meteor trail is available for signal enhancement. And there must be provision for storing messages during periods when no meteor trails are available.

Although meteor burst systems do not provide continuous operation, they offer lower power consumption, small antenna requirements, a wider usable spectrum and greater security in message transfer than do forward-scatter systems.

Because of the highly directive character of meteor burst reflections, there is less jamming and interference caused by reception of signals from other transmitters.

System Has Disadvantages, Too

The experiments indicate that signals from two coexistent meteor trails occur frequently enough to be a serious source of error. The system is also seriously affected by electrical storms, precipitation static, and nearby ignition systems and power lines.

Other sources of interference are ionospheric forward scatter, sporadic E-layer propagation, and at the higher-latitude installations, auroral-reflected signals. Tropospheric scatter signals are a problem, but only over fairly short paths, 100 to 200 miles in length. To avoid these sources of interference, the bureau recommends that a practical meteor burst communication system contain an automatic device for setting the system's threshold at a fixed margin above the short-term median signal strength. ■ ■

Signal Corps Sends 500 Kilobit PCM Pulses Over Tropo Circuit

What is claimed to be the first beyond-line-of-sight transmission of high-pulse-rate signals has been made by Army researchers.

Using an AN/GRC-50 radio set, an AN/TCC-40 multiplexer and an ITT Labs microwave power amplifier, Signal Corps engineers sent 500 kilobit pulses successfully over a tropospheric scatter path of 93 miles.

The 12-channel, 1830 mc pcm signal was sent at 1 kw through use of 15-foot parabolic antennas. Subjective talking tests made over the path indicate that voice transmission is not degraded by the randomly varying scatter signal above threshold.



SPRAGUE CUP TYPE TANTALEX CAPACITORS

now better than ever!

■ ■ ■ Sprague's NEW "Cup Type" Liquid-Electrolyte Sintered-Anode Tantalex Capacitors offer several major improvements in cup capacitor design: elimination of fluctuation in capacitance during operation; elimination of "early failures" from internal short-circuiting as sometimes occurs with other brands of cup capacitors; and large values of capacitance in small physical size. But there's more...

■ Rated for -55 C to +85 C operation without voltage derating (to +100 C with 15% derating), these capacitors provide equipment designers with long operating life, long shelf life,

outstanding capacitance stability, and very low leakage currents.

■ Sprague "cup" capacitors are available in two series: Type 131D for industrial, communication, and general military equipment; Type 132D for the severe vibration requirements and close performance parameters of military aircraft and missiles. Type 131 D, moderately priced and furnished in the comparatively wide capacitance tolerance of -15, +75%, is especially suited for filter, coupling, and bypass applications where this wide tolerance is permissible. Type 132D is furnished as standard in the closer capacitance tolerances of -15, +20% and -15, +50%.

Complete data on Types 131D and 132D Capacitors is given in Engineering Bulletin 3710A. Write Technical Literature Section, Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES

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THE MARK OF RELIABILITY

NEWS

Radar Studies of Meteor Trails Aimed at Better Communications

Harvard researchers using sensitive radars hope to record and analyze meteor showers with twice the accuracy previously obtained. Their forward-scatter studies may lead to day-to-day prediction of meteor arrivals.

If meteor showers were predictable, it might prove feasible to use meteor trails for long-range communication, making practicable an almost continuous system of world-wide communication. Meteor-trail forward scatter might prove a better method for this than microwave relay satellites, report Raytheon engineers supplying the microwave equipment.

Behind the research is the ionizing effect of meteors in air. Tiny particles of meteor dust hitting the atmosphere ionizes the air around them. Though the meteors may burn out almost instantly, the air they have passed through may remain ionized for several minutes.

It is these ionized columns of air that can be used for signal transmission. In fact, the investigators report, this meteor ionization may contribute significantly to the general level of ionization in the nighttime E-region.

Under the research program, sponsored by the National Bureau of Standards, three observation stations are being set up, linked by line-of-sight microwave pulse train with a huge antenna farm. Three more stations may be added.

A 40-mc transmitter of 4-megawatt peak power will be used with one of the largest corner reflectors ever made (see photo) to form Y plots on a scope screen. The plots will enable astronomers to determine radiants and orbits of the meteors for measurements of the time difference in signal arrivals.

Design requirements of the relay equipment included a wide dynamic range in the receiver and a high percentage of propagation reliability in the system.



One of the largest corner reflectors ever made is installed at Havana, Ill., to receive radar returns from meteor trails. The 35-foot-high antenna forms a 7-meter double-trough waveguide with an aperture 200 feet long, 70 feet wide.



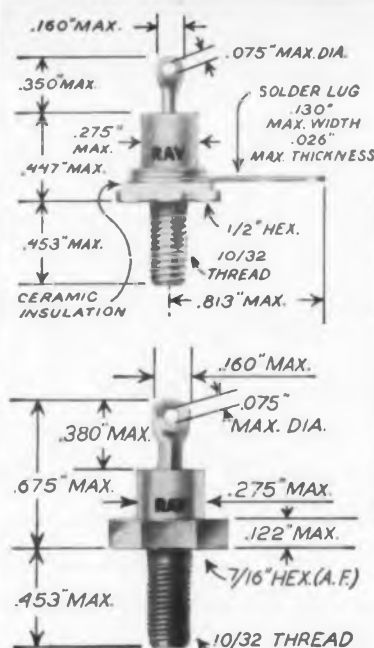
NEW RAYTHEON SILICON TRANSISTORS

Diffused-Base "MESA" Construction

NPN High Speed, High Gain Switches
NPN High Frequency and Video Amplifiers
Close parameter control
Up to 50 megacycles minimum f_{db}

High Voltage PNP Fusion Alloy Transistor

$V_{CBO} = -100$ volts max.
 $V_{CEO} = -80$ volts max.
 $V_{EBO} = -60$ volts max.



New 4 Amp Silicon Rectifiers (Temperature Range -65°C to $+165^{\circ}\text{C}$)

NON-INSULATED		INSULATED STUD	Peak Operating Voltage -65°C to $+165^{\circ}\text{C}$ volts	Ave. Rectified Current		Reverse Current max. μA at Specified Voltage		
Cathode to Stud	Anode to Stud			25°C amps.	150°C amps.	25°C	150°C	volts
1N2512	1N2512R	1N2518	100	4.0	1.0	2.0	250	100
1N2513	1N2513R	1N2519	200	4.0	1.0	2.0	250	200
1N2514	1N2514R	1N2520	300	4.0	1.0	2.0	300	300
1N2515	1N2515R	1N2521	400	4.0	1.0	2.0	300	400
1N2516	1N2516R	1N2522	500	4.0	1.0	2.0	350	500
1N2517	1N2517R	1N2523	600	4.0	1.0	2.0	400	600



NEW RAYTHEON GERMANIUM TRANSISTORS

Complementary circuitry with Raytheon PNP types
Highest reliability
Excellent fast switching characteristics
Low saturation voltage

High Speed Switches (Temperature Range -65°C to +175°C)

Type	V _{CB} max. volts	I _{CO} V _{CB} = 6 volts max. μA	V _{EB} max. volts	H _{FE} I _C = 10 ma V _{CE} = 5 volts min.	V _{SAT} I _C = 5 ma I _B = 2.5 ma max. volts	f _{ab} I _E = 1 ma V _{CE} = 6 volts ave. Mc	R _b ave. ohms	C _{ob} ave. μμf
2N1386	25	.1	3	30	.6	60	60	3.5
2N1387	30	.1	3	20	.6	50	60	3.5

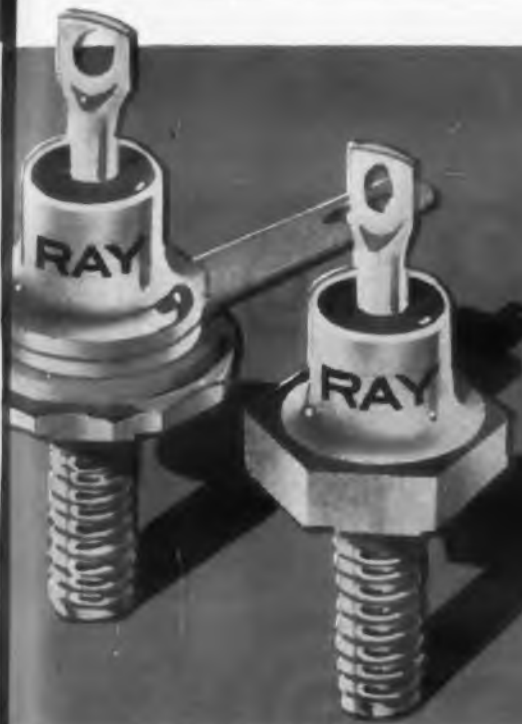
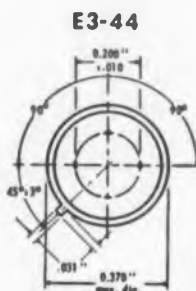
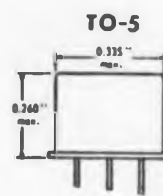
High Frequency and Video Amplifiers (Temperature Range -65°C to +175°C)

Type	V _{CB} max. volts	I _{CO} V _{CB} = 15 volts max. μA	F _T V _{CE} = 6V I _E = 1 ma Mc	R _{in} * at 10 Mc ave. ohms	R _{out} * at 10 Mc ave. ohms	Power Gain at 10 Mc ave. decibels	Gain-Bandwidth Product ave. Mc
2N1388	45	.5	60	500	5000	20	75
2N1389	50	.5	30	500	5000	15	45
2N1390	20	.8 @ 6V	12	400	6000	12	—

*Measured resistive component of the impedance

High Voltage PNP (Temperature Range -65°C to +160°C)

Type	V _{CB} max. volts	V _{CE} max. volts	I _{CO} max. μA	H _{FE} I _B = 0.1 mA V _{CE} = -0.5 V ave.	R _{SAT} max. ohms	V _{EB} max. volts
2N1275	-100	-80	1.0	15	60	-60



NEW RAYTHEON 4 AMP SILICON RECTIFIERS

3 Constructions for design and operating convenience

STUD INSULATED
STUD CONNECTED TO CATHODE
STUD CONNECTED TO ANODE

Low reverse current
High forward conductance
Fast reverse recovery
Exceptional stability

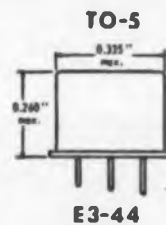
NPN Switches — Medium Current High Frequency, High Gain (Temperature Range -65°C to +85°C)

Type	V _{CB} max. volts	f _{ab} min. Mc	H _{FE} ave. I _C = 50 mA V _{CE} = 1.0 V	R _{SAT} ave. ohms
2N438	25	2.5	25	2
2N439	20	5.0	45	2
2N440	15	10.0	70	2

NPN High Gain IF and Converter For Broadcast and Auto Radio (Temperature Range -65°C to +85°C)

Type	Circuit Usage	V _{CE} max. volts	I _{CO} max. μA	C _{ob} f = 1 Mc ave. μμf	Gain 455 Kc db
2N1366	Converter	12	20	11	28*
2N1367	IF	12	20	11 ± 3	38

* Conversion Gain



EIA Asks U.S. to Stem Imports of Japanese Transistors

Claiming the "increasing penetration of the transistor market will impair the efforts of American producers to provide the capacity to meet existing and potential national security requirements," the Electronics Industries Association last month petitioned the Office of Civil and Defense Mobilization to "investigate growing imports of Japanese transistors and other semiconductor products and determine whether they threaten American security."

Production of Japanese transistors increased from 560,000 in 1956, to 26.7 million in 1958 to 14.9 million in the first quarter of this year, noted the EIA, which pointing out that U.S. transistor production rose only to 47 million in 1958 from 12.8 million in 1956.

A Japanese delegate to the ISA show in Chicago, Dr. H. Imai, of Tokyo's giant Toshiba Co., declared after hearing of the EIA action that imports of Japanese electronic equipment are not a threat to U.S. security, and that the growing strength of Japanese industry in this field is in reality an aid to America's defense.

Dr. Imai also stated that a "restrictive change in trade agreements legislation may, in effect have adverse reactions upon large segments of the U.S. electronic industry."

He pointed out that 1958 exports to Japan were \$829 million while imports from Japan were only \$673 million.

In another EIA action, taken at the organization's Fall meeting in Atlantic City, a "Buy American" campaign was approved.

End-equipment manufacturers will be encouraged to inform consumers with stickers that the products are "Made in America by Americans." Another part of the drive will be informing electronics employes that they are helping their own security by buying products made with U.S. parts.

Gage Measures Plating to Sixth Place



Gage at Bureau of Standards operates on both magnetic and radiation principles to measure platings.



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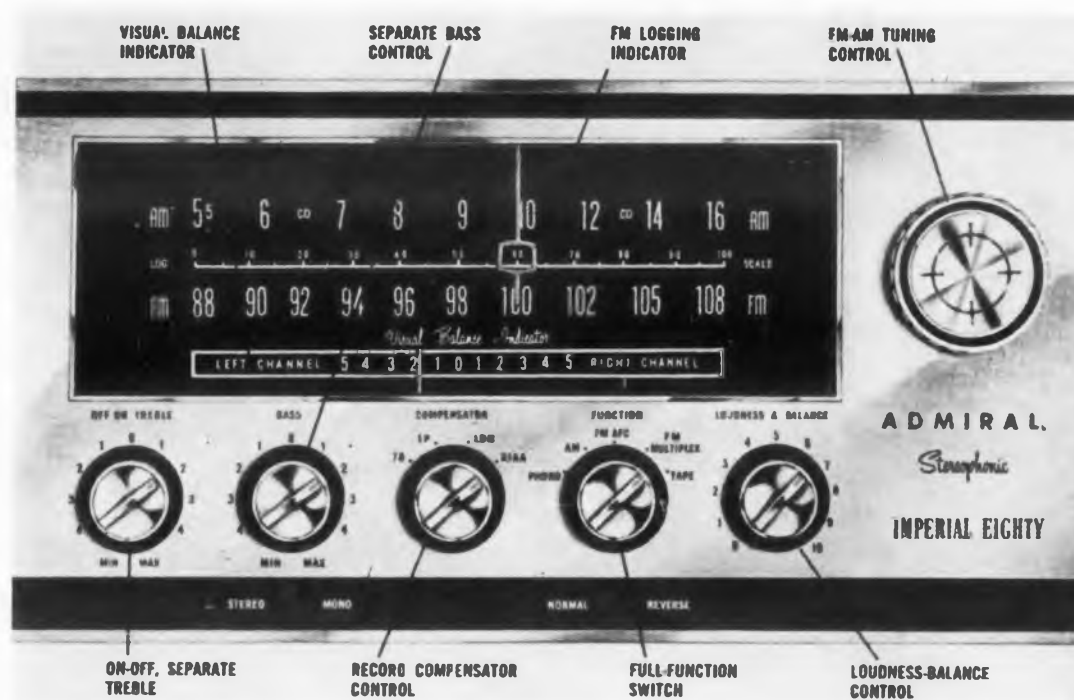


Major Manufacturers Launch Drive for Hi-Fi Stereo

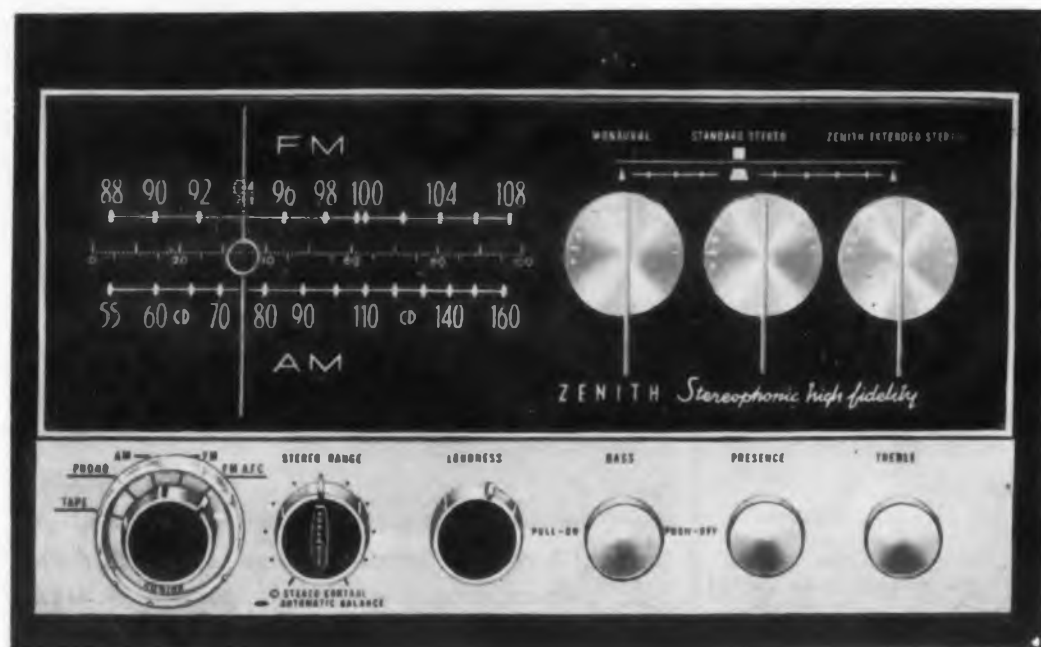
Philco's "Stereo-Dors" (below) act as acoustic mirrors to reflect middle and high stereo channels to the sides with lows radiated from cabinet front.



RCA (left) features push-button controls plus visual balance and tuning indicators in its control panel design.



Admiral's Control Center (above) features a visual balance indicator for stereo adjustments.



Prestige and quality are reflected in the professional-looking control panels designed for the RCA, Zenith, Philco and Admiral units illustrated here. Function controls include stereo balance with visual indication on the RCA and Admiral units.

Zenith's automatic balance control, (left) once set for desired stereo effect, retains the balance for all settings of the volume control.

Hi-Fi Stereo Market



HIGH OUTPUT power, professionally-styled control panels, and versatile speaker combinations—housed in luxurious cabinets—highlighted the design philosophy of major manufacturers exhibiting at the Chicago Hi-Fi® show. In an all-out effort to woo the public from “component” competition, companies such as RCA, Philco, Westinghouse, Zenith, Admiral and Motorola have assembled “packages” equipped with features previously available only with separate components.

Transistors Still Far Off

Circuit design ideas were disappointingly absent. Major component manufacturers in the tuner and amplifier field have concentrated their efforts on the task of combining tuner, preamplifier, and power amplifier units into one package.

Transistors, according to spokesmen for leading manufacturers, will not find their way into hi-fi equipment this year. Price, performance, and (perhaps most important) necessity do not warrant a switchover from tubes. With the present demand for higher and higher output power, completely transistorized equipment would be considered impractical. Hybrid units, produced strictly for glamour and promotion, might be a poor gamble.

Power Ratings High

An eye-opener to the die-hard hi-fi fan might be the unusually high power ratings specified in brochures handed out by major manufacturers of



PLUG-IN INPUT

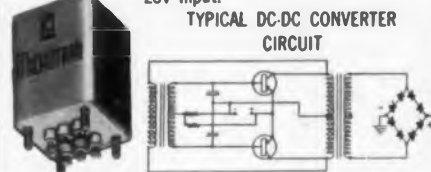
Matches commercial recorder and amplifiers.
Magnetic Shielding 65db. Frequency response 20-20,000 ± 2db Octal Type Plug.
Available on special order with alternate plug-in headers or hermetically sealed.

Part Number	Primary Impedance	Secondary Impedance
M8030*	250/50 C.T.	50,000
M8031	600 C.T./150	50,000
M8032†	250 C.T.	50,000
M8033†	50 C.T.	50,000

*M8030 designed as replacement for Ampex No. 1733-1
†M8032 and M8033 mates with sockets on many RCA amplifiers.

DC-DC CONVERTER

All Items Designed for 13.6V. Except 8034 which is for 28V Input.



Part Number	Total V.A. Output	D.C. Output			
		F. W. Bridge Volts	Ma.	C.T. Full Wave Volts	Ma.
M8034	125	500	250	250	420
M8035	125	500	250	250	420
M8036	40	450	90	225	155
M8037	22.5	250	90	125	155

TRANSISTOR DRIVER

Designed specifically for transistor, servo and audio
Frequency response 70-20K
Size AF mill through AH Hermetically sealed to MIL-T-27A.
EPOXY MOLDED See catalog for exact sizes and weights.

Part Number	Application	Pri. Imp.	Sec. Imp.	Unbal. Ma.	Level Watts
M8002*	Coll. to P.P. Emit.	560	400 C.T.	18	.15
M8003*	Coll. to P.P. Emit.	625	100 C.T.	20	1.5
M8004	Coll. to P.P. Emit.	5,400	600 C.T.	15	.075
M8005	Coll. to P.P. Emit.	7,000	320 C.T.	7	.040
M8006	Coll. to P.P. Emit.	10,000	6,500 C.T.	.75	.005

*Bi-Filar wound to minimize switching transients.

MICRO MINIATURE TRANSISTOR

Available in 4 case types
Hermetic (-H) 15/16" x 11/16" wt. 3/4 oz.
Open Frame (-F) 7/16" x 19/32" x 3/4", wt. .4 oz.

Part Number	Application	Pri. Imp.	Sec. Imp.
MMT 5*	Coll. to Speaker	50,000	6
MMT 7*	Coll. to P.P. Emit.	25,000	1,200 C.T.
MMT 9*	Line to P.P. Emit.	600 C.T.	1,200 C.T.
MMT 10*	Coll. to Emit.	25,000	600
MMT 11*	P.P. Coll. to Emit or Line	4,000 C.T.	600 C.T.
MMT 12*	Coll. to Speaker	2,000	3.4
MMT 16*	Coll. to P.P. Emit.	10,000	1,500 C.T.
MMT 17*	P.P. Coll. to P.P. Emit.	10,000 C.T.	200 C.T.
MMT 18*	P.P. Coll. to P.P. Emit.	25,000 C.T.	1,200 C.T.
MMT 19*	Coll. to P.P. Emit.	2,500	2,500 C.T.

*Add either -M or -H to part number to designate construction. See catalog for detailed information.

MINIATURE TRANSISTOR TRANSFORMERS from stock!

MICROTRAN transistorized transformers are ruggedized, military-type components developed to meet the growing demand for miniaturization. Design and performance meets or exceeds all applicable commercial and government specifications including MIL-T-27A, MIL-T-9219, AN-E-19, CAA-R-9786, MIL-E-5400, MIL-E-16400, MIL-E-4158, MIL-E-8189A, MCREE-553, MIL-T-945A. Available for immediate delivery from Franchise Stocking Distributors.



SILICON RECTIFIER Power Supply



Circuitry Primary 105/115/125 Volts**
Hermetic sealed to MIL-T-27A
See Catalog for additional information.

Part Number	Secondary A.C. Volts	R.M.S. Amperes	Rectifier Circuit C.T.** Full Wave	F.W.** Bridge
M8018*	18.5 C.T.	1	7V.	14V.
M8019*	18.5 C.T.	3	7	14
M8020*	35 C.T.	3	14.5	29
M8021*	70 C.T.	1	30	60
M8022†	18.5 C.T.	3	7	14
M8023†	35 C.T.	3	14.5	29
M8024†	70 C.T.	1	30	60

**380-1600 Cy. **DC output volts stated are for resistive or inductive loads. Capacitor input may be used if RMS AMPS is not exceeded.
*50-60 Cy.

TRANSISTOR OUTPUT



Frequency Response 200-15,000 ~
See catalog for case size

Part Number	Application	Pri. Imp.	Sec. Imp.	Level Watts
M8008	P.P. Output to Spkr.	25	3.4	3
M8007*	P.P. Auto Transf.	30 C.T.	4	2
M8009	P.P. Output to Spkr.	48 C.T.	3.2	8
M8010	P.P. Coll. to Servo	120 C.T.	1,000	6
M8011	P.P. Output to Spkr.	125 C.T.	3.4	1.5
M8012*	P.P. Coll. to Servo	140 C.T.	500	6
M8013*	P.P. Output to Spkr.	250 C.T.	3.4	4
M8014	P.P. Output to Spkr.	400 C.T.	11	25
M8015	P.O. Coll. to Servo	1,600 C.T.	800	2.5
M8016	P.O. Output to Spkr.	2,550 C.T.	12	.10

*Bi-Filar wound to minimize switching transients.

ULTRA MINIATURE TRANSISTOR



Open-frame (-F) Wt. .08 oz. size 3/16" x 3/16" x 11/32"
Molded (-M) Wt. .14 oz. size 1/2" x 1/2" dia.
Nylon Bobbin, Nickel-Alloy Case

Part Number	Application	Primary Impedance (DC)	Secondary Impedance
UM 21*	Input	100,000	1,000
UM 22*	Driver	20,000	1,000
UM 23*	Driver	20,000	1,200 C.T.
UM 24*	Output	1,000	50
UM 25*	Output	400	50
UM 26*	Output	400	11
UM 27*	Output	400 C.T.	11
UM 28*	Choke	10 Hy. (0 dc)	8 Hy (1.5 ma) 650

*Add either -F or -M to designate construction. See catalog.

VERI-MINIATURE TRANSISTOR



Open (-F) Wt. .16 oz. size 7/16" x 7/16" x 1/2"
Frame (-FB) Wt. .2 oz. 15/32" x 7/16" x 17/32"
Molded (-M) Wt. 1/4 oz. 9/16" x 9/16" x 1/2" high
4" color coded leads, resin impregnated.

Part Number	Application	Primary Impedance (DC)	Secondary Impedance (DC)
VM 3*	Interstage	25,000	600 (1 ma)
VM 4*	Input or Interstage	200,000	1200 (.72 ma)
VM 5*	Interstage	50,000	600 (1.0 ma)
VM 6*	Interstage	100,000	1200 C.T. (.72 ma)
VM 7*	Output	500 (3.5 ma)	3.4
VM 9*	Output	1250 (2.0 ma)	50
VM 10*	Interstage	2,500 (1.5 ma)	2500 C.T.
VM 11*	Choke	20 Hy. (0 ma)	12 Hy. (.5 ma)
VM 12*	Interstage	20,000 (.75 ma)	1000
VM 13*	Interstage	20,000 (.72 ma)	1000 C.T.

*Add either -F, or -M, or -FPB to part number to designate construction. See catalog.

LOW LEVEL CHOPPER



Efficiently transfers 30 to 500 cps. Transducer or Thermocouple signals to instrument amplifiers. Signal level range from .5µV to .5 volts. Resin impregnated to minimize mechanical vibration noise signal. Low hum pick up assured by 3 mu-metal and 2 copper shields.

Part Number	Turns Ratio		Ind. of Full Pri. @ .5V	Imped. of Full Pri. @ .5V
	To Full Sec.	To Full Sec.		
M8025	1:7.7	1:15.4	17.5	6,600
M8026	1:3.2	1: 6.4	60 Hy	22,500

Part Number	D.C. Resistance		Mag. Shield.	Hght.	Dia.	Wt. Oz.
	Full Pri.	Sec.				
M8025	365	4140	90 DB	125/32	13/16	4.5
M8026	455	3500	90 DB	125/32	13/16	4.5

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Write TODAY for catalog and price list of the complete MICROTRAN line.

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Good-All
CAPACITORS

50-Volt SUBMINIATURES for Transistor Circuitry



METAL ENCLOSED • MYLAR DIELECTRIC • HERMETICALLY SEALED

Six rugged new capacitor types designed SPECIFICALLY to SAVE SPACE in compact, transistorized assemblies. Two temperature ranges to choose from. All types rated for 500-hours accelerated life testing.

Types **626C - 627C** (Extended foil)
Types **628C - 629C** (Inserted tab)

Temperature Range—Full rating at 85°C — to 125°C with 50% derating.

Life Test—500 hours at 85°C and 125% of rated voltage.

Capacity Tolerance—All tolerances to $\pm 1\%$.

Insulation Resistance—40,000 meg. x mfd. at 25°C but need not exceed 70,000 megohms.

Case Styles—Available in all case style variations in MIL-C-25A.

Type **616G** (Extended foil)
Type **617G** (Extended foil)

Temperature Range—Full rating to 125°C - to 150°C with 50% derating.

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

Capacity Tolerance—All tolerances to $\pm 1\%$.

Insulation Resistance—50,000 meg. x mfd. at 25°C but need not exceed 100,000 megohms.

Case Styles—Available in all case style variations in MIL-C-25A.

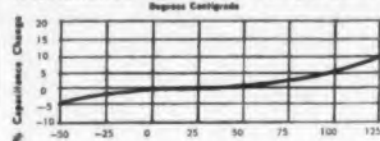
50-VOLT DIMENSIONS

Capacitance in Mfd.	626C*		627C		628C*		629C		616G*†		617G†	
	D	L	D	L	D	L	D	L	D	L	D	L
.001	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$
.0022	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$
.0047	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{8}$	.193 x	$\frac{1}{16}$	.193 x	$\frac{1}{8}$
.01	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{16}$	.173 x	$\frac{1}{8}$	.173 x	$\frac{1}{8}$	.193 x	$\frac{1}{16}$	.193 x	$\frac{1}{8}$
.022	.233 x	$\frac{1}{16}$	.233 x	$\frac{1}{16}$	.193 x	$\frac{1}{16}$	.193 x	$\frac{1}{16}$	.233 x	$\frac{1}{16}$	.233 x	$\frac{1}{8}$
.047	.312 x	$\frac{1}{16}$	.312 x	$\frac{1}{16}$	.233 x	$\frac{1}{16}$	.233 x	$\frac{1}{16}$	.312 x	$\frac{1}{16}$	.312 x	$\frac{1}{8}$
.1	.312 x	$\frac{1}{8}$	.312 x	$\frac{1}{8}$	.312 x	$\frac{1}{16}$	.312 x	$\frac{1}{16}$	.400 x	$\frac{1}{8}$	.400 x	$\frac{1}{8}$
.22	.400 x	1	.400 x	$\frac{1}{8}$	.400 x	$\frac{1}{8}$	.400 x	$\frac{1}{8}$	.500 x	1	.500 x	$\frac{1}{8}$
.47	.500 x	$\frac{1}{8}$	.500 x	$\frac{1}{8}$	.500 x	1	.500 x	$\frac{1}{8}$	.562 x	$\frac{1}{8}$	.562 x	$\frac{1}{8}$
1.0	.560 x	$\frac{1}{8}$	.560 x	$\frac{1}{8}$	.560 x	$\frac{1}{8}$	.560 x	$\frac{1}{8}$				

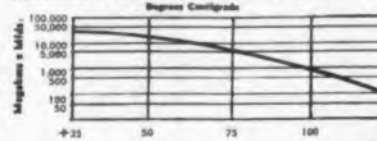
*These types have one lead grounded to the case. Others have both leads insulated.

†Also available in 150V, 400V & 600V ranges.

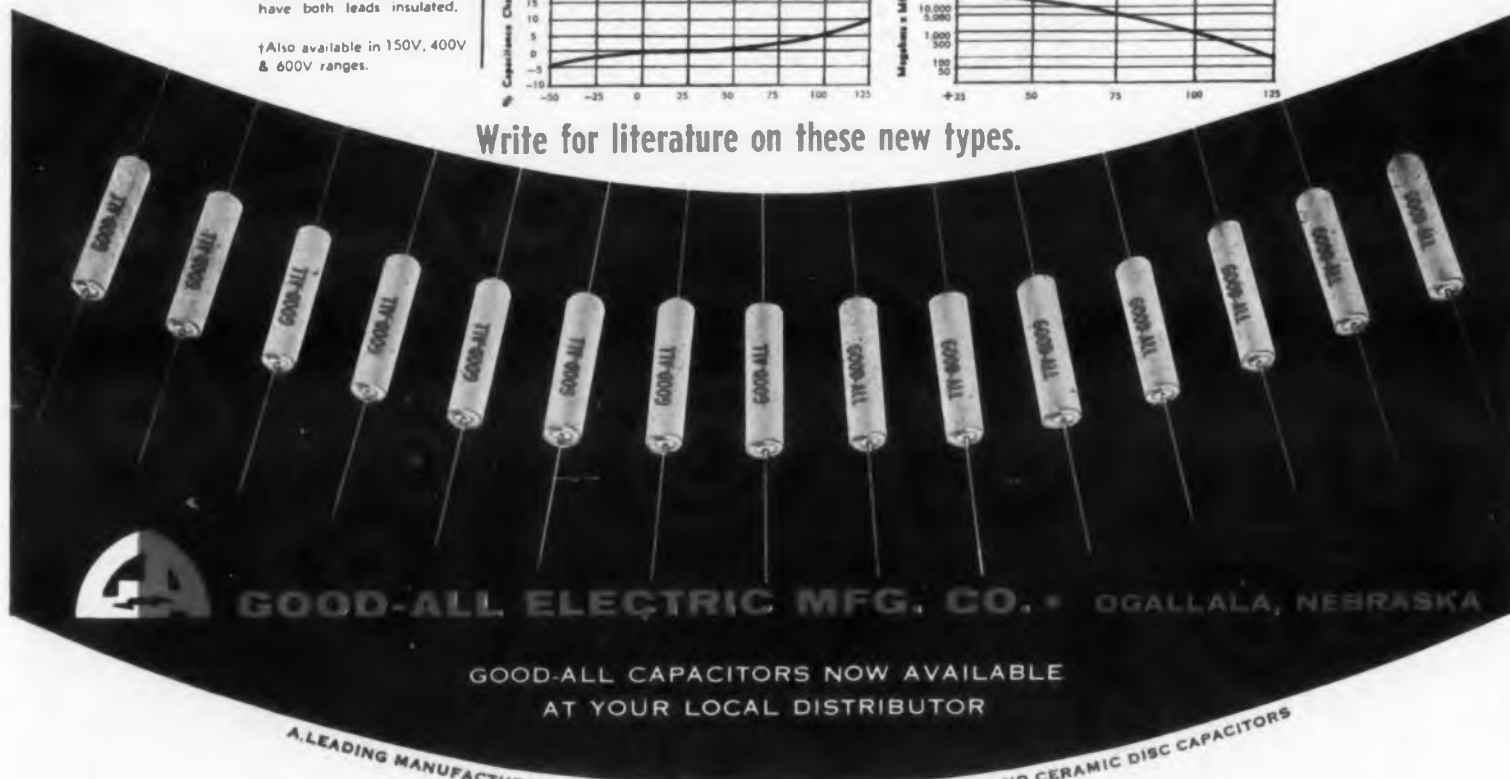
Capacitance Change vs. Temperature



Insulation Resistance vs. Temperature



Write for literature on these new types.



GOOD-ALL ELECTRIC MFG. CO. • OGALLALA, NEBRASKA

GOOD-ALL CAPACITORS NOW AVAILABLE
AT YOUR LOCAL DISTRIBUTOR

A LEADING MANUFACTURER OF TUBULAR, SUBMINIATURE ELECTROLYTIC AND CERAMIC DISC CAPACITORS

CIRCLE 12 ON READER-SERVICE CARD

stereo "packages." As high as 100 w were specified with 40 to 80 w claimed by several companies. Quick checks revealed that peak power ratings were stated; these values are cut in half to convert to the more common maximum undistorted available power. Dividing the resulting number by two yields the power output for each channel of the stereo unit.

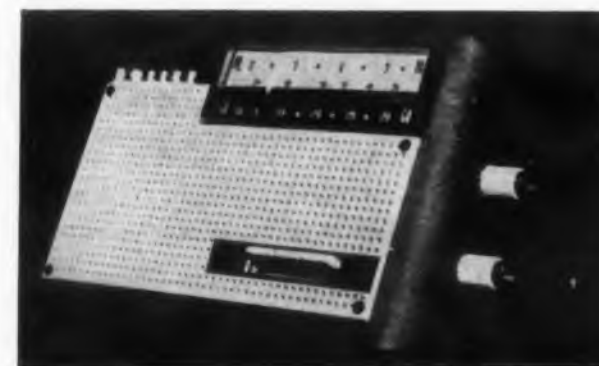
Versatile Cabinetry

Stereo had a slow start, most marketing people believe, because of the need for separate remote speakers with visible, often unsightly wiring between units. Housewives balked and refused to buy.

To placate the influential lady, latest "package" designs include modular assemblies which permit speaker sections to be self-contained, swiveled, or completely removed. In another approach, doors can be opened at the sides of the cabinet

French Cabinet Design Goes

These unusual cabinets by French designer Madame Doliet were shown recently at the Paris Radio and Television Salon, where they were launched with high-fashion techniques. The cabinets, of rf-processed plywood, are made with high precision at low cost. All designs are protected by law.



to permit sound to emerge from a source other than the front.

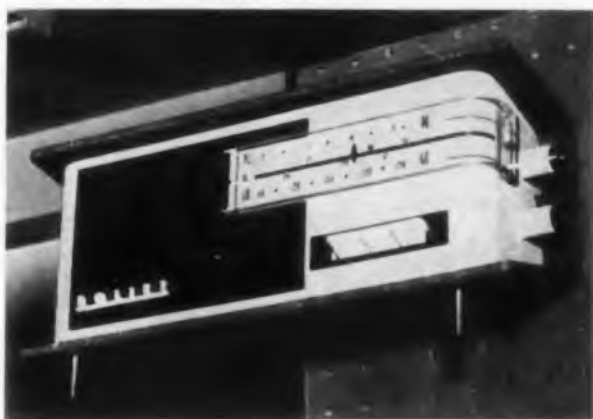
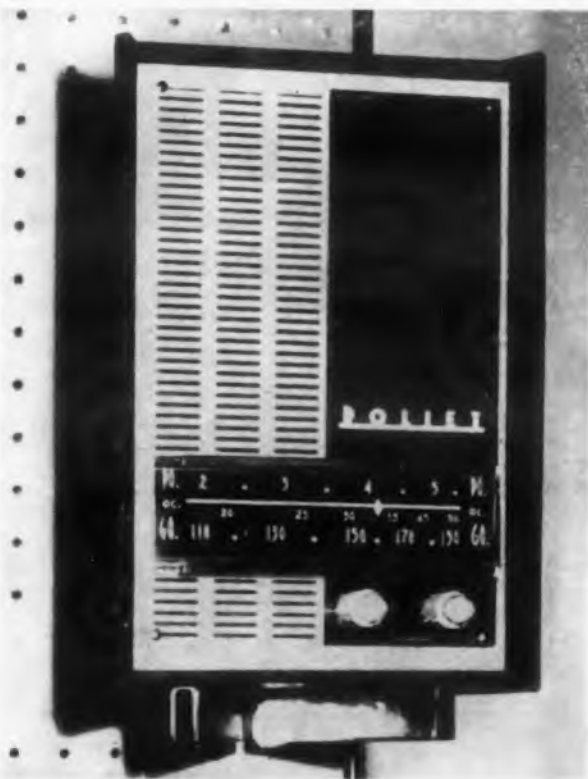
FM Multiplexing

Many of the 20,000 hi-fi enthusiasts shuffling along the three floors at the Palmer House September 18-20 were interested in fm multiplexing. Concerns marketing fm receivers, tuners, and "packages" were besieged with questions pertaining to the availability of multiplex adapters. Since the FCC has not yet approved any one system, potential customers were told "none available, but equipment will be ready the instant approval is granted."

Optimistic buyers seemed rather doubtful; skeptics mumbled that they refused to buy an expensive unit which might shortly become obsolete. ■ ■

*This issue went to press immediately prior to the New York Hi-Fi Show, Oct. 6-9. Interesting designs revealed at that show will be reported in a future issue.

Design Going High-Fashion?



pared down to fit where others can't... size 5 motor generators

Size 5 Motor Generators are now a reality! Servo engineers working against extreme space and weight limitations can specify the ultimate in miniaturization—*Daystrom Transicoil*. Weighing a mere 1.1 oz, these Size 5's develop a minimum stall torque of 0.11 oz-in and have a free speed of 10,000 rpm. Units are available for 400 cycle operation with 26 or 33 control phase winding. The control phase is split for operation directly with transistor amplifiers.

Complete specifications with drawings and graphs of performance characteristics are yours for the asking. Other types and sizes of motors and motor generators are also available. And be sure to get complete details on our new synchro line. Daystrom Transicoil, Division of Daystrom, Inc., Worcester, Montgomery County, Pa. Phone: JUnO 4-2421. In Canada: Daystrom, Ltd., 840 Caledonia Rd., Toronto 19, Ont. Foreign: Daystrom International Division, 100 Empire Street, Newark 12, N. J.

DAYSTROM TRANSICOIL
DIVISION OF DAYSTROM, INC.

Representatives in Canada and Other Foreign Countries
CIRCLE 13 ON READER-SERVICE CARD



Making ceramics work best for you is our business . . .



When ceramic materials are needed in your production processes we can help make them work best for you. Our business is the development of exactly the right materials and shapes to accomplish your requirements most efficiently and economically. Yes, we can provide ceramic materials and shapes in superior quality . . . but beyond this, we offer a broad service in the development of special materials and special shapes for specific applications. Our design staff, with many years experience in ceramic applications, and our modern manufacturing equipment fit us ideally to offer you a better answer to any ceramic requirement, no matter how unusual. Hand your ceramic problems over to us, we'll give you the best solution to them. Write us direct or, if you prefer, send us your sketches. You'll hear from us promptly.

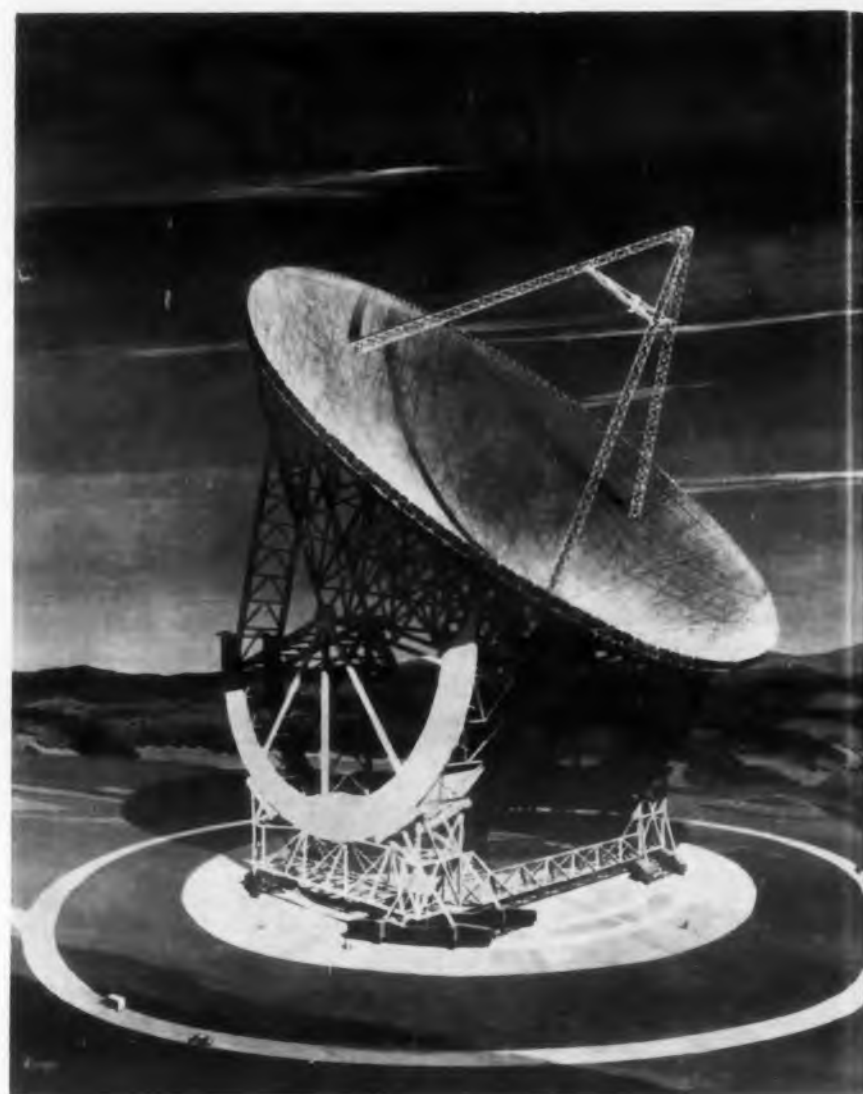
Engineered Ceramics Manufacturing Company

1441 West Fulton Street, Chicago 7, Illinois • CHesapeake 3-7633

CIRCLE 14 ON READER-SERVICE CARD

NEWS

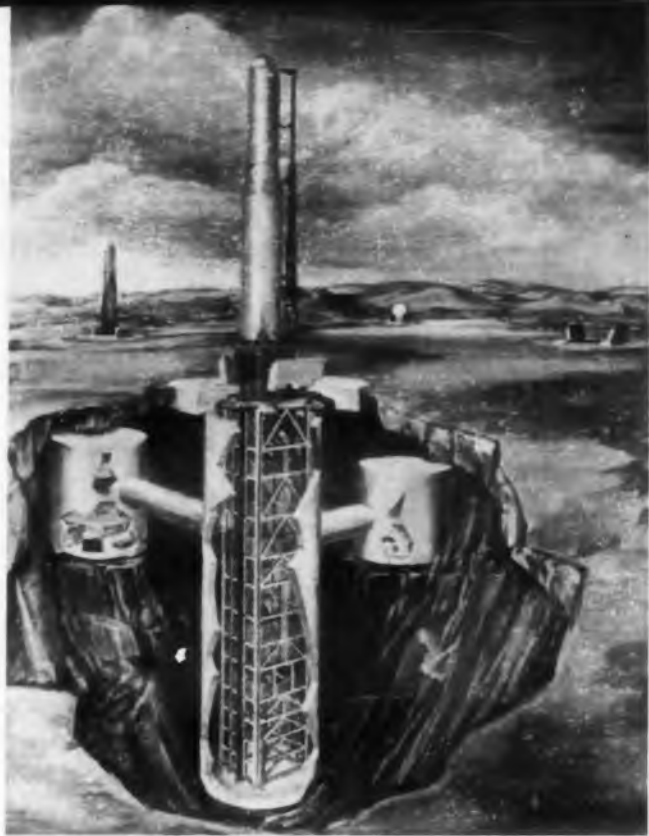
First drawing of Navy's giant radiotelescope now being built near Sugar Grove, W. Va., shows how rocker arms will be used to elevate the 600-foot-diameter reflector. Receiving surface of the dish will be made of aluminum mesh. Inertial guidance will control focussing and servos will adjust individual sections of the dish. Completion is scheduled for 1962.



Design News in Photos



Radar target simulator permits display of both real and synthetic radar returns. According to Philco, high degree of realism is achieved through x-y integration programming and incorporation of an accelerated-time-scale azimuth-gating circuit.



Titan launching system in artist's conception shows how missile will be stored underground, lifted to surface for firing. Facility also includes fuel storage chamber, guidance antenna, control centers and several tunnels. American Machine and Foundry, recipient of a \$42 million contract for building, testing and equipping the facilities, will install 18 launching sites at Lowry Air Force Base, near Denver.



Lockheed scientists inspect instrumentation package designed for Air Force Javelin program set up to measure radiation in the Van Allen belt above the earth. The 15-pound package includes scintillation radiation counters, a Schoenstedt magnetic aspect sensor and a hydromagnetic wave detector.

AT LAST!

Instrumentation Amplifiers with no moving parts



✓ REDCOR MODEL 361

Differential DC Amplifier

- 200 KC Bandwidth
- 100 megohm input impedance
- 120 db common mode rejection

REDCOR MODEL 259

Operational DC Amplifier

- 200 KC Bandwidth
- 0.001 ohm output impedance at dc
- .03% gain accuracy

REDCOR MODEL 260

Potentiometric DC Amplifier

- 200 KC Bandwidth
- 100 megohm input impedance
- 0.002% gain accuracy

New Transistorized Choppers mean Low Noise...High Reliability

Here is the first line of completely solid state amplifiers with solid state choppers for DC stabilization. These long life amplifiers have integral power supplies and operate over a wide temperature range. They meet the urgent need for wide-band, highly accurate amplification where noise reduction and reliability are of prime importance.

Redcor Development Corp.
Van Nuys, Calif.
Technically Represented By



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1905 Armacost Avenue, Los Angeles 25, California • GR 8-4247

STEMCO THERMOSTATS

for precise, sensitive temperature control



1, 2, TYPE C semi-enclosed (1), hermetically sealed (2). Small, positive acting with electrically independent bimetal strip for operation from -10° to 300°F. Rated at approximately 3 amps, depending on application. Hermetically sealed type can be furnished as double thermostat "alarm" type. Various terminals and mountings. Bulletin 5000.

3, 4, TYPE M semi-enclosed (3), hermetically sealed (4). Electrically independent bimetal disc types for appliance and electronic applications from -20° to 300°F. Rating: 8 amps at 115 VAC, 4 amps at 230 VAC and 28 VDC. Semi-enclosed with virtually any type terminal, hermetically sealed with pin or solder terminals, wire leads, various mounting brackets. Bulletin 6000.

5, 6, TYPE MX semi-enclosed (5), hermetically sealed (6). Snap acting miniature units to open on temperature rise for missile, avionic, electronic and similar uses. 2° to 6° differentials available. Rated at 3 amps to 1 amp, depending on duty cycle, at 115 VAC and 28 VDC for 250,000 cycles. Semi-enclosed types with metal or ceramic bases; hermetically sealed in circular or CR7 cans. Various terminals, mountings, brackets, etc. Bulletin 6100.

7, 8, TYPE S* adjustable (7), non-adjustable (8). Positive acting with single stud or nozzle mounting. Operation to 600°F. Rated at 15 amps at 115 VAC, 7 amps at 230 VAC. Spade, screw or elevated terminals, various adjusting stems, etc. Bulletin 1000.

9, TYPE SA* adjustable (9) or non-adjustable. Snap acting with electrically independent bimetal. Also single-pole, double-throw. Single stud or nozzle mounting. Non-inductive-load rating: 15 amps at 115 VAC, 10 amps at 230 VAC. Spade or screw terminals. Bulletin 2000.

10, TYPE SM* manual reset (10). Electrically same as Type SA (above) except for manual reset feature. Bulletin 2000.

11, TYPE B adjustable (11) or non-adjustable. For uses where heat generated by passage of current through bimetal strip is desirable. Various terminals, single stud or nozzle mounting. Operation to 400°F. Nominal rating: 5½ amps at 115 VAC of 40 cycles and higher. Bulletin 9000.

12, 13, 14, TYPE A* semi-enclosed (12, 13), hermetically sealed (14). Insulated, electrically independent bimetal disc gives fast response and quick, snap action control for appliance, electronic and apparatus applications from -20° to 300°F, or higher on special order. Rating: 3 to 4 amps, depending on duty cycle, at 115 VAC, 2 amps at 230 VAC and 28 VDC. Various enclosures and mountings, including brackets. Bulletin 3000.

15, TYPE R* sealed adjustable (15), sealed non-adjustable. Positive acting for operation to 600°F. Rated at 15 amps at 115 VAC, 4 amps at 230 VAC. Screw terminals. Bulletin 7000.

16, TYPE W* adjustable (16), or non-adjustable. Snap action bimetal strip type for operation to 300°F. Rated at 5 amps at 115 VAC, 3 amps at 230 VAC. Screw or nozzle mountings; spade, solder or screw terminals. Bulletin 4000.

17, TYPE H† adjustable. Positive acting for fry pans, skillets, sauce pans, etc. Fail-safe, open in low to 500°F in high. Rated at 1650 watts at 115 VAC. Bulletin 10,000.

18, TYPE D* automatic (18), or manual reset. For laundry dryers or other surface and warm air applications. Snap acting disc type U.L. approved for operation to 350°F. Open or enclosed styles. Rated at 25 and 40 amps at 120-240 VAC. Screw or spade terminals. Bulletin 8000.

Illustrations, for general information only, do not necessarily show size comparisons. Fully dimensioned and certified prints on request. Manufacturer reserves right to alter specifications without notice. AA-1230

*Refer to Guide 400 ED for U.L. or C.S.A. approved ratings.
†Patent Applied For.

NEWS



Cone protruding from last of the Vanguard's houses a magnetometer. The 20-inch sphere is expected to orbit for 200 years.

Last of Vanguard's Up; Was Project Worth It?

Through successful orbiting of the last of its scheduled satellites in September, the Vanguard program was able to leave the space scene in a favorable light. Question? Was this country's first space age program worth its immense cost and effort?

Dr. J. P. Hagen of the National Aeronautics and Space Agency, and a leading figure in the Vanguard program says yes: "In retrospect, I think it has all been worth it."

Yet only three of the eleven attempted launchings were successful. And the first, widely publicized, failure was labeled at the time a major propaganda setback.

What was achieved besides experience useful in the Discoverer and Explorer programs?

The first Vanguard, a tiny test vehicle, provided useful cloud-cover data. Vanguard II, a full-scale satellite, proved the practicality of solar-cell power supply in space and added support to the view that the earth is somewhat pear-shaped.

Vanguard III, just beginning its expected 200-year hitch in space, carries 50 pounds of instruments and electronic equipment and is expected to provide valuable information on space conditions for a long time. With its launching, one of the program's original goals has been exceeded: putting up one full-scale satellite in six tries.

STEVENS manufacturing company, inc.
P.O. Box 1007, Mansfield, Ohio



THERMOSTATS

◀ CIRCLE 16 ON READER-SERVICE CARD

Value of Japanese Electronic Production Skyrocketing

Figures on Japanese electronic production compiled by the Business and Defense Services Administration of the Commerce Department show, when converted to dollars, that if Japan's electronic growth continues at its present rate for the rest of the year, 1959 value of electronic production will be double that of 1957.

Figures include factory prices and taxes for equipment listed.

Japanese Electronics Value
Value in Thousand \$

	1957	1958	Jan.-Mar. 1959
Consumer Products	170,901	266,226	99,345
Industrial, Military Products	77,356	85,159	26,809
Tubes	69,502	76,466	27,295
Semiconductors	10,703	24,470	11,455
Other Parts	33,735	45,602	19,532

Quadruple Diversity Scatter Link Due for West Indies

A tropospheric scatter system using quadruple diversity uhf will be installed to link Trinidad and Barbados with six telephone speech channels.

Also to be incorporated, for automatic error correction, will be Marconi autoplex equipment.

One of the six channels will be used for telegraphy and will be made up of three 100-baud fm/vf channels. One fm/vf channel will be in two-channel (50 baud) time-division multiplex.

Quadruple diversity will be achieved by using a pair of 30-foot dish antennas at each end. Each pair will be separated by 100 feet and transmit signals separated by 4 mc. A different set of frequencies will be used for the two antenna pairs.

Cross-polarizing probes in each antenna feed horn will permit each dish to receive signals polarized at right angles to signals each transmits, enabling each antenna to be used simultaneously for transmission and reception.

Because of the physical spacing of the antennas, signals arriving at one are in space diversity with signals arriving at the other. This combined with the 4-mc frequency diversity gives quadruple diversity.

Marconi's Wireless and Telegraph Co., Ltd., will provide the uhf equipment and system design.

HOW MANY OF YOUR DESIGNS SHOULD USE THE RCA 6U8-A?

The popular RCA-6U8-A has been the designer's mainstay for years. Some of the many successful applications that have made this triode-pentode a Preferred Tube Type are described below.

VHF Oscillator-Mixer • Amplifier and Relay-Control Tube (*TV remote-control unit*) • Burst-Killer and Band-Pass Amplifier (*color TV*) • Sound IF and Noise Inverter (*color TV*) • 3.58-Mc Oscillator and Reactance-Control Tube (*color TV*) • Picture IF and Sync Output (*black-and-white TV*) • Sound IF and Audio Amplifier (*black-and-white TV*) • RF Amplifier (*garage door opener*) • Pulse Amplifier and Discharge Tube (*TV camera*) • Voltage Discriminator (*oscilloscope circuits*) • DC Amplifier (*navigational aids*)

RCA-6U8-A, like all RCA Preferred Tube Types, incorporates the results of a program of continuous improvement. For example, the pentode unit features a newly designed suppressor grid which improves the knee of the plate characteristic, and the triode unit has a new box-type plate which minimizes inter-electrode leakage.

In addition, both the pentode and the triode units use RCA's new N-132 vacuum-melt cathode sleeve for longer life and improved stability of electrical characteristics. Strict quality control includes 100% testing for interelectrode leakage as well as for shorts, continuity, gas, emission, rf noise, and af noise. The result is a tube of superior quality.

The 6U8-A has a 450-ma heater with controlled warm-up time for series-string applications. For applications requiring 600-ma heaters with controlled warm-up time, use the companion type RCA-5U8. Consider the many ways you can use RCA-6U8-A or RCA-5U8 to get top performance from your designs. Get full details from the RCA Field Office nearest you.



RADIO CORPORATION OF AMERICA
Electron Tube Division

Harrison, N. J.



EAST: 744 Broad St., Newark 2, N.J.
HUMboldt 5-3900

MIDWEST: Suite 1154, Merchandise Mart
Plaza, Chicago 54, Ill., WHitehall 4-2900

WEST: 6355 East Washington Boulevard,
Los Angeles 22, Calif., RAYmond 3-8361

ANOTHER WAY RCA SERVES YOU THROUGH ELECTRONICS

NEWS

Balloon Raises Antenna



Antenna wire is carried aloft by helium-filled balloon, part of a radio rescue beacon. Balloon-lofted antenna permitted signal reception up to 4500 miles from transmitter in FAA tests, according to the beacon designer Crosley Div., Avco Corp.

Speed of 120 IPS Records Half-Cycle FM to 1 MC

A recording system capable of taping extended fm lows down to a half cycle and the video band to 1 mc is operated at a 120-ips speed and has specially designed recording and playback heads.

The CV-107 was designed by Minnesota Mining's Minicom Division to measure time intervals in the megacycle range and to record transient wave forms of one mc.

The system can be operated in three modes: seven direct-recording and playback tracks of 400-cps-to-1-mc range; four analog tracks of that range plus three fm channels with half-cycle-to-100-kc range; and three tracks of the full range from one-half cycle to 1 mc plus one track with a 400-cps-to-1-mc range.

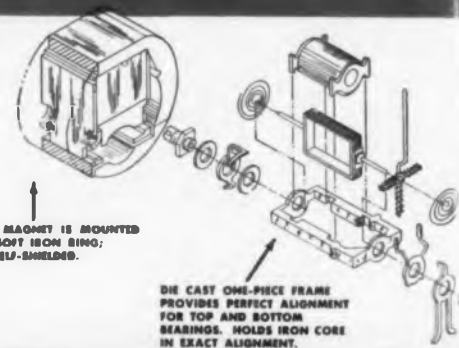
A single half-inch tape is used.



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BAR-RING TYPE MOVEMENTS (Exclusively Triplet)

- Self Shielded
- Not affected by magnetic panels or substantially by stray magnetic fields.
- More Torque
- Lower Terminal Resistance
- Faster Response
- Exceedingly Rugged and Accurate
- All Case Sizes



BURTON BROWNE ADVERTISING



Round Flush Mounting (2 1/4")
Model DC 221-T, AC 331-S, RF 241-T



Rectangular Flush Mounting (2 3/4")
Model DC 327-PL, AC 337-PL,
RF 347-PL



Round Flush Mounting (3 1/4")
Model DC 321-T, AC 331-S, RF 341-T,
Dyn. 361



Rectangular Flush Mounting (2 3/4")
Model DC 227-T, AC 237-S, RF 247-T



Rectangular Flush Mounting (4 3/4")
Model DC 420-PL, AC 430-PL,
RF 440-PL



Rectangular Flush Mounting
(2 1/2")
Model DC 227-PL, AC 237-PL,
RF 247-PL



Rectangular Flush Mounting (6")
Model DC 626, AC 636, RF 646



Shielded Instruments—1 1/2", 2 1/2" and 3 1/2"
In addition to the standard mounted line of panel instruments, Triplet supplies a complete line of ruggedized and sealed instruments designed to meet government specifications MIL-STD-1000A.



Round Flush Mounting (2 1/4")
Model DC 221-PL, AC 231-PL,
RF 241-PL



Rectangular Flush Mounting (1 1/2")
Model DC 227-T, AC 237-S, RF 247-T,
Dyn. 361-A

For complete details see your Electronic Parts Distributor, or write

LINE FULLY MEETS YOUR NEEDS

The name TRIPLETT has been on instruments of our manufacture for more than 55 years, and is regarded as a symbol of customer satisfaction to industrials and distributors in all parts of the world. Our instruments can be built to customer

specifications or provided from our large stocks of standard ranges in hundreds of sizes and types. We also carry in stock many semi-finished movements which can be converted readily to special customer needs.



Rectangular Flush Mounting (4 1/2")
Model: DC 420, AC 430, SP 440



Minimum Size-wise Panel Meters
—Model 130



Model 327-U Unimeter 3 1/2"
Sensitized



Model 354 Relay



Tilting Case Portable
Model: 325 (DC), 335 (AC)



Model 420-U Unimeter 4 1/2"
with mirror scale



Model 234 Unimeter Stand



Round Flush Mounting (3 1/2")
Model: DC 231-P, AC 231-A,
SP 241-A



Rectangular Flush Mounting
(2 1/2")
Model: DC 724, AC 734, SP 744



Model 424 YB Meter
Type A Series



4 1/2" Round Case, 2 1/2" Inside Portables
Model: 423 (DC), 415 (AC)

TRIPLETT
Quality...
First to last

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

Miniaturization Award Entries Invited

The miniaturization Awards Committee is ready to receive entries for the 1959 miniaturization competition.

In making this announcement, the contest sponsors, Miniature Precision Bearings, Inc., stated that the basis for awards will be:

- Ingenuity in solving basic miniaturization problems of broad interest to industry;
- New design concepts having wide potential;
- Development or manufacture of new types of components or assemblies that extend the frontier of miniaturization.

In addition, other criteria must be met by entries to be considered for an award. A kit with detailed information on the contest is available from the Miniaturization Awards Committee, Box 604, Keene, N. H.

Last year's winner was the Martin Co. for its five-pound SNAP nuclear-powered generator.

NBS Method Predicts Transmission Loss

Using data on terrain profiles and ground meteorological conditions, the National Bureau of Standards has developed a method of predicting the cumulative distribution with time of radio transmission loss at frequencies above 10 mc. The method is valid for transmissions over paths of arbitrary length.

Bases for the technique are standard atmospheres in which the radio refractive index decreases linearly with height for the first kilometer above ground, then decreases exponentially with height.

At frequencies of 40 to 10,000 mc, the Bureau reports, and at distance out to and just beyond the radio horizon, the dominant propagation mechanism is diffraction. At greater distances, to 1000 miles, the dominant mechanism is usually forward scatter.

The Office of Technical Services is publishing the NBS findings.

◀ CIRCLE 18 ON READER-SERVICE CARD



Engineer A. M. Darbie installs a Tung-Sol/Chatham 6336A twin power triode in a Harrison Labs 2B regulator, part of a 200B high current power supply. Superior power handling ability of the 6336A lets Harrison Labs offer the regulator with a 5-tube complement in addition to a 7-tube model.

Harrison Labs gains flexibility with Tung-Sol/Chatham 6336A!

Harrison Laboratories, quality manufacturer of Berkeley Heights, N. J., offers designers its 2B regulator with a 5 or 7-tube complement. Superior power handling ability of Tung-Sol/Chatham's 6336A twin power triode makes possible the 5-tube version that features operation over a wider line voltage variation without change of transformer taps.

Over more than a year, Tung-Sol/Chatham's 6336A has performed with exceptional reliability. Users of Harrison Labs 2B regulator especially appreciate the reduced downtime and maintenance

stemming from 6336A's long life and electrical stability. In all, Harrison Labs evaluates the Tung-Sol/Chatham 6336A a wise design choice.

Harrison Labs adds another name to the growing list of manufacturers benefitting from the reliable efficiency of Tung-Sol tubes and semiconductors. So can you. Tung-Sol makes a quality unit for virtually every industrial and military need. Our applications engineers will gladly assess your circuitry and help discover how you can profit by specifying Tung-Sol. Tung-Sol Electric Inc., Newark 4, New Jersey. TWX: NK193



TUNG-SOL®

NEWS

European Control Going Electrical, ISA Hears

Sixty per cent of all European industrial processes will be controlled electrically. This prediction was made by Holland's Prof. C.J.D.M. Verhagen at the 14th Annual Instrumentation-Automation Conference, held last month in Chicago.

Prof. Verhagen, chairman of the International Instrumentation Session, reported that an overwhelming number of processes are being installed with, or planned for, electrical rather than pneumatic or hydraulic control.

Automation in Europe has been slow because of the relatively small mass-production needs of the individual countries. Most top European industrialists are cautious and unwilling to gamble fortunes on automation, the professor added.

In the keynote session, Dr. Henry L. Cox, an industrial instrumentation consultant, pointed out that census figures predict a 40 per cent increase (70 million people) in U. S. population by 1975. This increase will mean demands for better living that will be beyond the range of labor available by that time. Either working hours will be increased (an unlikely event, in the opinion of Dr. Cox) or automation will have to be increased.

Therefore, automation is not only desirable, concluded Dr. Cox in a statement aimed at those who worry about the link between automation and unemployment, but automation is a necessary step for large-scale industries if shortages and accompanying inflation are to be avoided.

At the ISA show more than 400 exhibits displayed the full range of recent instrumentation developments. Over 180 papers were given, including papers on nuclear plant control, aircraft and weather equipment, and space equipment design from actual experience with Titan and Atlas missiles.

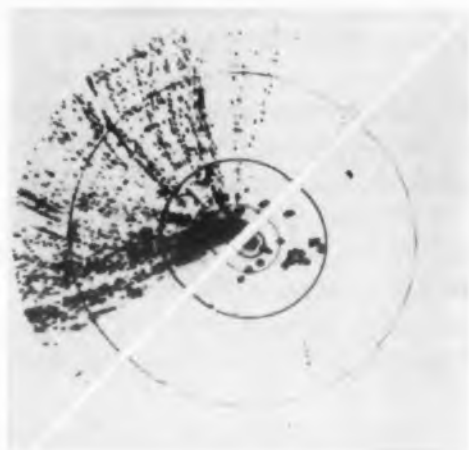
In pointing out the significance of the show, ISA president, H. C. Frost stated that Premier Khrushchev's confidence in the ability of

◀ CIRCLE 19 ON READER-SERVICE CARD

the U.S.S.R. to exceed the industrial output of the U.S. would have "evaporated" had the Soviet leader been able to spend even 15 minutes at the show.

ISA attendees who had visited the U.S.S.R. reported that only in photoelectric pyrometry does Soviet instrumentation exceed the U.S.

Defruiting Equipment Aids Beacon System



Display of aircraft over airport is shown both without (left) and with (right) defruiting by Airborne Instruments lab equipment operating as part of newly installed beacon system at New York's Idlewild and Newark airports. To eliminate spiral lines caused by nearby beacon interrogators, replies of transponders to successive interrogations are compared in a coincidence mixer. Beacon system, which is a modification of World War II's IFF recognition method, will be used in all FAA installations. Up to 63 recognition codes can be pulsed over the system's primary radar.

Form Space Spectrum Group

A committee to recommend designation of "the parts of the radio spectrum where frequency allocation should be made for space research" has been formed by the International Telecommunications Union. Committee members are the U.S., the Soviet Union, Britain, France and Czechoslovakia.

The group was also asked to recommend bandwidths suitable for space studies.

COORS PRODUCES CERAMIC TO MEET YOUR REQUIREMENTS!



Eighteen years ago, this insulator was the answer to a need for a new ceramic for use on an early atomic project—Coors first production run of large ceramic parts using the isostatic technique.

Coors precision finishing improves accuracy of electrical characteristics—this window for a traveling wave tube has thickness tolerances of $\pm .0005$ ", and a flatness of 2 to 3 light bands.

Brazing temperatures of 1083° C were used in making this hermetic ceramic-to-metal assembly, permitting high operating temperatures in the final use of this design.



New ceramic compositions, and new techniques have been introduced many times by Coors. Eighteen years ago Coors met the requirements of engineers in an early atomic project by supplying both a new ceramic composition and a new isostatic technique for forming ceramic components. The result—a new, mechanically strong, completely homogenous ceramic having excellent electrical properties.

Demands for better, stronger materials have been answered by Coors throughout the 47 years of their experience. Continuous re-

search assures future developments. For example, Coors AD-99 is only one of several ceramic materials recently developed to meet the new needs of the electronic industry.

Parallel with the development of new ceramic compositions is the research for new and better techniques. For example, a completely new department for metalizing and brazing was installed and recently enlarged. Ceramic-to-metal assemblies can be furnished where brazing temperatures go as high as 1083° C—bonds have tensile strengths as high as 9,000 to 12,000 psi.



Ceramic compositions or production techniques are of little value without precise control. You need close tolerances—you obtain them from Coors in production runs, or experimental prototypes. Customary, careful work by over 600 skilled workers permits holding tolerances of 30 millionths of an inch on production runs.

To meet increased demands, additional engineers are being assigned to the field—Coors engineers in your neighborhood give

you on-the-spot ceramic design service. They need only your invitation to help you with your ceramic problems.

For information concerning our facilities and for data about Coors high alumina ceramics, please write for bulletin 858.

Coors

COORS PORCELAIN COMPANY

600 Ninth Street, Golden, Colorado

CIRCLE 20 ON READER-SERVICE CARD >

ELECTRONIC DESIGN • October 14, 1959



Another Tinnerman Original...

Self-locking **SPEED NUT**[®] goes on fast, never shakes loose...and reduces costs!

With only one piece to handle, you can quickly position this Tinnerman Flat-Type **SPEED NUT** in screw-receiving position in one motion. No threaded nuts, no lock washers, no spanner washers to worry about.

Drive the screw and this spring-steel fastener locks tight, never to shake loose; yet easy to remove and reuse whenever you desire. **SPEED NUTS** won't freeze on screw threads!

Tinnerman Flat-Type **SPEED NUTS** are made in a full range of sizes, tensile strengths and corrosion-resistant finishes. Design variations also provide many multiple-function special types.

Lower cost per thousand plus lower cost of assembly give you maximum cost-reduction benefits... with maximum fastening assurance.

For more information, refer to your Sweet's Product Design File, section 7-Ti. Your Tinnerman representative has samples and prices. He's listed under "Fasteners" in the Yellow Pages. Or write to:

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Speed Nuts[®]



FASTEST THING IN FASTENINGS[®]

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

CIRCLE 21 ON READER-SERVICE CARD

NEWS

Soviet Moon Rocket Carried Three Transmitters

Two transmitters in the lunar rocket's instrument compartment and one in the vehicle's second stage telemetered back data on five types of space phenomena, according to Soviet reports: micrometeorites, interplanetary gases, cosmic radiation, and radiation and magnetic fields of the moon.

The most significant finding announced so far is the fact that the rocket's instruments were not able to detect a magnetic field around the moon.

Scientists have predicted that no moon magnetic field exists, and the corroboration supports the view that the earth's magnetic field is a result of a rotating liquid core.

The transmitters, which operated at 19.993 and 39.986 mc, 19.997 and 20.003 mc, and 183.6 mc, made it possible for several stations around the world to track the moon rocket.

A Soviet announcement reported an increase in ionized particles within several thousand miles of the moon.

Moon Hit or No: U.S. Still Instrument Leader

Engineers interviewed by *ELECTRONIC DESIGN* at the ISA conference last month praised the Soviet moon-shot success while asserting that instrument technology is further advanced in the U.S. than in the U.S.S.R.

Soviet success in missile guidance, *Electronic Design* was told, is a result of great concentration on a large-scale space-vehicle program.

Some experts feel that the Soviets have been forced to do the best with the least complex, while the U.S. is continually making state-of-the-art improvements throughout the breadth of the industry. (For other news of the ISA show see p. 23)

NEWS BRIEFS . . .

. . . **VALIDITY OF PATENTS** awarded late Major Edwin Armstrong, developer of frequency modulation, regenerative circuit, and superheterodyne receiver, has been upheld in Federal Court. Action supports his widow's suit against Emerson Radio, and could lead to successful patent-infringement suits against many other firms.

. . . **COMPUTER-PLANNED MEETINGS** will be studied with support of the National Sciences Foundation. Idea is to reduce magnitude and complexity of scheduling, and to avoid conflicts.

CIRCLE 350 ON READER-SERVICE CARD >

ELECTRONIC DESIGN • October 14, 1959

... **FIRST OF FLYING WEATHER LABS** has completed flight tests as part of AN/AMQ-15 Air Weather Reconnaissance System. Goal is a wide-area, 3-D, continuous picture of the weather, which could provide insights into the causes and effects of weather. Boeing 707 jet, loaded with Bendix probes, sensors, cloud and storm radars and instrument-carrying sondes, made the tests.

... **PHONOGRAPHS ARE READY** to pass radios as second-largest dollar-volume product of consumer electronic industry, according to TV Digest. Under impetus of stereo, phono sales might reach \$425 million by end of 1959. Last year's radio sales were \$382 million, states the publication.

... **NEW COMPUTER ELEMENT**, Transwitch, claimed to eliminate need for flip-flops designed with two transistors, will be available to computer designers soon from Transitron Electronic Corp. To operate in the 2-10-ma range at up to 20 v, the units will stay on and off when turned on and off, but will remember their last instruction.

... **MOBILE TELEPHONE** service on a country-wide basis, a possibility if the FCC releases, new frequencies now under study, would involve closer coordination than in any previous venture by some 4100 companies serving the two-thirds of the nation handled by independent companies, reported A. C. Culbertson, of Lenkurt Electric Co., at an IIEE meeting.

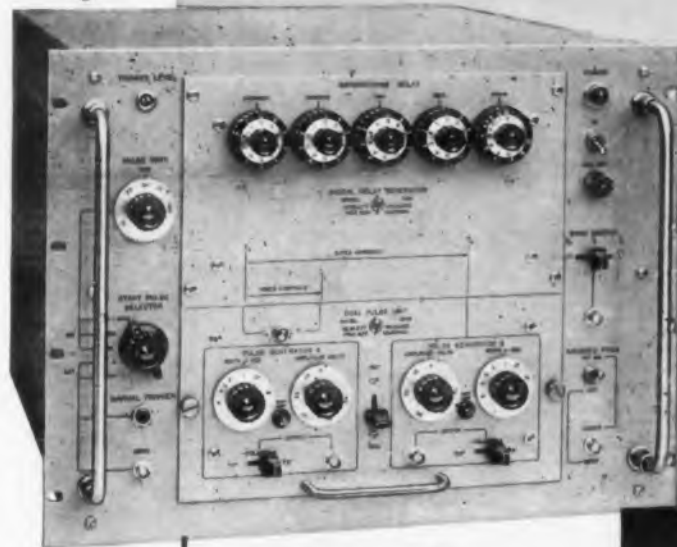
... **THERMOELECTRIC MARKET** of \$100,000,000 is predicted in five years by General Instrument Corp., which has formed a thermoelectric division to finish development of a small nuclear generator, a conventionally fueled thermoelectric power supply, and refrigerating units.

... **TELEPHONE CALL RESTRICTOR** has been developed at North Electric Co., Galion, Ohio, that will pass, outgoing, only calls with approved combination of digits. Purpose: discouraging personal long-distance calls.

... **MAGNETIC DOMAIN COMPUTING** techniques will be investigated by two more companies: Servomechanisms, Inc., will explore use of magnetic-domain interaction in thin evaporated films to miniaturize and boost reliability of digital circuitry, and Litton Industries will study, for Douglas Aircraft, design of a radical, magnetic-domain digital computer. Servomechanism has also announced entry into thermoelectric research; concentration will be on materials that can retain thermoelectric properties at very high temperatures.



MEASURE TIME; 0.1 μ sec ACCURACY!



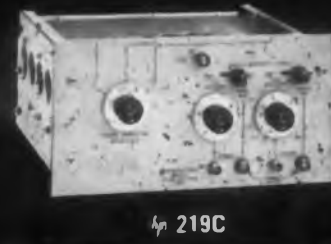
hp 218AR Digital Delay Generator produces crystal controlled pulses accurately spaced in time. It is a perfect slave to any pulse, even though random, and locks in constant phase during each counting period.



hp 219A



hp 219B



hp 219C

Time measurement and pulse simulation in radar, loran, Tacan, DME, oscilloscopes, computers, fast gates, pulse code systems—almost any kind of time measurement single- or double-pulse simulation is now yours quickly and accurately with hp 218AR Digital Delay Generator.

Built along strict military standards, hp 218AR uses a pulsed crystal oscillator synchronizable in constant phase with an initial trigger pulse (zero time) and two positionable terminating pulses. Time is counted with a 1 Megacycle pre-

set counter, and two independent output pulses are available in any relationship.

PULSE GENERATOR PLUG-INS

For utmost versatility, output pulses are generated in various arrangements by three plug-in pulse generators. These include hp 219A, supplying two positive pulses, hp 219B providing two pulses, each positive or negative and variable in amplitude, hp 219C, providing a high power pulse, positive or negative, digitally controlled as to delay and duration, variable in amplitude.

Condensed Specifications

(Basic 218AR Generator; plug-ins essential)

Time Interval Range:	1 to 10,000 μ sec	Recovery Time:	50 μ sec or 10% of interval, whichever is greater
Accuracy:	$\pm 0.1 \mu$ sec $\pm 0.001\%$	Sync Output:	50 v pos. pulse, 0.1 μ sec rise time
Digital Adjustment:	1 μ sec steps, full range	1 MC Output:	1 v pulses, 500 ohm impedance
Interpolation:	Variable 0 to 1 μ sec	Price:	-hp- 218A, \$2,000.00
Input Trigger:	Internal 10 cps to 10 KC; External 0 to 10 kc pulses, also sine wave		-hp- 219A Dual Trigger Unit, \$100.00
Jitter:	0.02 μ sec or less		-hp- 219B Dual Pulse Unit, \$450.00
	Data subject to change without notice. Prices f.o.b. factory		-hp- 219C Digital Pulse Duration Unit, \$350.00

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Field representatives in all principal areas



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CIRCLE 350 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

CIRCLE 23 ON READER-SERVICE CARD

WASHINGTON REPORT



Ephraim Kahn

More Money Recommended For Military R & D

More money for military R & D has been enthusiastically recommended by the House Science and Astronautics Committee. Even though the Defense Department will spend almost \$6 billion on about 2000 distinct projects incorporating many thousand separate sub-programs in fiscal 1960, more would be helpful, particularly to the Army and the Navy.

Electronics would participate generously if more money were voted to the Army, for example. "Budgetwise," says the Committee "the Army research and development program is, at present, just barely 'getting by.'" The Army's chief of R & D, Lt. Gen. Arthur G. Trudeau, feels that it is not following up more than half of the possible research areas that might be of genuine utility. Brig. Gen. William T. Ely, the Army's R & D director, has laid great stress on the importance of electronics in meeting the dispersed battlefield conditions of the future. Electronics in general, he says, has seen a tenfold increase since World War II and another tenfold increase can be expected by 1970. Nevertheless, budget conditions for the coming fiscal year will be "considerably tighter" than they have been in the past.

In view of the speed of scientific advances, "research and development money clearly seems inadequate" at all levels. "The amount allocated for research within the total administration budget appears inadequate; the amount allocated to the Army within the Defense Department budget appears inadequate; and the amount allocated by the Army within its own budget may also be inadequate in view of its dependence on research and development." As a consequence of the "fiscal anemia" which appears to afflict the Army, its spending on "basic and applied research, as distinguished from its developmental, test, and evaluation activities, appears to be very low."

Four Problems Beset Army R & D

Four big problems are faced by the Army's R & D program:

(1) Overcoming lengthy lead-times, now thought to be about double the Soviet Union's



COOLANOL: Monsanto T. M., Reg. U. S. Pat. Off.

FRESCANAR (frequency scan radar) is the eyes of the Army's "Missile Monitor," a guided missile fire distribution system for mobile field army use in air defense. This revolutionary electronic beam radar system developed by Hughes Aircraft Company scans space without requiring a separate height-finding radar system! Hughes designed it for rugged reliability, ease of maintenance, reduced size and weight, speed, and total simplicity of operation.

FRESCANAR consists of a single antenna in the inflated radome on the trailer, one power van with a diesel generator and one equipment van for the radar gear. It can be converted for travel in minutes. **FRESCANAR** concentrates all available power in sharp pencil beams of energy flashing on and off in fan-shaped array—pinpoints targets at great distance with extreme accuracy. The **FRESCANAR** klystron tube efficiently and effectively produces the tremendous RF pulse power required.

COOLANOL 45 coolant-dielectric liquid assures reliability by keeping klystron temperatures within critical operating limits. Versatile **COOLANOL 45** provides efficient heat transfer for accurate temperature control of many electronic systems. It also serves as a high-temperature hydraulic fluid in a number of units . . . remains a pumpable liquid over the remarkable temperature range of -65° to 400° F.!

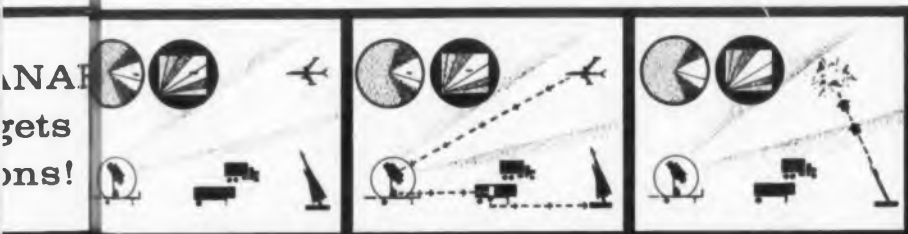
When you need a synthetic fluid, come to Monsanto—creator of fluids for the future.

Coolanol 45 Hughes Aircraft

How **FRESCANAR**
pinpoints targets
in 3 dimensions!

*COOLANOL 45 liquid
cools the FRESCANAR
high-powered klystron
Pumped around the collector
COOLANOL 45 absorbs
surface heat from
tube wall and carries it
away for dissipation
in the heat exchanger*

45 liquid cools klystron in new Frescanar—first "3-D" radar



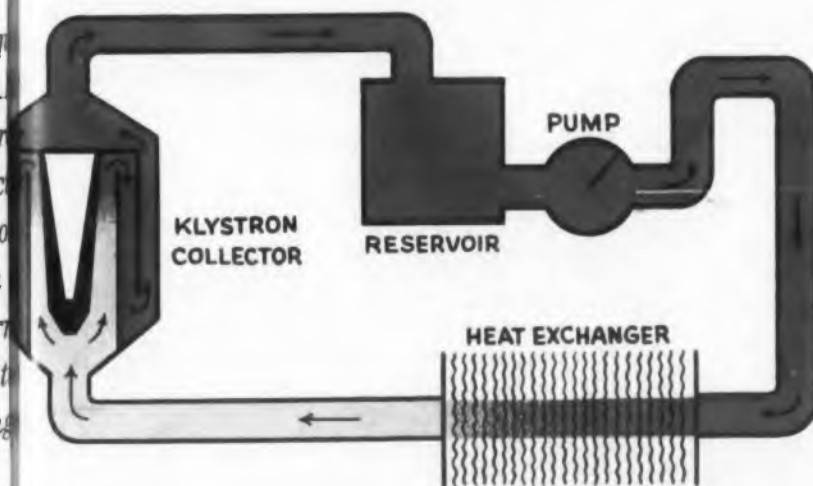
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pencil-beam antenna scans
at extreme range to de-
"enemy" craft. Almost
stantaneously, it...

flashes range and azimuth on
one monitorscope, altitude on
another, and relays essential
data to control centers.

While guided missile scores
"kill," FRESCANAR continues
to seek other targets... can
track many more than conven-
tional systems.

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Send for New Booklet...



Gives useful information about static and dynamic cooling methods, how to apply the package concept to cooling design, how to simplify and standardize cooling and hydraulic units. Through a step-by-step solution to a typical klystron cooling problem, it shows you how to apply principles of heat transfer in actual practice. For your copy, circle the reader-service number or write:

Monsanto

Monsanto Chemical Company
Organic Chemicals Division
Dept. AV-12
St. Louis 66, Missouri

four to five years from conception to operation of a weapons system.

(2) Obtaining adequate and timely funding. This will entail guaranteeing enough money for the whole research period for any program.

(3) Streamlining research management within the Defense establishment. The legislators complain that "only a few have the power to say 'Yes' to a given research and development project, while many have the authority to say 'No.'" While it may be useful and economic to have many "decision levels" in some government activities, the committee says it is "dangerous" in R & D, "where a high degree of vision and imagination is essential." It then twists the knife by adding: "Unfortunately, many of those with the power of veto over research and development projects do not have the training or foresight necessary to recognize the ultimate potential of these projects."

(4) Obtaining scientific information. Though the group believes that interchange of data within the Armed Services is "reasonably good," scientific information developing "outside military contract areas and in foreign countries is neither comprehensive, properly capsuled, nor adequately disseminated."

Developmental Publications Dangerous?

With seeming ambivalence, however, the lawmakers recommend that the Defense Department "confer on a broad scale with industrial leaders and private contractors in efforts to restrict the output of scientific *developmental* publications which may contain information useful to totalitarian governments—insofar as such restrictions may be consistent with (a) traditional freedoms of information and (b) palpable security needs."

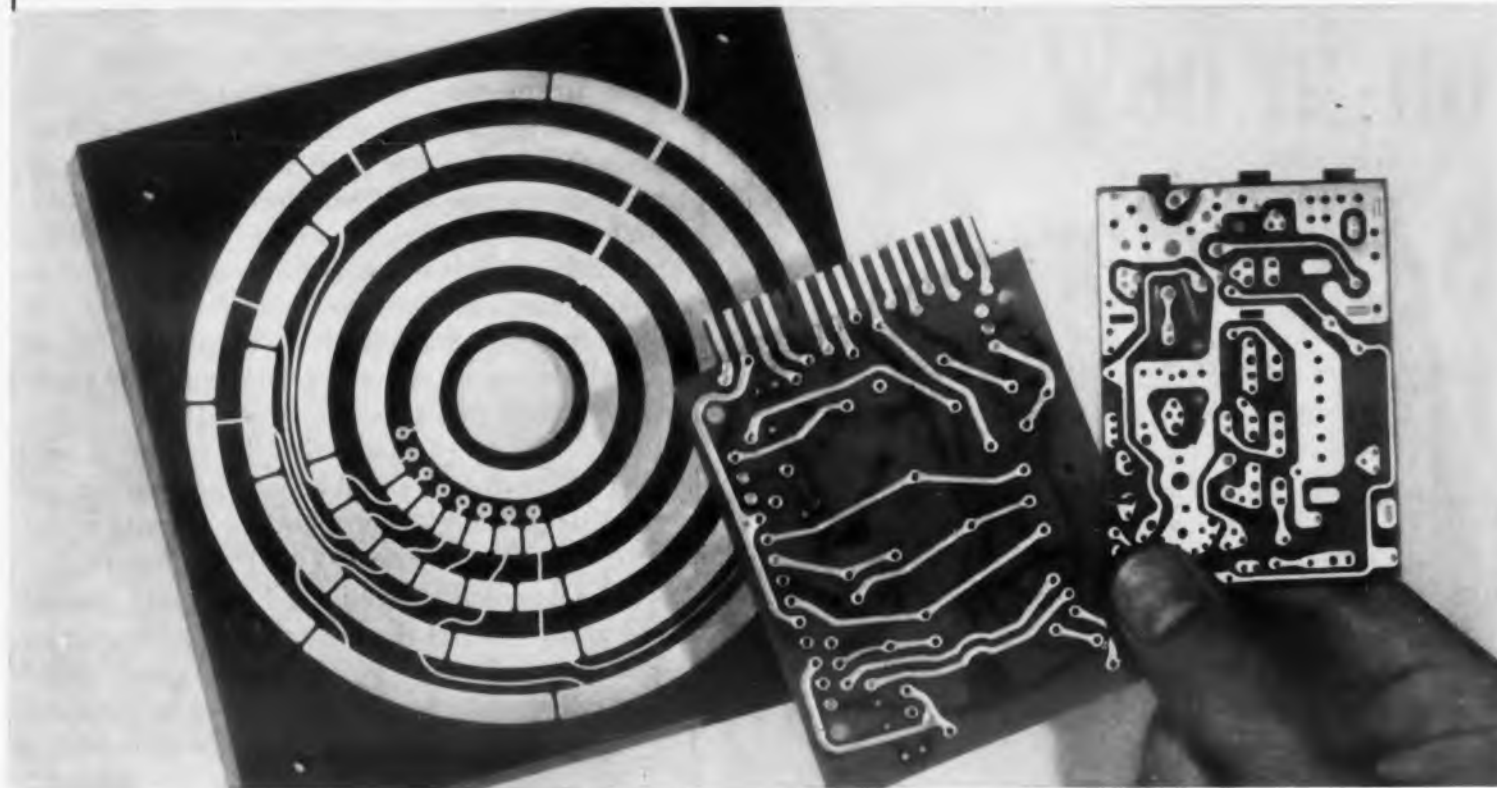
Navy R & D Funds Shrinking

Navy R & D is handicapped because the sum available for basic and supporting research is becoming relatively smaller each year. A subcommittee commented that research and development in the field of electronics (for both detection and communications) appears to be making good progress, "but at too low a level of support." Data-processing systems are receiving "major emphasis." Navy witnesses told the group that major gaps in the R & D program are "basic and supporting research, component development, and electronics." The subcommittee recommended that these be beefed up, "regardless of budgetary levels."

The Air Force subcommittee—in contrast to the Navy group—praised the weapons system concept, at least to the extent that it encourages concurrent development of components.

Industrial Laminates

from the company that really knows the electrical and electronics industry—General Electric



Printed circuits...faster... from Textolite® Circuit Specialists

Independent Textolite circuit specialists give you the best in service and specialized process technology, backed up by General Electric's advanced developments in Textolite materials

You get better, faster service on fabricated copper-clad Textolite parts because they come to you from *specialists* . . . independent fabricators who specialize in tool design and in etching and processing techniques. Right now a Certified Textolite Circuit Specialist is ready to help you with etched circuit problems and give you fast, dependable service on your printed circuit requirements. When you have questions about the selection and application of basic copper-clad laminate, phone your local G.E. Textolite Sales Engineer or write: *R. T. Walsh, Manager, Technical Service, Laminated Products Dept., General Electric Co., Coshocton, Ohio.*

East: Defiance Printed Circuit Corp., 81 Albion St., Wakefield, Mass.; EPEC, Needham Industrial Center, Needham Heights, Mass.; General Circuits, 1645 St. Paul St., Rochester, N. Y.; Jaco Products Co., 2150 St. Clair Ave., Cleveland 14, Ohio; Photocircuits Corp., 31 Sea Cliff Ave., Glen Cove, Long Island, N. Y.; Photocalor Corp., W. Commercial St., East Rochester, N. Y.; Precision Circuits, 750 Fulton Ave., Mt. Vernon, N. Y.; Ucinite Co., Div. United Carr-Fastener Corp., 459 Watertown St., Newtonville 60, Mass.; Sibley Co., Haddam, Conn.

These Certified Textolite Circuit Specialists will give you expert service and fast delivery on Textolite printed circuits

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CIRCLE 25 ON READER-SERVICE CARD

Specify copper-clad Textolite for every printed circuit application

Self-extinguishing 11574—Unique epoxy-paper base surpasses all XXXP grades.

Cyanide-resistant 11558—Easily-machined Grade G-10 takes cyanide plating and soldering without blisters.

New self-extinguishing 11559—Best-quality G-11 has high flexural strength at 300°F.

General Electric makes a full line of Textolite phenolic-paper, epoxy-paper, and epoxy-glass base laminates clad on one or both sides in 1, 2, or 3 oz. copper. Outstanding for reliability and for uniformly defect-free copper surface.

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MEETINGS

Calendar of Events

October

- 22-23 Fifteenth Annual National Conference on Industrial Hydraulics, Illinois Institute of Technology and Armour Research Foundation, Hotel Sherman, Chicago, Ill.
- 26-28 Sixth Annual East Coast Conference, IRE Professional Group on Aeronautical and Navigational Electronics, Baltimore, Md.*
- 28-29 Michigan Industrial Electronics Exposition, Electronic Representatives, Inc., Detroit Artillery Armory, Oak Park, Michigan.*
- 28-30 Annual Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.
- 29-30 Fifth Annual Electron Devices, IRE Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C.*

*Includes meetings described herewith.

Michigan Industrial Electronics Exposition, October 28-29

Electronic Representatives, Inc. will sponsor this show at the Detroit Artillery Armory, Oak Park, Mich. Exhibitors will include manufacturers of industrial electronic equipment and components as well as Michigan electronics representatives. Technical papers will be presented at sessions scheduled to run concurrently with the exhibitions. Show manager is R. G. Wood, 830 W. Vernor, Detroit 1, Mich.

5th Electron Devices Meeting, October 29-30

To be held at the Shoreham Hotel, Washington, D.C. The conference, sponsored by the IRE PGED, will present papers dealing with material of an applied or developmental nature in the field of electron devices. This should include electron tubes, semiconductor devices, masers, parametric amplifiers, and other solid state device configurations. John A. Hornbeck of Bell Telephone Labs, Murray Hill, N.J., is technical program chairman for the meeting.

6th Annual East Coast IRE Aero-Electronics Conference, October 26-28

The unclassified sessions of the IRE PGANE conference, sponsored by the Air Research and Development Command, are as follows:

Monday, October 26—9:30 to 12:30 A.M.

Session 1. Communications

Application and Design Consideration for Public Address Amplifier in Commercial Aircraft,

S
 C. K. Hartwigsen Bendix Radio
 Selective Calling Equipment, Al-
 len I. Perlin, Bendix Radio
 Integration of Radio Equipment
 Controls for High Performance Air-
 craft, W. D. Philips, Bendix Radio
 Reliable Communications, W. M.
 Pulford, Bendix Radio
 Design Analysis of Airborne Elec-
 tronics Equipment for Aircraft-Im-
 posed Vibration Loads, Charles
 Mitropoulos, Sylvania Electronic
 Systems

**Monday, October 26—
 2:00 to 5:00 P.M.**

Session 3. Navigation

Automatic Flight Scheduling in
 the Volcan Air Traffic Control Cen-
 tral, J. A. Herndon, Avco Manufac-
 turing Corp.

A Multi-Bearing Radio Range For
 Air Navigation, Jos. T. Nessmith, Jr.

An All-Transistor 75 Megacycle
 3 Light Marker Beacon Receiver,
 J. M. Tewksbury, Bendix Radio

A Bellini-Tosi ADF Loop Using
 Ferrite, Alfred A. Hemphill, Bendix
 Radio

Accuracy of the Loran-C System,
 Walter N. Dean, Sperry Gyroscope
 Co.

**Tuesday, October 27—
 9:30 to 12:30 A.M.**

Session 5. Antennas

Flat Array Antenna For a Doppler
 Navigation System, Robert E. Wil-
 ley, Bendix Radio

A Simple Inertialess Scan An-
 tenna Type, E. Wolff, M. Ringer-
 bach, Westinghouse Electric Corp.

Coupling Effects Between An-
 tenna Arrays of Different Frequency
 Bands as a Function of Skew Angle
 & Spacing on a Cylindrical Missile
 Body, Sheldon Isaccson, Martin Co.

Combined Antenna-Mixer-Filter
 Circuit, Edwin M. Turner, Wright
 Air Development Center

Antennas for Microwave Radiom-
 etry, H. Warren Cooper, Westing-
 house Electric Corp.

A Yagi Adcock System for Satel-
 lite Tracking, H. W. Ehrenspeck &
 W. J. Kearns, Air Force Cambridge
 Research Center

(Continued on page 30)

CIRCLE 26 ON READER-SERVICE CARD ➤

without E-W cooling units, electronic gear in this hut would burn out in minutes!

The Ellis and Watts Model A-9 Unit that keeps this critical electronic gear cool has a cooling capacity of 9000 BTU's per hour. Without this vital cooling capacity the electronic equipment would burn itself out in a matter of minutes! Wherever electronic gear is used, it creates heat problems. And, in compact airborne huts these problems are especially serious.

Designing and building specialized units to keep electronic gear cool is our business at Ellis and Watts. Units of any capacity, configuration, control requirements or functions can be designed and built to any applicable military or commercial specifications. E-W Units will function perfectly in any climate conditions on earth.

For additional information on Ellis and Watts Model A-9 Unit for cooling electronic gear in airborne huts or similar installations, write for Bulletin #130-D.



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Compact, Model A-9 Unit, developed especially to provide cooling in airborne huts, measures only 27 1/4" x 26 1/8" x 16 1/8" high—leaves maximum space for vital electronic equipment.



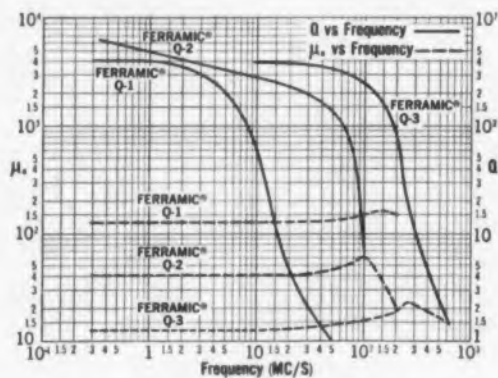
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Only GENERAL CERAMICS offers a complete line of HIGH FREQUENCY FERRITE CORES

Make G-C your single source for a complete line of H-F ferrites ranging in frequency from 300 kc to 220 mc.

Ferramic® Q-1, Q-2 and Q-3 materials, developed and introduced by G-C, feature exceptionally low losses, temperature stability and high permeability. Whether your ferrite requirement is for the commercial entertainment industry, military, ground or air borne communication equipment or industrial electronic applications, G-C will meet your needs with the broadest line of high frequency ferrite materials and in the shapes you require.

This curve demonstrates the exceptional qualities of G.C.'s "Q" family of materials—high permeability and low loss.



Q-1 Material

Ideally suited for IF transformers at 455 kc and antenna cores from 500 kc to 1700 kc.

Magnetic properties include: Initial permeability at 1 mc/sec.—125; Maximum permeability—400; Saturation flux density—3300 gauss; residual mag.—1800 gauss; coercive force—2.1 oersted; temperature coefficient of initial permeability—.10%/°C max; Curie point—350°C; vol. resistivity—high; loss factor at 1 mcs/sec.—.000020; loss factor at 5 mcs/sec.—.000050.

Standard Ferramic parts in various sizes and shapes offer a dependable, quick solution to design problems. Custom parts can be produced to your specifications. Contact General Ceramics' engineering advisory service. Our staff is ready to discuss your problems and make recommendations.



Q-2 Material



This material produces excellent results in TV receiver IF applications at 45 mc; and FM radio applications at 10.7 mc.

Magnetic properties include: Initial permeability at 1 mc/sec.—40; Maximum permeability—115; Saturation flux density—2400 gauss; residual mag.—750 gauss; coercive force—4.7 oersted; temperature coefficient of initial permeability—0.10%/°C max; Curie point—450°C; vol. resistivity—high loss factor at 10.0 mc/sec.—0.000085; loss factor at 50.0 mc/sec.—0.000017.



Q-3 Material

The exceptionally high Q, excellent temperature stability and high permeability of Q-3 ideally suits it for applications in the 88 mc–108mc FM band and television RF frequencies from 50 mc–216 mc.

Preliminary specifications include: Initial permeability μ_0 —14; Maximum permeability μ_{max} —42; Saturation flux density B_s —2600 gauss; Residual magnetism B_r —1470 gauss; Coercive Force—21 oersted; Q at 100 mc—250; Q at 150 mc—150; Q at 200 mc—70; Resistivity high; Curie point 330°C; Temperature coefficient of μ_0 —0.09%/°C max.

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CIRCLE 27 ON READER-SERVICE CARD

GENERAL CERAMICS

Industrial Ceramics for Industrial Progress... Since 1906

MEETINGS

Tuesday, October 27—2:00 to 5:00 P.M.

Session 7. Space Problems

Tracking of Satellites, Werner W. Gerbes & Otho E. Kerr, Air Force Cambridge Research Center

Diagrammatic Methods for Coordinate Conversion, Solomon A. Zadoff, Radio Receptor Co.

Relative Motion of Two Bodies With Small Velocity Differences on Gravitational Field, Werner Furth, The Martin Co.

Simplification of Certain Orbit Characteristics by Use of e^0 , Roy C. Spencer, The Martin Co.

A Pure Inertial Attitude Reference System for Orbital Vehicles, Robert L. Gordon, Sperry Gyroscope Co.

Gyro Configuration Requirements for Optimum Accuracy, J. B. Chatterton, Moeller Instrument Co.

Wednesday, October 28—9:30 to 12:30 A.M.

Session 9. Human Factors

Moderator: M. Scott Hasler, The Martin Co.

The Design Engineer and Human Engineer—A Coordinated Approach, Douglas R. Nicklas & Don Petersen, The Martin Co.

Design of Integrated Cockpit, Gerald J. Fox, and Clifford Seitz, Gruman Aircraft Co.

Visibility of Cockpit Cathode Ray Tube Navigation Displays, C. Thomas Goldsmith & Milton A. Grodsky, The Martin Co.

Reliability and Man in Space, R. D. Sorkin & Milton A. Grodsky, The Martin Co.

Consideration for Electronic Equipment for Space Suit, R. K. Cassatt & F. J. Conley, Jr., and Milton A. Grodsky, The Martin Co.

Maintenance of Electronic Equipment in Space, Milton A. Grodsky, The Martin Co.

Wednesday, October 28—9:30 to 12:30 A.M.

Session 10. Doppler

A Doppler Navigational Radar Utilizing New Techniques, B. L. Cordry, Bendix Radio

Applications of Doppler Radar to the Navigation Problem, C. C. Bath, Bendix Radio

Doppler Navigator Accuracy by Photogrammetric Measurement, Gerald Cooper, Raytheon Co.

A New Doppler Radar Frequency Tracker, E. O. Kirner, Bendix Radio

A Hybrid Airborne Computer for Doppler Application, T. Owens & C. Christianson, Bendix Radio

A Transistorized Frequency Summing and Differencing Device Capable of Coherent Algebraic Manipulation of the Four Data Frequencies in a Doppler Radar Computer, W. G. Gunkel & C. L. Christiansen, Bendix Radio

Wednesday, October 28—9:30 to 12:30 A.M.

Session 11. Radar

Radar Cartography, Daniel Levine, Consulting Engineer.

A New Technique for Measuring Operational Radar Antenna Patterns, A. E. F. Grempler, Bendix Radio

Active Radar Target Area Cross-section Enhancement, A. G. Cheney, Convair

An Automatic, Quantitative and Qualitative Performance Test Set, H. Dean Gulnac, Motorola, Inc.

Spherical Radar Reflectors With High-Gain Omnidirectional Response, Helmut E. Schrank, Westinghouse Electric Corp.

CW Velocity Track Loop Simulation by DC Electronic Analogue Computer, S. Baida, T. A. Prinscilla, Westinghouse Electric Corp.

Wednesday, October 28—2:00 to 5:00 P.M.

Session 12(H) Panel Discussion

Opportunities for Engineers—Today and Tomorrow

Wednesday, October 28—2:00 to 5:00 P.M.

Session 13. Panel Discussion

The Air Force Applied Research Planning Document on Computer and Data Processing Techniques

Wednesday, October 28—2:00 to 5:00 P.M.

Session 14. Circuits and Techniques

Design and Evaluation of Space Transmission Systems Using Computer Simulation Techniques, D. R. J. White, American Machine & Foundry Co.

Hit-Miss Detector, Jerome Machlis, Radioplane, Northrop Corp.

Pedestal Free Switches, S. L. Anema, Bendix Radio

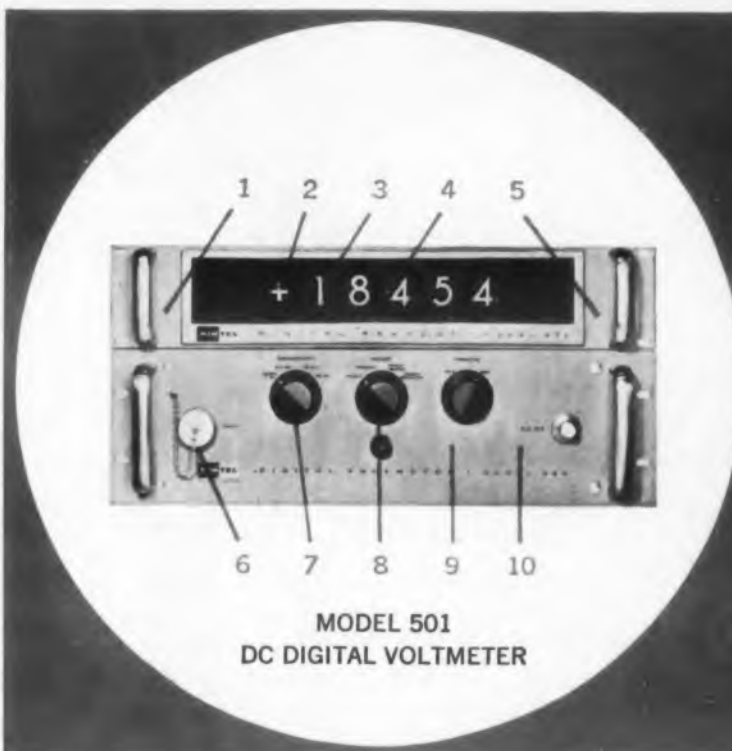
A Transistorized True Integrator, Wesley H. Jory, Bendix Radio

Accurate Diode Rate Counters and Some Applications, John Collins, Raytheon Co.

Impact of Electronic Costs on Weapon Systems Evaluation, Russell E. Winslow, Boeing Airplane Co.

The classified sessions will be held concurrent with the unclassified presentations and will cover: "Correlation Techniques of Data Processing," "Advanced Radar Techniques," and "Phased-Array Radars." Correspondence concerning clearance may be addressed to T. M. O'Connor, Security Coordinator, IRE ECCANE, Bendix Radio, Baltimore 4, Md. The location of all sessions will be the Lord Baltimore Hotel, Baltimore, Md. Dr. R. C. Spencer of the Glenn L. Martin Co., Baltimore 3, Md., is Papers Chairman.

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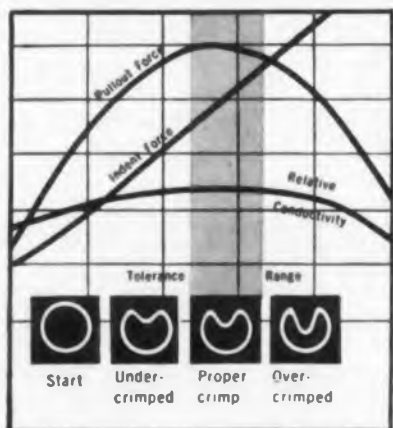
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NEW PRODUCT

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A highly versatile crimp-type snap-locked modular HYFEN® connector for miniature coaxial cable has been introduced by the Omaton Division of the Burndy Corporation, Norwalk, Connect. This modular HYFEN offers the facility of simple removal of individual snap-locked contacts or gang disconnect.



Both inner and outer contacts are crimped to the conductors, simplifying a previously complicated and difficult process. In addition this process eliminates many of the parts formerly used, and also eliminates any heat in the connection process. The result is a reliable coax connection, easily and quickly installed.

The new plug-and-receptacle unit will presently connect RG195U and #24 shielded miniature coax cable. Connectors for other sizes of miniature coax will be available soon.

Connector frames, of die-cast anodized aluminum, accommodate three, five, or eight inserts, snapped in from either front or back. Inserts for coax cable, of glass-filled diallyl phthalate, accommodate up to 21 contacts. A plug or receptacle insert may hold male or female contacts, or they may be intermixed. Coax cable inserts and standard wire inserts (35 contacts) may be mounted in the same frame.

Contacts can be crimped to cable ends either before or after the harness is in place. Engaging and disengaging forces of low magnitude make it easy to insert, remove, and replace contacts and inserts individually for flexibility and economy in circuit changes and checks.

Burndy Corporation, Norwalk, Connect.

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EDITORIAL

Engineering By Fear

"Better be safe than sorry" is a fairly sound admonishment. But an adage it is and not a law of nature. Too many an engineer seems to proceed on the assumption that it is a law. He thus saves himself the trouble of investigating alternate choices—he simply buys a familiar part from a familiar supplier.

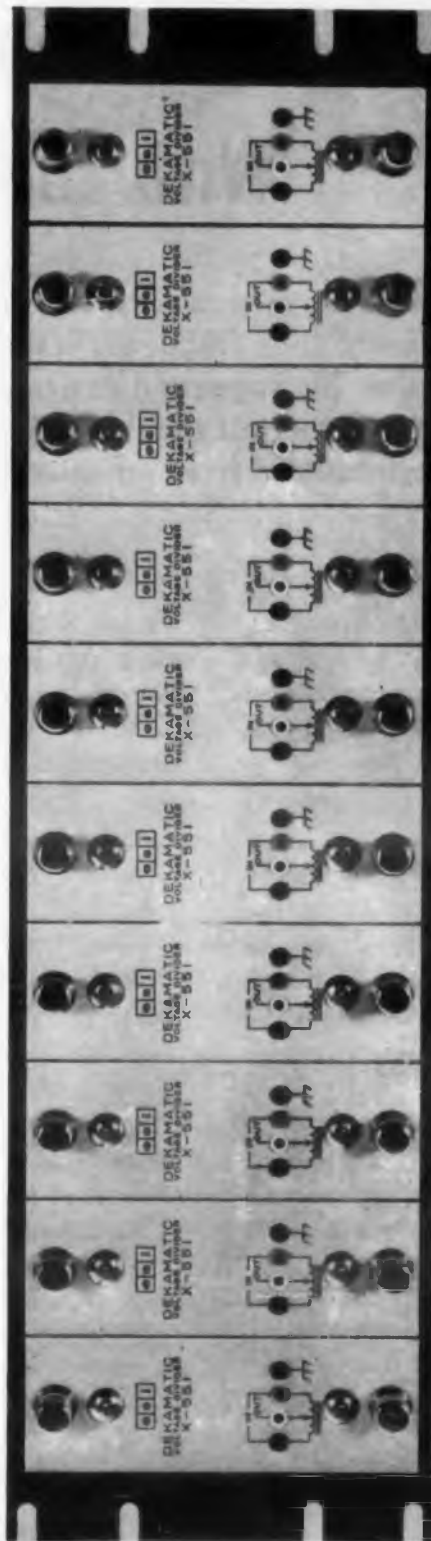
This is engineering by fear. No gamble, no risk, no selling his supervisor on a new idea or a new product. Such an approach to problem solving might occasionally be just plain laziness or it might be too much busy-ness. But when it's timidity to stretch one's neck out, it is engineering by fear. The outcome is nice, safe mediocrity.

An even more insidious form of engineering by fear is the practice of over-specifying the accuracy, the precision, or the tolerances needed for electronic parts when one doesn't know. Fearful that an admission of ignorance will lessen his standing with his boss or peers, this engineer protects himself by asking for the impossible from others. Others fail in accomplishing the near-miraculous and our insecure engineer fortifies his masquerade as a knowledgeable man by showing up others as failing.

For the fellow who is working beyond his ken, some form of subterfuge might be necessary so that he can live with his fears. The engineer who is willing to learn, who is disposed to master the unknown, need not engineer from fear nor need he be fearful to question, to show his lack of knowledge in areas where he has had experience.

The designer who does not engineer by fear will make some occasional mistakes but he will also make some outstanding engineering contributions. Because he does not lack confidence, he becomes an ever-better engineer by openly seeking new information from fellow engineers, sales engineers, professional meetings, trade literature, books, and progressive magazines such as the one you are now reading.

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Achieving Stable High-Frequency Design With the Mesa Transistor

Considerable differences of opinion exist regarding the "when" and "how" of unilateralization of high-frequency transistor amplifier stages. Donald Paterson feels that his suggested design procedure, unilateralization by mismatching, will permit the design engineer to directly determine stability and performance from manufacturers' data sheets.



Donald G. Paterson
Semiconductor Products Div.
Motorola Inc.
Phoenix, Ariz.

STABILIZATION of cascaded high-frequency transistor amplifiers by neutralization methods is generally costly, time-consuming, and optimized for only one frequency. By introducing deliberate interstage mismatch, lower net gain per stage is realized but unilateralization can be achieved even in wideband applications.

A basic approach to the matching technique involves the calculation or measurement of the forward gain and reverse attenuation of an amplifier stage; a criterion is then established such that the reverse gain numerically must exceed the forward gain by a margin large enough to ensure stability.

The high frequency equivalent circuit of a Mesa transistor becomes increasingly complex as the operating frequency rises. The parameters listed in Table 1, together with the power gain and noise figure of Fig. 1, illustrate the type of performance typical of this device. The 8 db per octave reduction in gain is explained by the 6

db per octave fall-off in current gain, Fig. 2, and an approximate 2 dv per octave loss incurred by the changing impedance ratio of the unit. Plots of the change in input and output impedance respectively with both frequency and collector current are given in Figs. 3 and 4. Two equivalent circuits with typical parameters and operating conditions are shown in Fig. 5.

Basic Design Problem

As operating frequency increases, one of the basic problems of high-gain amplifiers is that of stability. The emitter-collector capacitance, although minimized in the Mesa construction, causes components of signal current to feed back from output to input, and given the proper conditions of gain and phase, produces regeneration. This signal transfer, in the reverse direction to the desired signal flow, may be represented as a reverse transfer impedance. A well-designed amplifier stage will maintain a low forward-transfer

impedance and a high reverse-transfer impedance. This ratio of reverse-to-forward transfer impedances then becomes a useful measure of the design stability.

Many designers feel a value of at least 10 db to be minimum for this ratio. For example, an amplifier with 29 db of forward power gain should have at least 39 db attenuation from output to input to insure stability.

Isolation by Neutralization

While circuits commonly employ feedback neutralization at lower frequencies to cancel the effects of the transistor's bilateral nature, the method becomes difficult to use as frequency increases. Several circuits, however, have been investigated using the 2N700 Mesa transistor with this technique.

The amplifier of Fig. 6 achieves isolation by employing an additional winding to feed back to the input a component of output current equal in

Table 1. General Electrical Characteristics of 2N700 UHF Mesa Transistor

Maximum Collector to Emitter Voltage	(at 100 μ a)	30 v
Maximum Emitter to Base Voltage	(at 100 μ a)	0.5 v
Maximum Collector Dissipation in Free Air Derate 1.0 mw/C above 50 C		50 mw
Collector Cut-off Current	($V_{CB} = -12$ v) ($I_E = 0$)	1 μ amp
Collector Capacitance	($V_{CE} = -6$ v) ($I_E = 0$)	0.8 μ mf
Small Signal Current Gain	(1 kc $V_{CE} = -6$ v) ($I_C = 2$ ma)	20
Small Signal Current Gain	(100 mc $V_{CE} = -6$ v) ($I_C = 2$ ma)	5
Base Connection Resistance		50 ohms

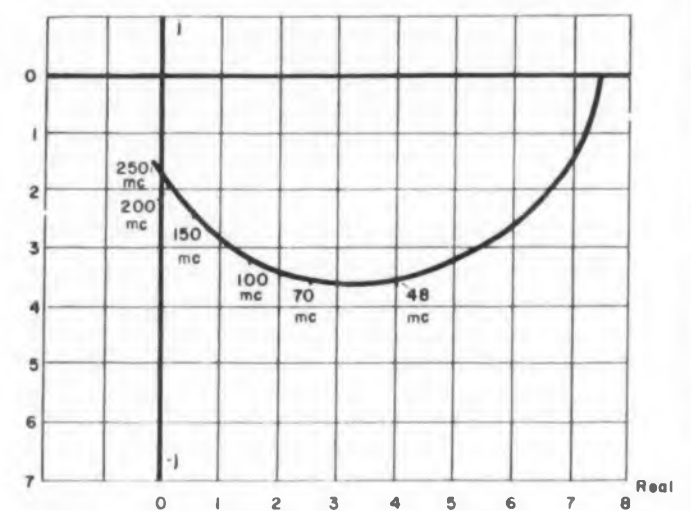
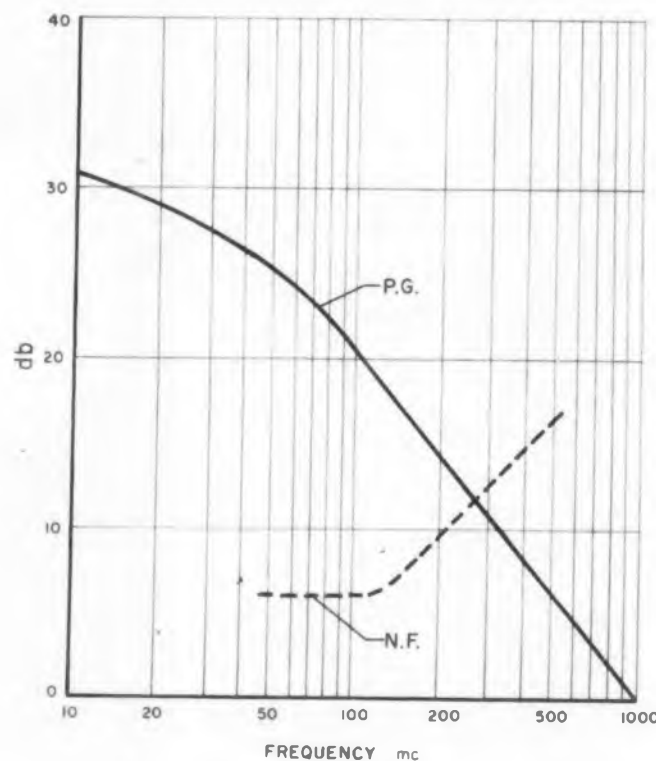


Fig. 2. Magnitude and phase variation of grounded emitter current gain with frequency for the 2N700 uhf amplifier.

Fig. 1. (left) Neutralized power gain and noise figure vs frequency.

GROUNDING EMITTER INPUT IMPEDANCE vs FREQUENCY

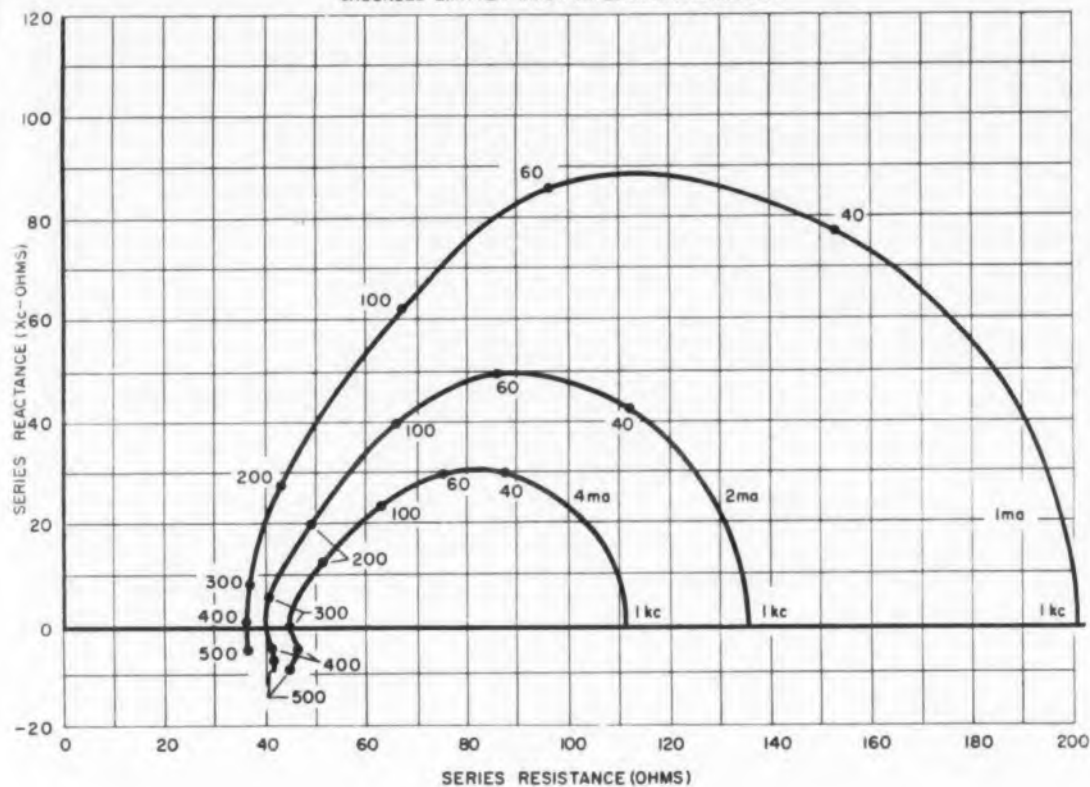


Fig. 3. Grounded emitter input impedance vs frequency.

GROUNDING EMITTER PARALLEL OUTPUT RESISTANCE (INPUT SHORTED) vs. FREQUENCY & BIAS

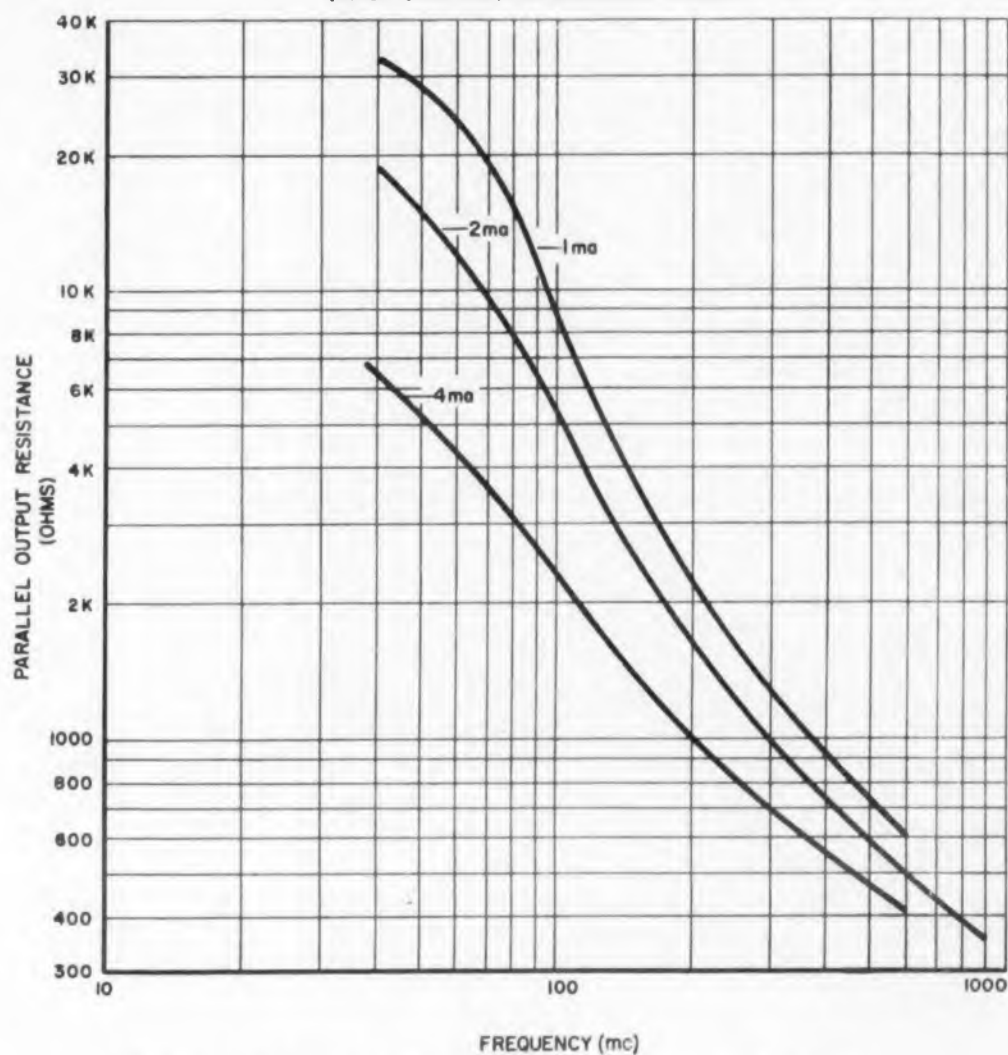
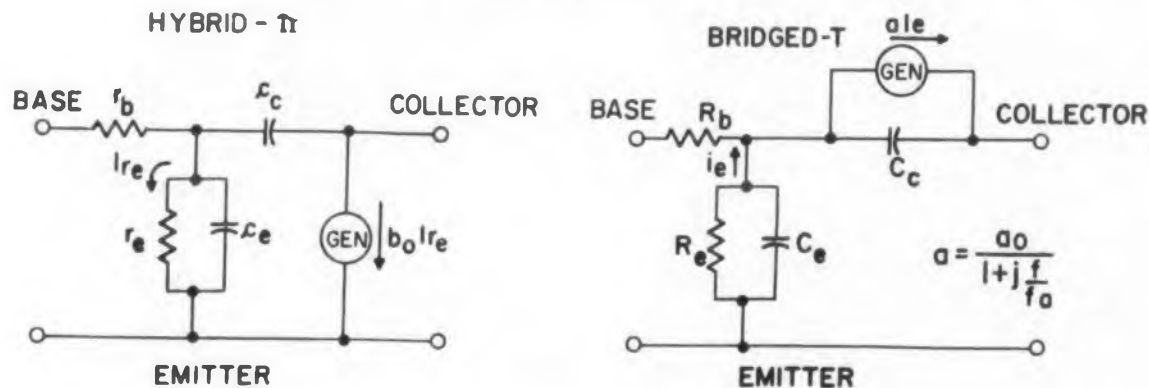


Fig. 4. (right) Grounded emitter parallel output resistance (input shorted) vs frequency and bias.

Fig. 5. Two equivalent circuits for the 2N700.



D.C. COLLECTOR-TO-EMITTER VOLTAGE (V_{CE}) = 6 VOLTS

D.C. EMITTER CURRENT (I_E) = 2 ma

$r_b = R_b = 50$ OHMS

$C_c = C_e = 1.2$ $R_e = 15$ OHMS

$C_e = 20 \mu\mu f$ $b_o = 12$

$r_e = 500$ OHMS $a_o = 0.92$

$C_e = 15 \mu\mu f$ $f_a = 400$ Mc/sec.

magnitude but opposite in phase to the reverse transfer current. The component values shown are chosen for a center frequency of 70 mc and the performance is illustrated in Table 2 and Fig. 7.

Another method of achieving the same end result is illustrated by Fig. 8. Here the bypass capacitor C_3 is chosen so that its impedance through the passband of the amplifier provides a divider network with the reactance of timing capacitor C_2 . The equivalent circuit is shown in Fig. 8b. Complete cancellation of the undesired component is difficult, owing to the phase shift produced by R . This circuit is somewhat simpler to construct in practice and, although compensation is not perfect, offers the advantage of economy over the former method.

Isolation by Mismatch at the Interstages

It soon becomes obvious to the designer of high-frequency equipment intended ultimately for mass production that isolation by neutralization is expensive, both from the standpoint of component cost and adjustment time. Wideband amplifiers (that is, circuit Q less than 10) particularly present compensation problems since lumped parameter values change over the passband and the neutralization circuit can be made optimum for only one set of values and frequency. It is possible to reduce the effects of the transistor's bilateral nature and avoid compensation for the large number of lumped elements in the high frequency equivalent circuit by sacrificing gain at the interstage networks. Isolation by this technique is il-

lustrated in Fig. 9 and will be discussed in the following example.

Basically, the problem involves calculation of the forward and reverse power gain in terms of

Table 2. Performance Data for Conjugate Matched and Neutralized 70 mc Amplifier

Emitter Current	$I_e = 1$ ma	$I_e = 2$ ma
Forward Gain	21 db	24 db
-3 db points	65.5 mc, 73.5 mc	64.5 mc, 73.7 mc
Reverse Gain	70 mc—42 db 73.5 mc—33 db 64.5 mc—35.3 db	—42 db —33 db —37 db

the transistor's internal and matching impedances. The condition may then be imposed that the reverse gain numerically exceeds the forward by a margin large enough to insure stability (as determined in the previous criterion) and the matching network calculated from the resulting solution.

Consider the circuit of Fig. 10 which represents the passive network seen at the load, approximat-

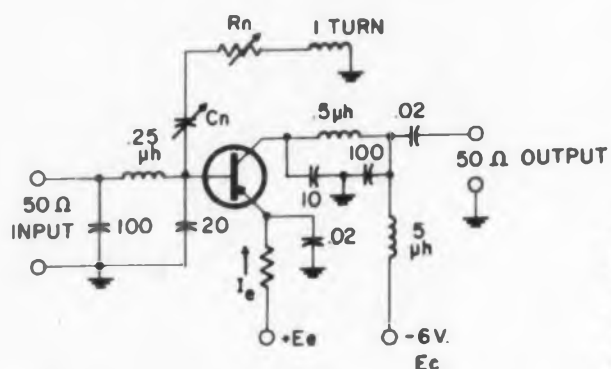


Fig. 6. Conjugate matched and neutralized amplifier for 70 mc using the 2N700.

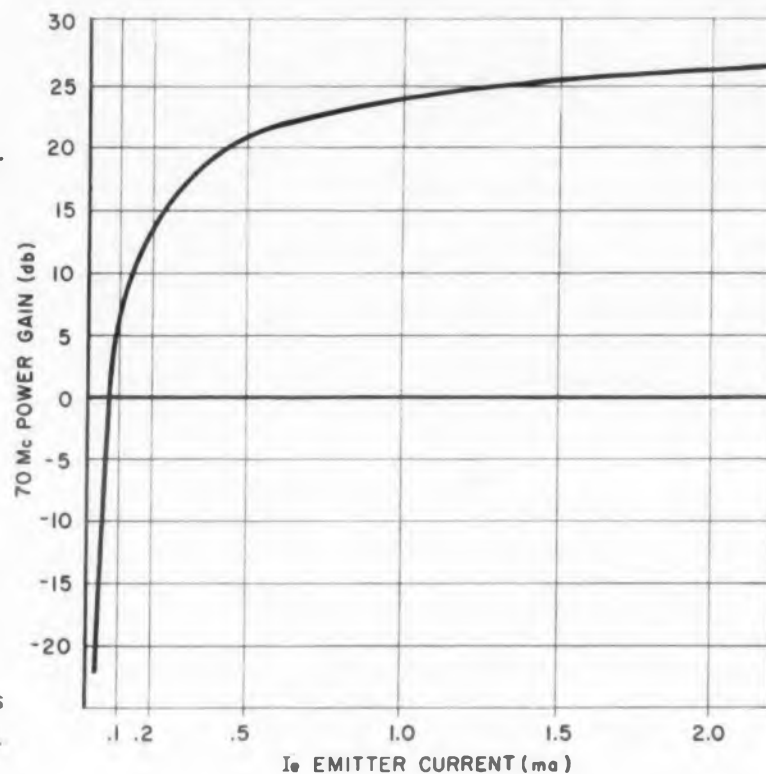


Fig. 7. (right) Plot of 70 mc power gain (db) vs emitter current (ma) for the circuit of Fig. 6.

ing the effect of the actual transistor. (The circuit is derived from the equivalent "pi" network of Fig. 5.) The reverse power gain or attenuation is found by impressing a voltage $v_{ce} = V_{ce} e^{j\omega t}$ at c .

Consider as an actual case a matched single-stage 70 mc amplifier using the 2N700 Mesa transistor, with a source impedance of 100 ohms and a load of 10 k ohms. At this frequency, the impedance of C_c is much greater than the base and

emitter impedances, so that very nearly

$$i = \frac{v_{ce}}{X_{C_c}} \quad (1)$$

The current divides in the ratio

$$\frac{Z'_{br}}{Z'_{be} + Z'_{bb} + Z_g} = k \quad (2)$$

The voltage developed across Z_g is then $Z_g \cdot k \cdot i$ numerically, at 70 mc

(3)

$$\begin{aligned} Z'_{be} &= 15 \text{ ohms} & Z_g &= 100 \text{ ohms} \\ Z'_{bb} &= 50 \text{ ohms} & X_{C_c} &= 2280 \text{ ohms} \end{aligned}$$

$$k = \frac{15}{15 + 50 + 100} = 0.091$$

$$i = \frac{jv_{ce}}{2280}$$

$$|V_{be}| = 100 \times 0.091 \times \frac{v_{ce}}{2280}$$

$$\text{Then } \left| \frac{v_{be}}{v_{ce}} \right| = \frac{100 \times 0.091}{2280} = 250$$

Now the attenuation is given by

$$\frac{(v_{be})^2}{Z_g} \frac{Z_L}{(v_{ce})^2} = \frac{(v_{be})^2}{(v_{ce})^2} \frac{Z_L}{Z_g} \quad (4)$$

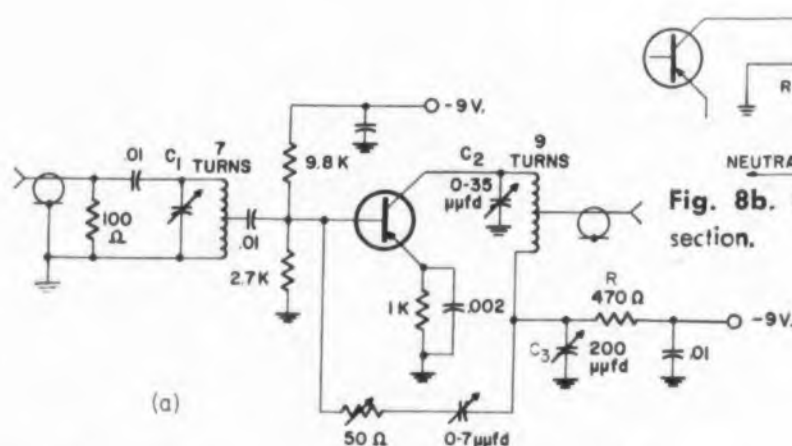


Fig. 8a. Amplifier neutralization by capacitive divider.

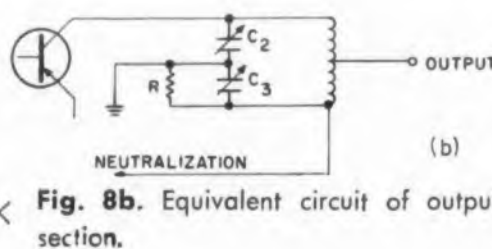


Fig. 8b. Equivalent circuit of output section.

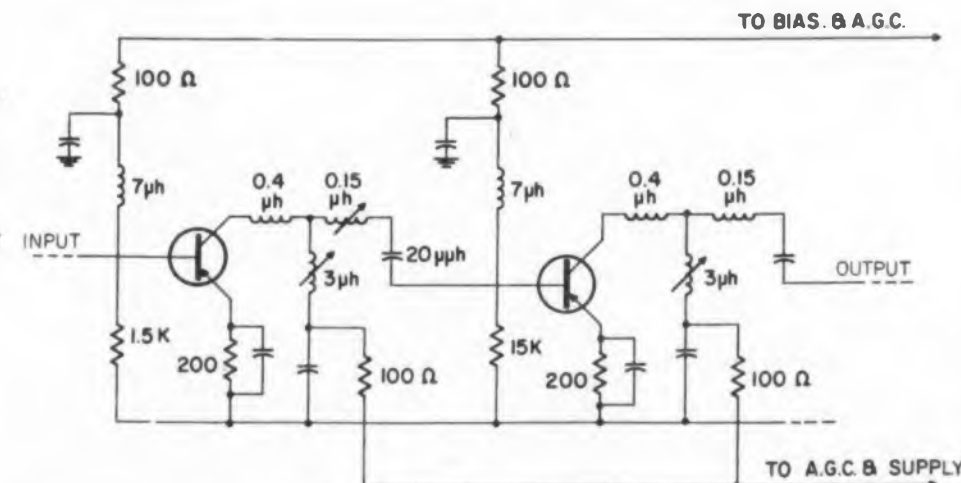


Fig. 9. Isolation by interstage networks.

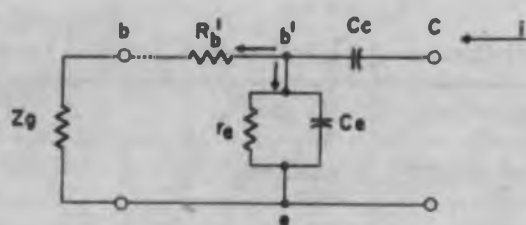


Fig. 10. Approximate equivalent circuit of a high-frequency amplifier.

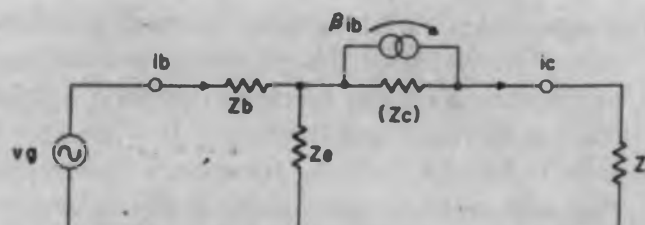


Fig. 11. Equivalent T circuit of a high-frequency amplifier.

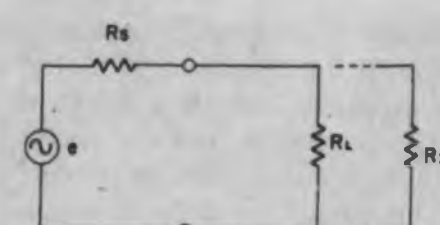


Fig. 12. Simplified circuit for output power reduction.

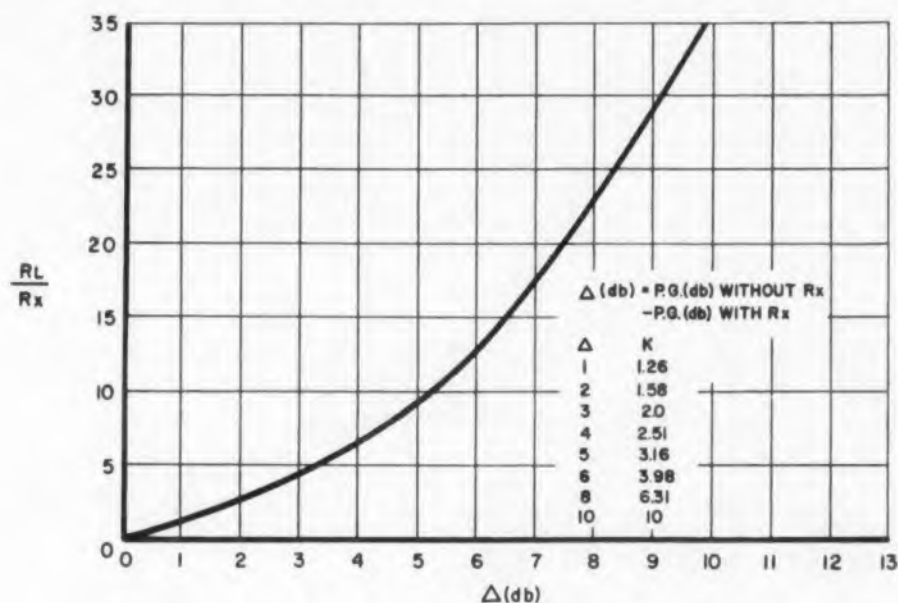


Fig. 13. Reduction in power gain (Δ -db) with mismatch.

$$\begin{aligned} \text{or } N_{db} &= -20 \log \frac{v_{ce}}{v_{be}} + 10 \log \frac{Z_L}{Z_u} \\ &= -48 + 20 = -28 \text{ db} \end{aligned} \quad (5)$$

Then, approximately, the unneutralized Mesa transistor shows about -28 db reverse attenuation at this frequency.

Forward power gain from the standard equivalent circuit shown in Fig. 11 in terms of the load impedance, Z_L , may be expressed by:

$$\text{P.G.} = \frac{i_b^2 \frac{(\beta Z_c)^2 Z_L}{(Z_e + Z_c + Z_L)^2}}{i_b^2 \left(Z_b + Z_e - \frac{\beta Z_c Z_e}{Z_L + Z_c + Z_e} \right)} \quad (6)$$

Now in the actual circuit,

$$\begin{aligned} Z_b &= R_b = 50 \text{ ohms} \\ Z_e &= R_c 11 C_e = 15 \text{ ohms} \\ Z_c &= X_{C_c} = 2280 \\ &\quad - 90 \text{ deg ohms} \end{aligned}$$

The output resistance of the 2N700 at 70 mc is about 10,000 ohms. So, assuming matched conditions (with the output reactances tuned out)

$$Z_L = R_L = 10,000 \text{ ohms} \quad (7)$$

Substitution in (6) gives $\text{P.G.} = 800 = 29.2 \text{ db}$

It is obvious that the criterion of 10 db difference between forward power gain and reverse attenuation is not met in this case. In fact, at 70 mc an unneutralized matched amplifier using the Mesa transistor has tendencies toward instability. If the reverse attenuation is numerically equal to or less than the forward power gain, the circuit becomes oscillatory.

Lowering the source impedance will help in some cases by increasing the reverse attenuation, but the transistor input impedance at 70 mc is already low. The other alternative is to lower the

power gain by mismatching the output. The decrease in amplifier power gain with load mismatch has been discussed in the literature.² Fig. 13 shows a curve of mismatch ratio to gain loss in db calculated for the 2N700 at 70 mc, the curve, or discrete values of load, necessary for a given gain reduction at a given frequency may be found in the following manner.

Consider the circuit of Fig. 12. Assume the output power is to be reduced by a factor $1/K$ where K is the numeric equivalent of the number of decibels loss in power gain required. If the generator is matched by the load R_L , the new output power is

$$\text{P.G.} = \frac{1}{K} \frac{e^2}{4R_L} \quad \text{when } R_L = R_S \quad (8)$$

The value of load R_X necessary to decrease the gain by the factor $1/K$ is found by placing a resistance R_X in parallel with load resistance, and solving with Eq. (8)

$$\text{Then } R_X \text{ is given by } \frac{R_L}{2} = \sqrt{\frac{K}{K-1}} \quad (9)$$

In essence, the design procedure involves first checking the stability of the matched amplifier at the frequency in question and determining the reduction in gain required to reach the desired stability. The numeric equivalent of the gain reduction may then be substituted in Eq. 9 to determine the necessary parallel resistance for correct mismatch. The experimental results from circuits designed with this technique show correlation within two to three db of the calculated values for both gain and stability. ■ ■

References

1. V. R. Saari, "Transistor 70 MC IF Amplifier," 1958 Transistor and Solid State Circuits Conference, Philadelphia, Pa.
2. L. Arguimbau, R. Adler, "Vacuum Tube Circuits and Transistors," 1956, Wiley.



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CIRCLE 32 ON READER-SERVICE CARD

Selection of Alloy Tubing for Glass Sealing

Malcolm W. Keenan
Superior Tube Co.
Norristown, Pa.

Solid pins, tubular pins, ribbon and wire are generally used for glass-to-metal sealed feed-through terminals. Headers with tubular pins are sometimes preferred, since the glass-sealing alloys available are generally not good electrical conductors.

With the hollow-tube pin, a lead wire is fed through to carry current. The inside extension of the tube can be held to a minimum, since the lead wire is fed directly through without an interior joint being made.

Mr. Keenan includes a table of coefficients of expansion for glass-sealing alloys and outlines the considerations for selecting these alloys.

SEVERAL METHODS are used to bring metal tubing in contact with glass: an *inside seal*, in which the metal is enclosed or surrounded by glass; an *outside seal*, where the glass is surrounded by metal; and the *inside-outside seal*, in which glass covers both the inside and outside of the metal.

Tubular seals are further differentiated as *normal-edge* and *thin-edge* seals. The normal-edge ones require a good match in thermal expansion

of glass and metal. Thin-edge seals—made by tapering the end of the tube in contact with the glass to a feather edge—permit a wider variation, because the thin metal yields during expansion and contraction.

Expansion and Other Factors

The principal factor governing the selection of alloy for pins is the coefficient of expansion in

relation to the glass in the seal. Thermal expansions for 12 glass-sealing alloys are shown in Fig. 1. The mean thermal expansion coefficients for the same alloys are listed in Table 1, along with the chemical composition and mechanical and physical properties. If the expansion curve of the glass is available, the curves of Fig. 1 are more useful than the coefficients listed in the table, however.

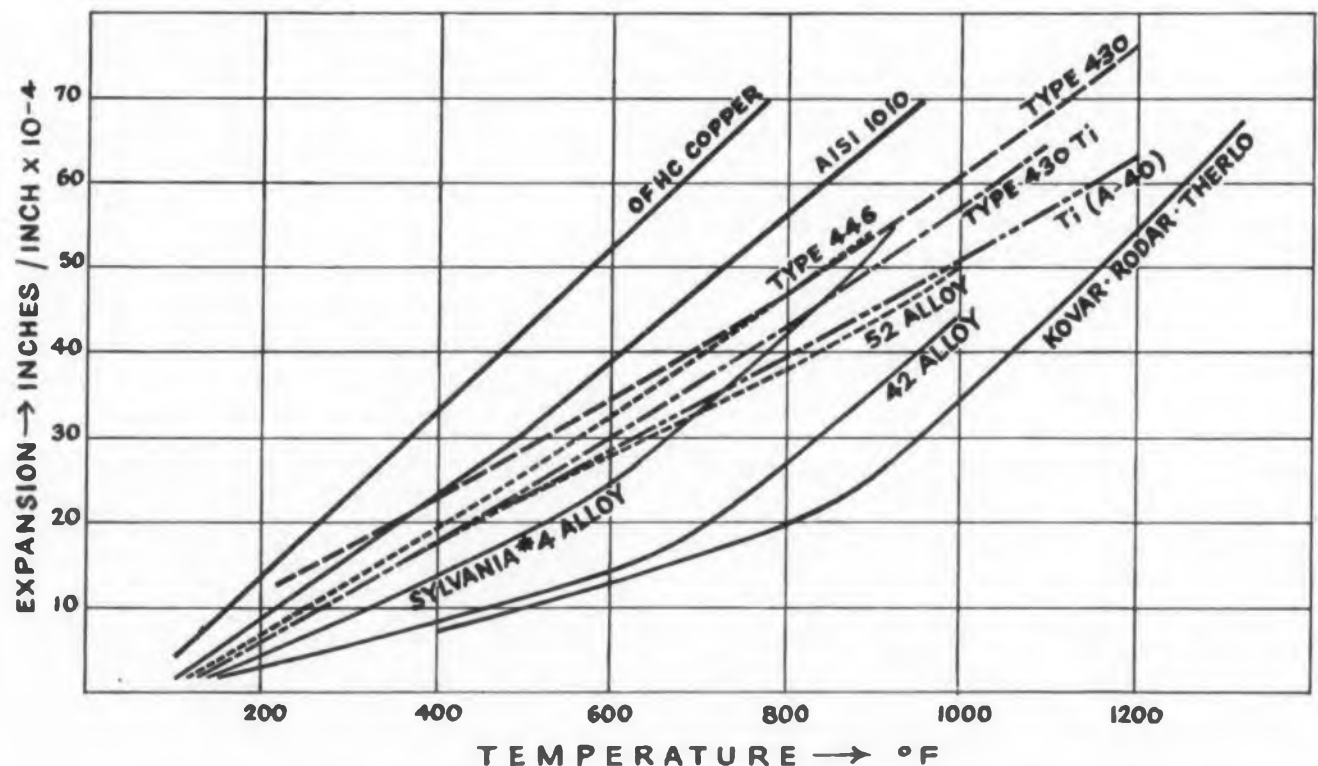


Fig. 1. Thermal expansion curves for 12 standard glass-sealing alloys.

Composition and properties of glass-sealing alloys

As noted above, the effect of different coefficients of expansion between glass and metal can be minimized by giving the tubing a thin edge. But since this is an additional production step, it should be avoided if possible.

Other considerations in selecting an alloy are strength especially if the tubular element has to support tube parts); thermal conductivity; ease of fabrication and machining; ease of cold welding or crimping; ease of welding, soldering or brazing; magnetic permeability, and oxidation and corrosion resistance. Figures for the first three properties are given in Table 1.

Since we are talking about tubular rather than solid pins, electrical conductivity is not a factor.

Types of Alloys

Here are alloys from which to choose:

■ **Iron-Nickel-Cobalt Alloys.** *Kovar, Rodar and*

Mechanical properties are for tubing with 1/8-inch OD by 0.015 wall and larger. Elongation values are the same as expected from tubing where wall thickness is within 6 to 20 per cent of the OD. Temper designations are: 1. fully annealed; 2. half-hard; 3. full-hard.

Therlo: All three are practically identical in chemical composition. Their thermal expansion curve is a very close match for certain hard glasses. Their oxides fuse into the glass, forming a vacuum-tight chemical bond. They are readily machined, welded, soldered and brazed. These alloys are used for nearly all types of glass-metal seals and for sealing high alumina ceramics in ceramic-to-metal seals. They resist attack by mercury.

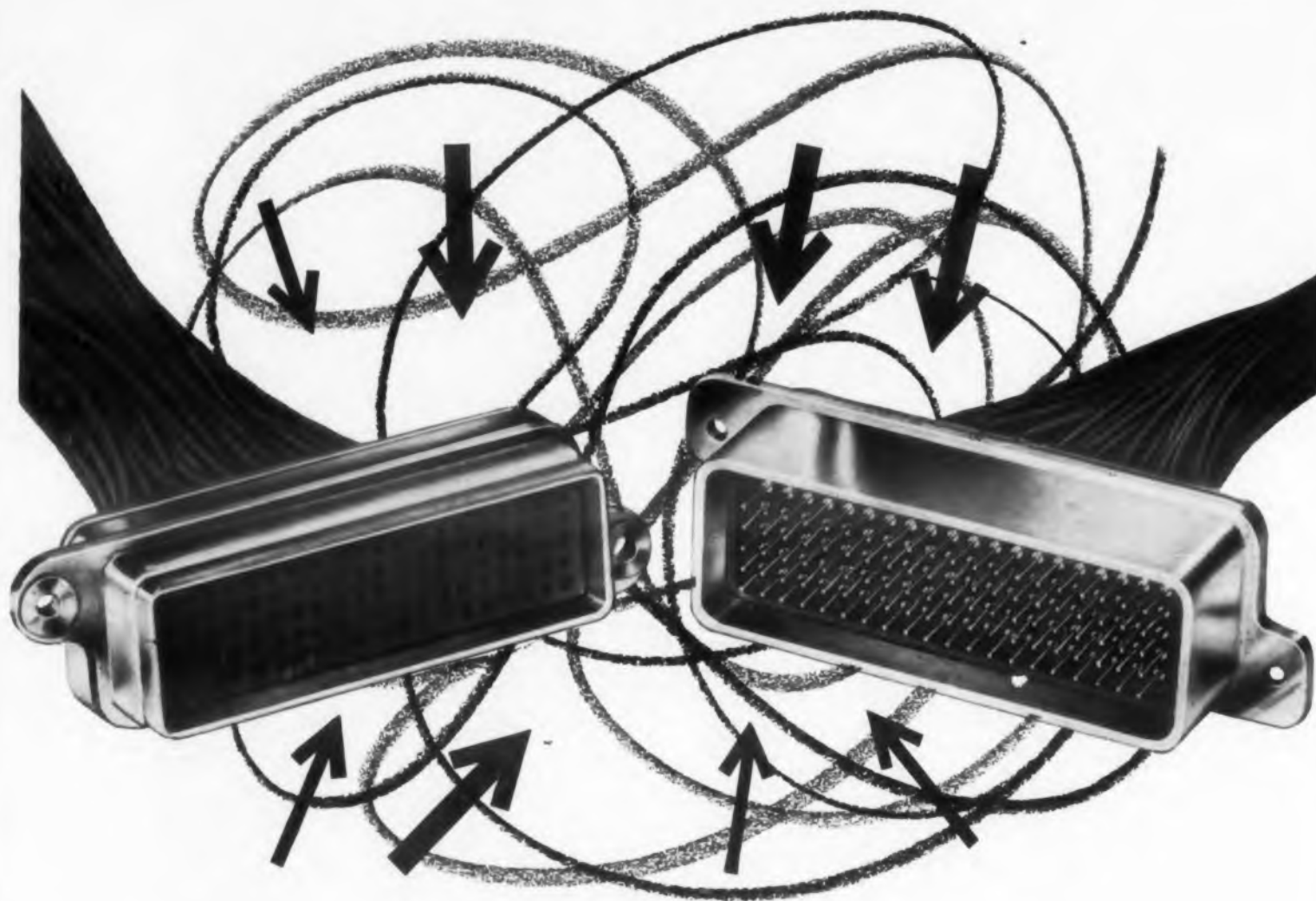
■ **Nickel-Iron Alloys.** #42 Alloy: Its coefficient of expansion makes it suitable for use with soft glasses. #52 Alloy: Its coefficient of expansion is about the same as that of Forsterite type ceramics and several commercial glasses. With a high magnetic permeability at both low and high-flux densities, it is popular for use in sensitive magnetic applications and in thermostats.

■ **Nickel-Chromium-Iron Alloy.** *Sylvania #4:* Its coefficient of expansion is well-matched to

Material	Chemical Composition	Temper	Tensile Strength X 1000 psi	Yield Strength X 1000 psi	Elongation % in 2 in.	Mean Linear Thermal Expansion in./in. x 10 ⁻⁷	Thermal Conductivity Cal./CM ² /Sec/°C	Remarks
Kovar	Ni 29.0% nominal Co 17.0% nominal Mn .50% max. Si .20% max. C .06% max. Fe Remainder	1	80 max.	40-60	40-25	50.3-53.7 (30-450C)	0.0395	Hard Glasses
		2	85-105	60-75	24-10			
		3	105-125	75-90	10-3			
Rodar	Ni + Co 40.5-41.75% Mn 1.00% max. Si .15-.35% C .10% max. Fe Remainder	1	82 max.	40 max.	30-40	53 (20-400C)	0.038	Soft Glasses
		2	95-115	45-65	15-25			
		3	115-140	70-90	12-3			
Therlo	Ni + Co 50.0-51.0% Mn .60% max. Si .30% max. C .10% max. Fe Remainder	1	85 max.	40 max.	30-50	95 (20-400C)	0.04	Soft Glasses Ceramic Seals
		2	85-105	45-65	15-28			
		3	105-125	70-100	12-3			
42 Alloy	Ni 41.50-42.50% C .07% max. Mn .15-.25% Si .15-.30% Cr 5.40-5.90% Al .15% max. Fe Remainder	1	75 max.	40-55	30-40	85 (25-300C)	0.032	Soft Glasses
		2	75-95	60-80	12-25			
		3	95-140	80-95	10-2			
Sylvania #4	C .12% max. Mn 1.00% max. Si .75% max. Cr 16.00-18.00% Ni .50% max. Fe Remainder	1	85 max.	40-55	40-25	62 (20-500C)	0.057	Soft Glasses
		2	82-96	60-88	24-11			
		3	98-112	82-95	13-5			
430	C .10% max. Mn 1.00% max. Si 1.00% max. Cr 16.00-18.00% Ti 5 x C min. Fe Remainder	1	85 max.	40-55	40-25	61 (20-500C)	0.057	Soft Glasses
		2	82-96	60-88	24-11			
		3	98-112	82-95	13-5			
430 Ti	C .20% max. Mn 1.50% max. Si .75% max. Cr 25.00-30.00% Fe Remainder	1	95 max.	45-75	35-20	105 (25-300C)	0.06	Soft Glasses
		2	98-115	70-90	22-10			
		3	118-135	85-105	14-4			
446	Si .10% max. Fe .25% max. Mn .15% max. N .05% max. C .10% max. Ti Remainder	1	80 max.	35-60	35-22	97.2 (20-426C)	0.036	Ceramic Seals
		2	75-95	50-75	20-7			
		3	90-115	75-95	15-5			
Titanium (A-40)	C .05-.15% Mn .30-.60% Si .10% max. Fe Remainder	1	57 max.	28-40	45-35	125 (25-300C)	0.108	Soft Glasses
		2	58-70	45-62	28-14			
		3	72-87	60-78	17-15			
MT-1010	Cu + Ag 99.9% P .015-.040%	1	40 max.	—	45-30	165 (25-300C)	0.92	Soft or Hard Glasses with thin Edge Seal
		2	42-52	28-40	32-15			
		3	52-65	38-47	17-15			

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CIRCLE 33 ON READER-SERVICE CARD

certain soft glasses. Its thermal conductivity is the lowest of any of the 12 standard glass sealing alloys listed in the table.

■ **Stainless Steels.** *AISI Type 446:* A high chromium iron ferritic stainless steel used with soft glasses. It has the highest heat resistance of the chromium irons used for glass sealing. Welding is difficult because the result tends to be large-grained and rather brittle. *AISI Type 430:* With less chromium content than Type 446, it is more readily fabricated and is easier to work. It is used with soft glasses.

Thermal and electrical conductivity is slightly better than for Type 446. Type 430 requires special care to avoid coarse-grain welds of low ductility. *AISI Type 430 Ti:* Properties are the same as for Type 430, but welding has been improved with the addition of titanium.

■ **Titanium.** The coefficient of expansion for titanium is a very close match for that of Forsterite type ceramics. Titanium is also used as a bonding agent in ceramic-to-nickel seals. Because it absorbs nitrogen, hydrogen and oxygen at elevated temperatures, titanium is used as a getter inside electron tubes. It has very good corrosion resistance and is a better thermal conductor than either Type 446 or Type 430 stainless steel.

■ **Low Carbon Steel.** *AISI Type MT-1010:* This steel is easily bent and flared. It is used as inserts in the headers of button stems. When used

Table 2. Commercial Tolerances for glass-sealing alloy tubing*

Outside Diameter Range (in.)	Nominal OD (in.)	Nominal ID (in.)	Nominal Wall (+)
Up to, but not including 3/32 OD	+0.002, -0.000	+0.000, -0.002	10%
3/32 to, but not including 3/16 OD	+0.003, -0.000	+0.000, -0.003	10%
3/16 to, but not including 1/2 OD	+0.004, -0.000	+0.000, -0.004	10%
1/2 to, but not including 1-1/2 OD	+0.005, -0.000	+0.000, -0.005	10%

for internal seals, it is usually copper or silver-plated to prevent oxidation. Internal seals with Type MT-1010 tubing require high-expansion glasses. External seals can use glass with a rate of expansion different from that of the metal, since stresses in the glass are all compressive.

■ **Copper. OFHC Copper:** The letters stand for "oxygen free high conductivity." Since its expansion coefficient is far above that of any glass, thin-edge seals are necessary. With the thin-edge seal, copper can be used with either soft or hard glasses. Because of its high conductivity it has been widely used for anodes of air-cooled transmitting tubes. It is readily cold-welded, permitting quick closing of the ends of tubes.

Temper Influences Properties

Selection of a glass-sealing alloy may require the weighing of a number of properties, with a final compromise on the material that gives the most desirable combination. The mechanical properties are influenced by the temper in which the alloy is furnished. The effect of temper on tensile strength is shown in Table I.

Temper also has a considerable effect on forming and machining properties and may also affect, to a lesser extent, the other selection factors that have been listed.

The availability of all 12 alloys in three different tempers—fully annealed, half-hard and full-hard—gives more latitude in the selection of an alloy. For example, an alloy may have the desired coefficient of expansion but may be hard to machine. Selection of the right temper may solve that problem.

Size and Length

Most glass-sealing alloys are supplied in standard sizes for small-diameter tubing. Commercial tolerances are listed in Table II. Closer-than-commercial tolerances can be supplied when required.

Tubing is furnished in random lengths or in cut lengths. Commercial random lengths in sizes up to 1/8-inch OD, and thin wall tubes over this OD, are subject to a range of one to 15 feet. Sizes over 1/8-inch OD are subject to a range of five to 22 feet and long random lengths to a range of 15 to 22 feet.

Addenda

The following alloys, listed in this article, are trademarked and registered at the U. S. Patent Office:

Kovar, by Westinghouse Electric Corp. Kovar alloy tubing is stocked and sold through the Stupakoff Div. of the Carborundum Co., Latrobe, Pa.

Sylvania #4, by Sylvania Electric Products, Inc.

Therlo, by Driver-Harris Co.

Rodar, by Wilbur B. Driver Co.

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CIRCLE 34 ON READER-SERVICE CARD

Standard Meters Read Frequency

Almost any circuit in which current or voltage varies with frequency can be used for measuring frequency. This article discusses a new design which results in a frequency meter offering flexibility, economy and uniformity.

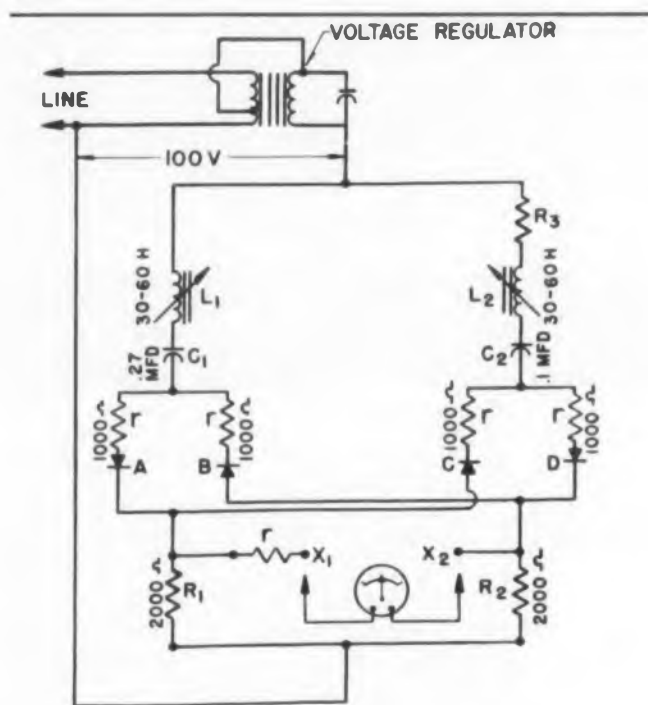


Fig. 1. Circuit of a non-reed frequency meter designed to use standard indicating instruments.

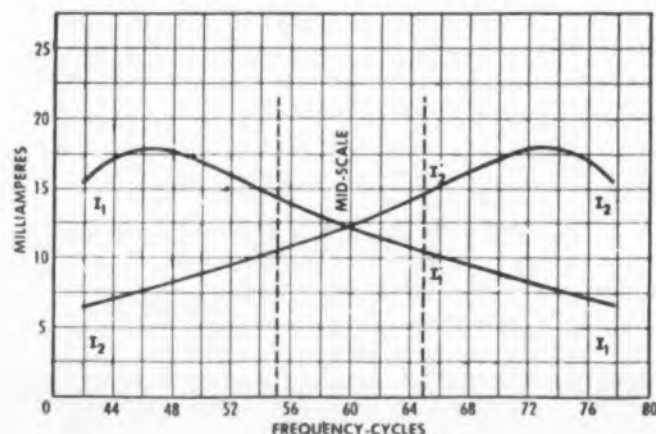


Fig. 2. Relationship of frequency and current.

FREQUENCY meters have been developed to combine in one unit a device that can be used with all sizes and classes of instruments and, as far as possible, to use standard non-reed instruments for indicating.

A frequency "transducer" developed by U. L. Smith, design engineer with Westinghouse Electric Corp., Newark, N.J., uses a circuit that relates frequency to dc voltage.

Any conventional dc voltmeter, either indicating or recording with electrical characteristics selected and adjusted to the output and with scale marked in cycles, may be used to measure its output.

A device of this type provides several functional advantages:

- It permits the use of conventional dc indicating or recording voltmeter merely by selecting and adjusting the instrument's calibrating resistance to match the output of the transducer.
- Any size or shape of instrument may be used and the performance is well within ASA standard requirements.
- Ranges as narrow as 59 to 61 cps can be built, but broad ranges such as 50 to 70 cps are equally practical.
- The instrument can be furnished for any basic frequency such as 50, 60, or 400 cps.
- Only one size and type of meter circuit is needed.
- The scale is nearly uniform over the entire range.
- It eliminates the necessity for tooling, building, servicing and stocking mechanisms that are used only for frequency meters.

The circuit, Fig. 1, is completely separate net-

work. Either an indicating or recording instrument is connected to the point X_1 and X_2 . The instrument and the circuit are calibrated together to make a frequency meter.

Each branch of the circuit contains inductance, capacitance, and resistance in series. The value of each component in Fig. 1 is for a 60 cps circuit. Branch 1 is adjusted for resonance below the operating range and branch 2 is adjusted for resonance above the operating range. Currents through the circuits are shown in Fig. 2. The null or balance point is located at the 60 cps point in this figure but this balance point can be located any place within the range by changing the positions of the resonant points.

Easily Calibrated

In the circuit described, this is done by varying the inductances L_1 and L_2 . These two inductances are adjustable, by screwdriver, over a range of 30 to 60 h. They afford a flexible means of widely adjusting the circuit. For broad frequency coverage, the resonant points are set far apart. For narrow frequency ranges, where it is necessary to obtain more sensitivity from the circuit, they are set closer together. They also provide a ready and quick means of calibrating the circuit to a fixed output by changing the resonant points slightly.

The currents I_1 and I_2 are rectified so a dc instrument can be used. The instrument actually measures the difference in voltage produced in R_1 and R_2 . At the balance point the voltages are the same across these resistors and there is no voltage across the dc instrument. A red mark is put on the instrument dial at this point and the pointer must be set to this mark before energizing. With a



Fig. 3. Frequency meter being adjusted for use with a dc indicating voltmeter which will be calibrated to read frequency in cps.

change of frequency, one of the currents I_1 or I_2 will increase and the other decrease. The voltages across R_1 and R_2 will be unequal and the dc instrument will read right or left, depending on which of the two currents I_1 and I_2 is larger. These resistors R_1 and R_2 affect the output and different values can be used, depending on the output desired. In the circuit shown these resistors are fixed at 2000 ohms and were selected to provide enough output to operate a direct reading recorder as well as indicating instruments. For a 55 to 65 cps range, the output is approximately 1-1/2-0-1-1/2 volts across a load of 3000 ohms. The four 1000 ohm resistors shown in Fig. 1 limit the current in one branch from being shunted into the other branch.

Can Change Frequency

The circuit shown is a basic 60 cps design and will cover ranges from 45 to 70 cps, such as 50 to 70, 59 to 61, etc. The instrument or recorder used is a 0.5-0-0.5 ma and the different ranges are obtained by adding resistance (r) in series with the instrument. For other basic ranges, such as 400 cps, it is necessary to change the inductances and capacitors, but the resistors, rectifiers, and instru-

ments remain the same and the output is the same. The inductances and capacitors vary as the inverse of the basic frequency and for 400 cps they will be 60/400 of the values shown. These values may be varied so standard value capacitors can be used, as long as the relation $\omega L = 1/\omega C$ is met for the resonant points.

In circuits of this kind, the dc output is influenced by changes in line voltage except at the null point where the output voltage is zero. To make the entire scale independent of voltage change, the transducer contains a saturation-type regulator that holds the voltage constant over a range of 100 to 130 volts.

Fig. 3 shows the transducer without cover. All the components, with the exception of the inductances, are mounted on a printed circuit. The two inductances are adjustable by screwdriver, as indicated by the arrows in Fig. 1; and openings are provided in the shields and cover so it can be done after the unit is completely assembled. Fig. 1 also shows the resistor (r) that goes in series with the instrument and is adjusted to the range desired. It is placed in the transducer so that a standard 0.5-0-0.5 dc milliammeter can be used on all ranges. ■ ■

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CIRCLE 35 ON READER-SERVICE CARD

Oscilloscope Trace Recording With Polaroid Land Photography

Part 2. Camera and Oscilloscope Settings

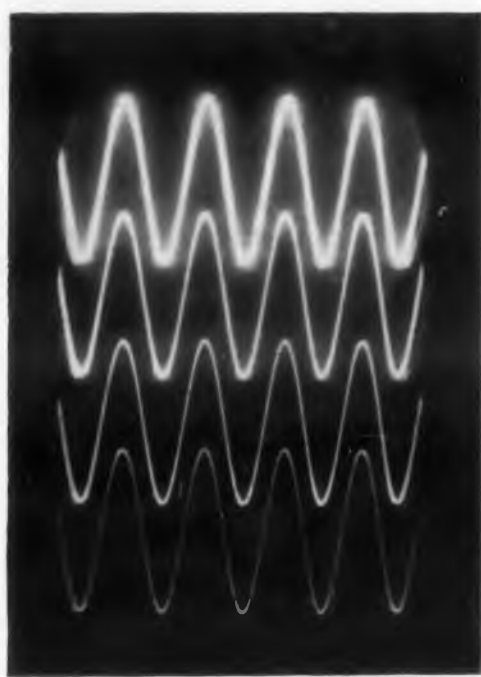


Fig. 3. (left) Exposures over a wide range produce acceptable pictures. Aperture settings, reading from top to bottom, were $f/2.8$, $f/5.6$, $f/11$ and $f/22$. Shutter speed constant at $1/100$ sec. Intensity was set for comfortable viewing of sharp 30 kc trace on P-11 phosphor.

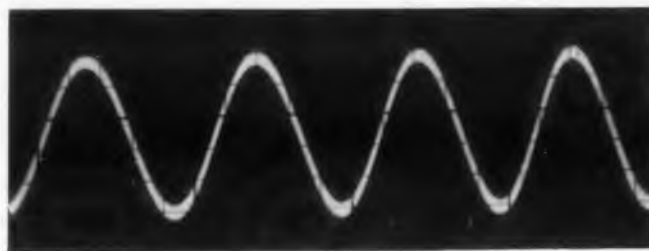


Fig. 4. (left) Top trace overexposed at $f/4$, $1/25$ sec. Lower trace slightly underexposed at $f/16$, $1/50$ sec. Intensity remained unchanged.

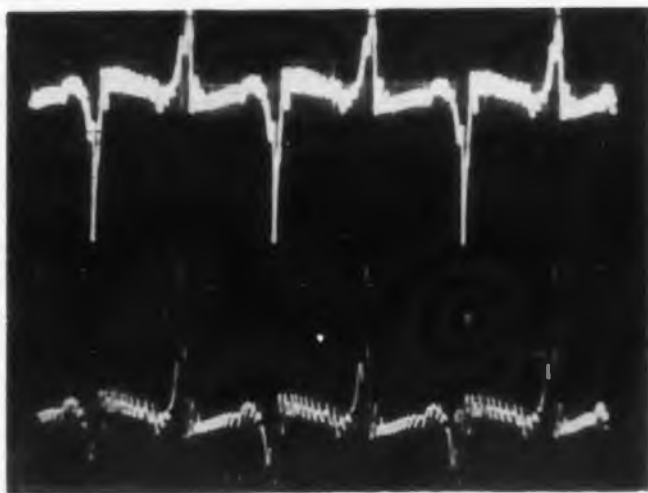


Fig. 5. Blooming of upper trace (as it appeared to the eye) is eliminated in lower trace by deliberate underexposure. Upper trace exposed at $f/1.9$ for $1/100$ sec. Lower trace shot at same speed at $f/16$.

This is the second of a three-part series on oscilloscope trace recording. The first part, which appeared in the September 16th issue of *ELECTRONIC DESIGN*, covered Films and Cameras. The final part will cover Special Techniques, Tube Phosphors, and Projection Films.

Kemon P. Taschioglou
Polaroid Corp.
Cambridge, Mass.

Hy P. Mansberg
Airborne Instruments Lab.
Mineola, L. I.

KNOWING THE EFFECTS of camera settings, cro settings, and of the signal waveform can save an engineer time and film. It can help him rapidly select the best exposure for a given trace.

Camera Setting

Most scope cameras have conventional shutter and aperture settings. F/numbers usually range from $f/1.9$ to $f/22$. The f/numbers commonly listed on the lens are in a progression such that, with each increase in f/number, the amount of light reaching the film is cut in half.

Similarly, shutter speed settings are marked off in progressive half-time intervals, from one second, $1/2$ second, $1/4$ second, down to $1/100$ of a second. Just as in conventional photography if the shutter speed is doubled, for example, from $1/25$ to $1/50$ second and, simultaneously, the aperture setting is doubled from $f/8$ to $f/5.6$, there is no change in the exposure (total light reaching the film).

The exposure of the film is the product of the size of the opening through which the light passes and the length of time the shutter is open. Changing exposure by a factor of two, i. e., doubling or halving either aperture or time, changes exposure by one "stop".

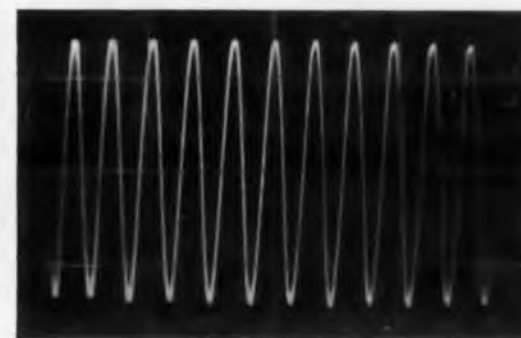
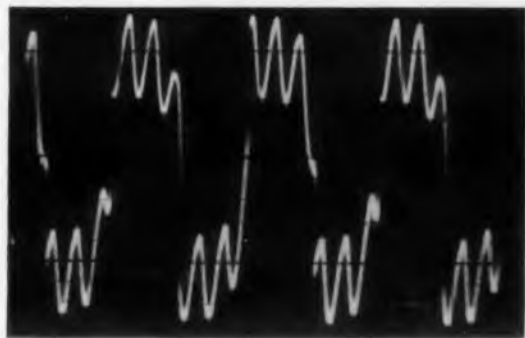


Fig. 6. Left signal has slow modulation, gave blurred record when exposed for 1/2 sec. Increase of shutter speed to 1/50 gave well-defined right trace. Aperture setting changed from f/16 to f/4.

Fig. 7. Part of left trace was lost due to shutter being open long enough (1/10 sec.) for only two to three sweeps. Keeping the shutter open longer (1/2 sec.) for right trace yielded uniform trace intensity.

The "B" or bulb setting and the "T" or time setting are most often used in recording single transients. The technique requires holding the shutter open and waiting for the transient to appear. Exposure for single transients is usually controlled by varying only the aperture setting.

Range of Exposures. For most repetitive traces, an acceptable picture of a trace is usually possible within a range of exposure settings of four to six "stops". All of the traces in Fig. 3 were taken with the same beam intensity, set for comfortable viewing on a P-11 phosphor.

Notice that with a maximum exposure (upper trace) the film begins to record spot halo objectionably. The trace appears to "bloom" as if the intensity setting were too high. From this point of "blooming" to the other extreme of a too-faint trace, there are about six stops.

A medium intensity trace, when overexposed, does appear to bloom, while an underexposed trace will indicate fine detail. This point is illustrated in Fig. 4.

Incidentally, when the intensity setting is too high and visible blooming actually appears on the tube face, it can be reduced in the picture by cutting down the exposure, as illustrated in Fig. 5.

Aperture and Shutter Speed. In all the examples given, shutter speed and aperture controls can be varied together to achieve different effects on the film. Each can be changed to compensate for required changes in the other. Together, they cover a wide range of exposures needed to record variations in image intensities with different films.

Aperture control is the only variant used in recording transients, because the shutter is usually left on the "Bulb" or "Time" setting. In general, for both transients and stationary traces, it is desirable to keep aperture to a minimum for sharper focus and less optical distortion.

Precise selection of shutter speed becomes important in recording continuously varying traces, signals with a slow jitter, and signals requiring

very low sweep repetition rates. In Fig. 6, for example, a severely jittering signal was clearly defined in the picture by shortening the time setting from one second to 1/50 second.

When very low sweep rates are used, the camera shutter must remain open for at least the time of one sweep, or an undesired blank space may occur in the recording. Even if the shutter is open slightly longer than the sweep duration, uneven exposure of the trace may result, as shown in Fig. 7. As a general rule, exposure time should be at least five to ten times the sweep duration for uniform recording.

Scope Choice

A cro should be chosen for design features such as amplifier sensitivity, bandwidth, stability, sweep range, sync characteristics, cost, etc. But, other factors being equal, these are the two most important features affecting cro photography:

1. Accelerating Potential. Cro's with higher accelerating potentials usually produce greater spot intensity and more actinic light output. This is

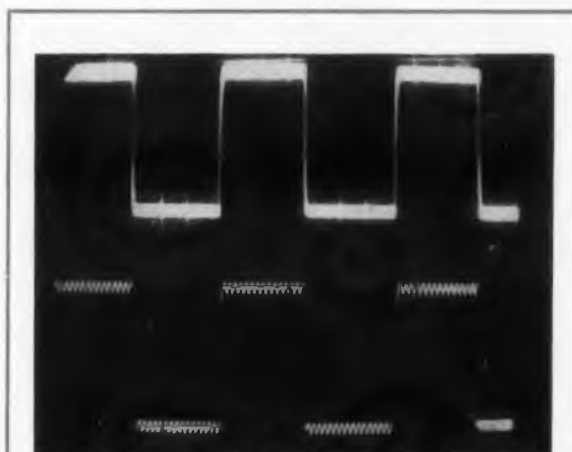


Fig. 8. Upper trace exposed at f/1.9, 1/10 sec. to show rise time while losing detail on flat top. Exposure decreased eight stops to f/11, 1/50 sec. to show flat top. Rise time was underexposed.

particularly important when recording high speed transients. Wideband cro's with accelerating potentials greater than 3 kv are usually needed, both to see, as well as to record fast-moving transients. As a guide, one can assume that the amount of actinic light available under given signal conditions varies roughly as the accelerating potential.

2. Tube Phosphor. Polaroid[®] Land films are recommended for recording with all of the commonly used crt phosphors. Some are more effective than others in photo recording. Some of these phosphors are used with filters for observation and for photo recording. Some have two color outputs, an initial emission resulting from the direct flash of the electron beam and the afterglow which remains after the beam has passed.

The selection of tube phosphors and use of filters are discussed in more detail in Part 3 of this article.

Cro Settings and the Signal

Intensity. The intensity setting on the cro controls the beam current and, thus, can have the greatest effect on proper photographic exposure. Slight changes in intensity settings, almost unnoticeable to the eye, can have the same effect as the change of one or two "stops" in camera settings. However, the film latitude yields good exposures within a wide range of intensity settings.

Spot Size. Cro's which produce smaller and more uniform spot size over the entire screen area are best for obtaining good resolution and detail. Those with higher accelerating potential generally produce smaller spot diameter, but usually at some sacrifice in the viewing area covered by the entire trace. Naturally, the focus and astigmatism controls of the cro should be set for the best spot size and uniformity at any particular intensity setting.

However, it is sometimes beneficial to misadjust the astigmatism controls for optimum focus in one

[®]Polaroid is a registered trademark of the Polaroid Corporation.

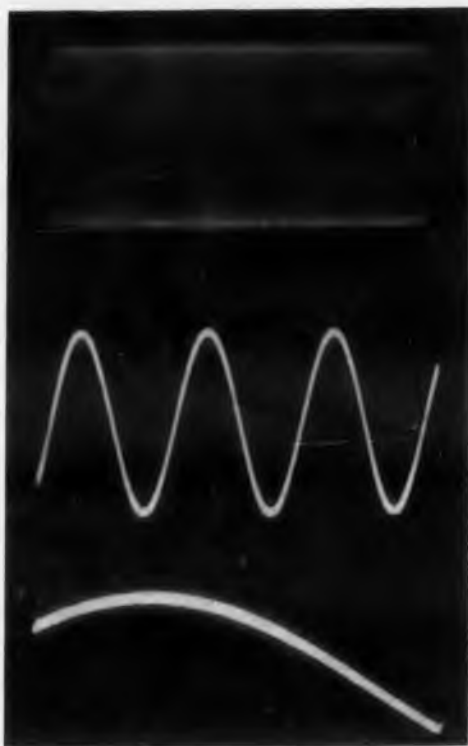


Fig. 9. Only the sweep rate was changed for these three pictures of a 30 kc trace. Top picture shows 16 cycles/in.; middle shows 1 cycle/in., and bottom picture shows 1/16 cycle/in. on the crt. Camera set at $f/5.6$, $1/50$.



Fig. 10. Only the X-gain was changed for these three pictures. A 30 kc trace was expanded from 16 cycles/in. on the crt. Camera set at $f/5.6$, $1/50$.



Fig. 11. No change in exposure is seen as signal frequency is increased from 30 kc to 300 kc to 3 mc. Sweep rate was adjusted to maintain 1/4 cycle/in. on the crt. X-gain was held constant. Camera set at $f/5.6$, $1/50$.

30 kc trace was kept constant, and the sweep rate was increased from 16 cycles per inch on the screen to 1/16 cycle per inch. All traces are readable, yet they could be improved by changes in exposure.

Fig. 10 shows the effect of changing gain to compress the pattern. All traces are made at the same exposure and beam intensity.

Increasing the frequency and changing the sweep repetition rate to produce the same number of cycles on the screen would have no effect on the exposure—again, as long as a high duty cycle sweep is used. In Fig. 11, there is no noticeable change in exposure of the 30 kc, 100 kc, and 3 mc traces; intensity and gain controls were held constant.

Occasionally, a high frequency signal has to be displayed on the cro with a very low duty cycle sweep, rendering the signal practically invisible to the eye. The maximum exposure with high speed Type 47 film will often record such a low duty cycle trace.

Recording Stationary Traces

The technique for recording stationary patterns is straightforward. If the trace can be seen, it can be photographed. Actually, with Type 47 film, one can photograph traces invisible to the eye under normal conditions. Here are some general rules:

1. Settings on the cro should provide the sharpest trace and most comfortable viewing that brings out the details of greatest interest.
2. Whenever possible, apertures should be small—down to $f/5.6$ or $f/8$ (higher f /numbers)—to increase depth of field, to improve camera focus, and to reduce optical aberrations.
3. With slow sweeps, the shutter speed should be at least low enough to record a single full sweep and preferably five to ten sweeps if no jitter of drift is apparent.
4. Exposure time should be minimized to reduce fogging or blurring caused by drift or undesirable modulation.

It is impractical to determine precisely the combined effect of intensity settings, spot speed, spot size, etc. The choice of best exposure values is made, at first, by trial and error. But it very soon becomes almost intuitive.

As a rough guide for first exposures, the following can be used:

For Type 42— $f/8$ at $1/5$ sec.

For Types 46, 46-L— $f/8$ at $1/10$ sec.

For Type 47— $f/8$ at $1/50$ sec.

This assumes recording a 50 kc trace with four cycles on a P-11 phosphor. Intensity is set at a comfortable level for viewing with a cro of 3 kv accelerating potential. Camera reduction ratio is 2:1.



Fig. 12. Intensity was too high to record details in the transient on the left. Intensity turned down for picture on the right. Both taken at $f/1.9$. (Courtesy Avco Corp.)



Fig. 13. Effect of prefogging Type 47 film to increase maximum writing rate. Left transient recorded with no prefogging. Prefogged film used for right transient with same camera and intensity settings. Maximum writing rate was doubled.

coordinate of spot motion. For example, to record a very fast rise time on a square wave pulse, one can misadjust the astigmatism control to favor focus on the vertical position, sacrificing focus on the flat-top portion.

Spot Speed. The exposure produced by the spot varies inversely as the spot writing speed. As the speed of the spot increases, more exposure or higher intensity may be required.

When recording traces with peaks, one must remember that the spot speed decreases near the peaks. The exposure must be selected to catch the interesting portion of the trace. In Fig. 8, a portion of the trace is deliberately under-exposed to increase detail in another portion.

Similarly, increasing the amplitude of either axis will increase the spot speed and lower the brightness. A trace, four inches from peak to peak, may require four times as much exposure as one which is one inch high.

Frequency and Sweep Rates. Changing the frequency or sweep repetition rate of a given signal affects exposure, but not drastically, as long as a high duty cycle sweep is used. When a repetitive sweep of high duty cycle ratio is used, an increase in sweep speed also results in increased repetition rate. So, even though exposure time per sweep is less, more sweeps occur during this time.

For example, in Fig. 9, the intensity of the

Camera settings of two stops either side of the above would, of course, give acceptable pictures.

Recording Transients

Basically, the same considerations apply in recording transients as in recording stationary patterns. Exposure is controlled by varying the aperture, for the shutter is usually held open to record one complete sweep. With a non-repetitive transient (whether controlled or random) there is no choice but to leave the shutter open until the transient occurs.

In general, the spot is positioned on the left side of the screen; the camera shutter is held open with the "B" or "T" setting; the transient is initiated, and the shutter is closed.

With cro's having automatic beam gate circuits, the intensity control is usually turned down so that the spot is invisible, to avoid fogging the film while waiting for the transient. When a transient is initiated, the beam is automatically gated on, brightening the trace at the same time the sweep is triggered.

Because available light from the trace is usually at a premium, trial exposures should be made with the lens aperture wide open. But, of course, intensity and apertures have to be adjusted for best exposures as in recording stationary patterns. Fig. 12 illustrates exposure correction in recording a transient.

Maximum Writing Rate

The term "maximum writing rate" is used to indicate the sensitivity of a particular film for recording transients. Maximum writing rate specifies the maximum linear speed of the crt spot, in a single traverse, that can produce a barely read-

able record on a film for a particular combination of cro, camera, and settings.

Maximum writing rate is, in a sense, analogous to the ASA exposure index, which is used to indicate the sensitivity of a film for recording daylight scenes. Exposure index and maximum writing rate, however, are not necessarily related.

Most important, ASA exposure indices are determined from the film's response to daylight or tungsten light, both of which have spectra much different from that of any particular tube phosphor. For very high speed transients, the exposure time is very short (with short persistence phosphors). For extremely short exposures, the reciprocity relationship of brightness and exposure time fails, and the ASA index loses significance.

Furthermore, exposure index is a measure of the exposure required to reach a particular contrast gradient in the film's characteristic curve, while readings for maximum writing rates are determined in the threshold region of the characteristic curve of the films. The threshold region on a positive print is the region of deepest black.

There are three ways of increasing the maximum writing rates of Land films. All can be very useful when a film is being pushed for its maximum sensitivity. Increasing the maximum writing rate will often reveal invisible portions of a fast trace.

1. Decreasing the Development Time. Developing Land prints only 20 to 30 sec will about double maximum writing rate. The best period is about 20 sec. The picture is removed from the back door 20 sec after pulling the tab. The over-

all background is considerably lighter and contrast is lowered, but detail can be seen in parts of a fast trace which would not be visible with 45 to 60 sec development.

This method requires no extra effort and could be used at all times when one is shooting high speed transients.

2. Prefogging. Controlled marginal exposure of the film to a light source before exposure to the trace will increase maximum writing rate two to three times as shown in Fig. 13. Prefogging is the most effective single method for increasing maximum writing rate.

Prefogging does not cause as sharp a drop in contrast as underdevelopment, and it is not necessary to prefog enough to lighten the background considerably.

A variety of different procedures can be used to prefog. A convenient method is to point the camera at an Eastman Kodak 10 in. x 10 in. transparency viewer or sheet of ground glass, illuminated with a 15-watt bulb covered with three or four thicknesses of tissue paper. Type 47 should be exposed at f/16 at 1/100 sec. The camera should be far enough away (a foot is sufficient) so that the texture of the tissue paper or ground glass is out of focus, and yet close enough so that the illuminator covers the entire field of view of the camera.

Other easy methods of prefogging can be developed by experiment. One can, for example, point the camera at a light wall or white card with the proper brightness. A reflection brightness reading of 30 candles per square foot from a light source is a good guide.

A handy guide for determining the best combination of exposure and light source is to develop an unperfogged Type 47 picture for 30 seconds. The background gray level in this picture is about the same density as optimum prefogging would create on a picture developed for 60 seconds.

3. Transillumination. When parts of a trace are not quite readable, a print viewed directly over a bright diffused light source such as a 100-watt lamp will render visible very dim or unreadable traces with surprising clarity. Another technique which may come in handy when a fast trace is not readable is to glance at the negative still in the back of camera. Though it will rapidly fog under light, valuable information is often available.

A still greater increase of writing rate can be achieved by combining prefogging and underdevelopment. To keep the background dark enough and to achieve best results, one should develop for a slightly longer period (30-35 sec.), and use the same prefogging techniques.

Table 3 lists the maximum writing rates of Land films for normal development and for prefogging. A guide for prefogging exposure is also given. ■ ■

Table 3. Typical Maximum Writing Rates of Land Films

Film Type	*ASA	Maximum Writing Rate—Normal (cm. per microsecond)	Maximum Writing Rate—Prefogged (cm. per microsecond)	Prefogging Exposure with 30 Candles/ft. ² Illumination
42	200	400	700	1/100 sec. at f/8.
46, 46-L	600	490	1000	1/100 sec. at f/11.
47†	3000	(over 3500)	(over 8500)	1/100 sec. at f/16.

Note: Maximum writing rate measurements made on Tektronix 517A cro, 24 kv accelerating potential. Displayed was single 450 mc damped sine wave transient. Camera reduction ratio 1:1 at f/1.9.

*ASA equivalent daylight exposure index.

†Figures extrapolated from results with smaller aperture than f/1.9.

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Life: 100,000 op. min. at 125°C; rated current.
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Duty: Continuous

Amb. Temp. Range: -65°C to +125°C.

Contacts: DPDT for BR-8 & BR-8H
SPDT for BR-8S & BR-8HS

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Release Time: 5 millise. max.

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Phase Multilock Receiver

Needs No Local Oscillator

HIGH SIGNAL-TO-NOISE ratio without phase ambiguity for any digital data transmission system results from an unusual receiver design. Input phase modulated signals provide their own phase reference signal: they are rectified, multiplied and divided, until they have the same frequency they came in with and a standard phase.

With the trend toward phase-shift communication growing, because of the ex-

tremely narrow bandwidths required, the new system will find application in tele-metering, teletyping, remote control and computer digital data transmission.

Developed at the Robertshaw-Fulton Controls Co. of Anaheim, Calif., by Cecil A. Crafts, engineering supervisor, and Maynard McFarlane, research scientist, the phase multilock system is fully coherent. It can transmit pulse code modulation, pulse position modulation and

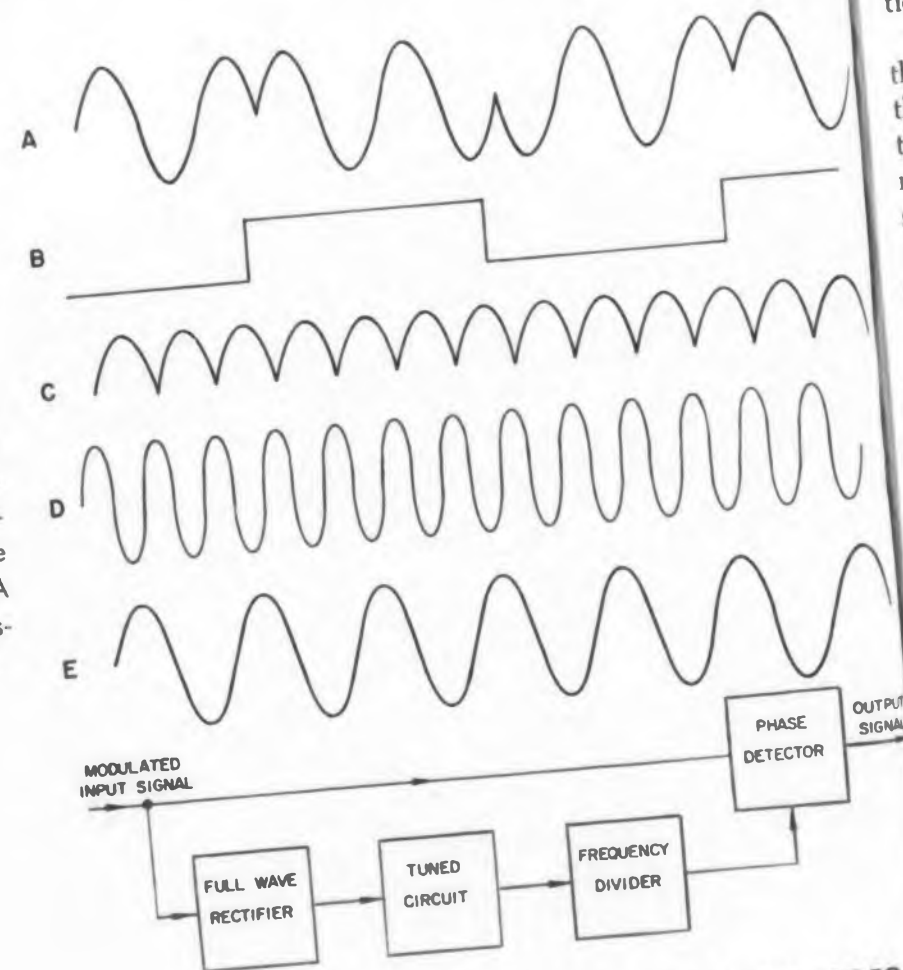


Fig. 1. Phase reference signal formation is shown above block diagram of circuits. Keying provides 180-degree phase shift. On Line A shift occurs at axis crossings for convenience.

ELECTRONIC DESIGN • October 14, 1959

CIRCLE 36 ON READER-SERVICE CARD

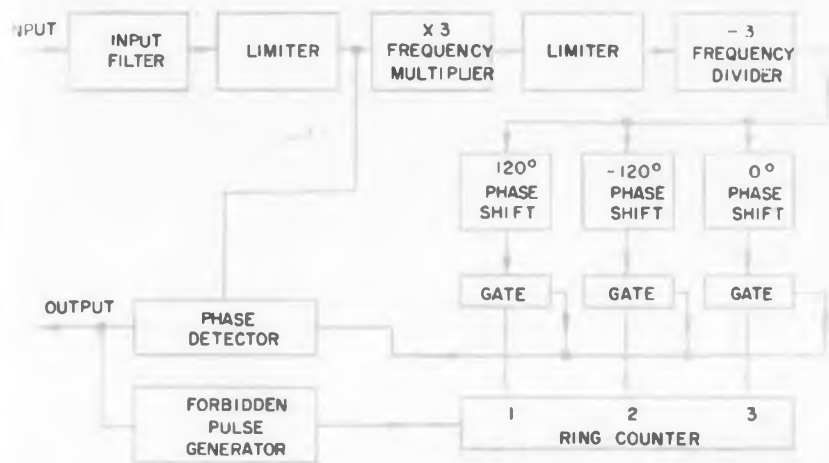


Fig. 2. Phase multilock receiver block diagram. Input signal is shifted 120 degrees. Two phases are used for information; the third provides non-ambiguity by means of the correction circuit.

pulse width modulation. It is not restricted—as are differentially coherent systems now in use—to one of the three modulations.

How It Works

The essential requirement of a coherent phase-shift keying system is an extremely stable reference phase at the receiver, so the phase shifts of the transmitted signal can be interpreted. In the phase multilock device, the incoming carrier is used to produce the reference.

A two-phase system (180-deg phase shift) is diagrammed in Fig. 1. Line A is a 180-deg phase-shift keyed signal produced by the signal of line B. That the phase shifts occur at the axis crossing is merely a convenience for illustrative purposes and not necessary to system operation.

When the input of line A is passed through a conventional full-wave rectifier, the output takes the form of line C. After this signal is applied to a high Q parallel resonant circuit, the signal appears as shown on line D—with twice the input frequency but with no remaining traces of the phase shift. The same result can be produced by a two-time multiplier.

An additional purpose served by the high Q resonant circuit, Mr. Crafts says, is to smooth distortion caused by noise, momentary signal interruptions and keying transients. The double-frequency signal is then divided by two in a frequency divider with a sinusoidal output, as on line E. This output is at the carrier frequency—but has no phase-shift modulation. It now constitutes the phase-stable reference wave, since its phase characteristic is not affected by phase shifts in the transmitted frequency.

This is fine—so long as the received signal is strong enough to maintain the phase lock condition.

Resolve Phase Ambiguity

But what happens when the signal is lost in noise momentarily? The reference signal may be displaced to another transmitted phase, when it starts again. A variation of the basic circuit avoids this problem. The phase shift used is the equivalent of a three-phase system: while actually only two phases are used for the information, a third phase is used at the receiver to restore proper phasing if it should be in error.

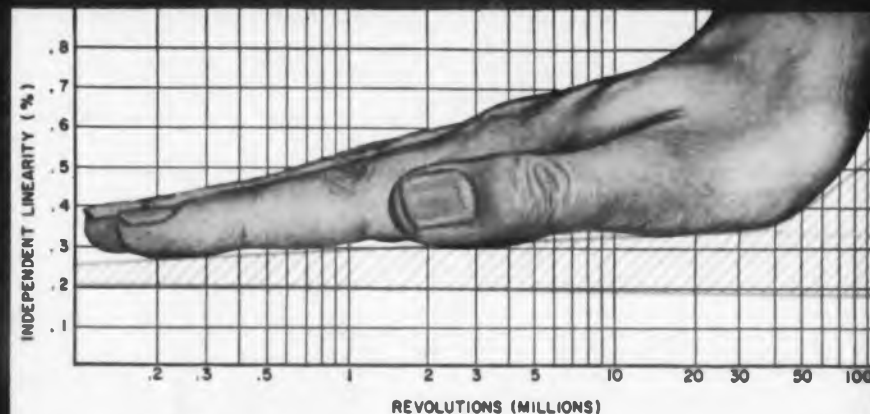
For example, mark and space teletype signals may be transmitted at 0-deg and 120-deg phase shift by means of the phase shifting network at the transmitter. The transmitter sends out no signal at the 240-deg phase-shift position.

At the receiver, signals received in the 0-deg and 120-deg phase positions are recorded properly as mark and space signals; any signal occurring in the 240-deg phase-shift position indicates an error in the phase of the reference signal, since this is a forbidden phase for transmission.

On receipt of a forbidden signal, a correction circuit (Fig. 2) shifts the phase of the reference by 120-deg steps until the forbidden phase is no longer receiving a signal. When this occurs, the transmission is taking place between the predetermined phases, and the reference signal is in correct phase with the transmitter carrier or subcarrier.

In the three-phase system, the incoming signal is multiplied by three. The circuit remains operative on a phase spacing of 120 deg, and the stable phase reference wave is produced by dividing this triple frequency by three. The operation is exactly analogous to the phase reversal case described in Fig. 1.

For further information on this phase multilock system, turn to the Reader-Service Card and circle 101.



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Like many engineers, R. H. Parvin felt a need for a more graphic picture of the various design parameters involved in choosing servo gear ratios. In this article he provides graphical data on these parameters.

How To Choose A Servo Gear Ratio

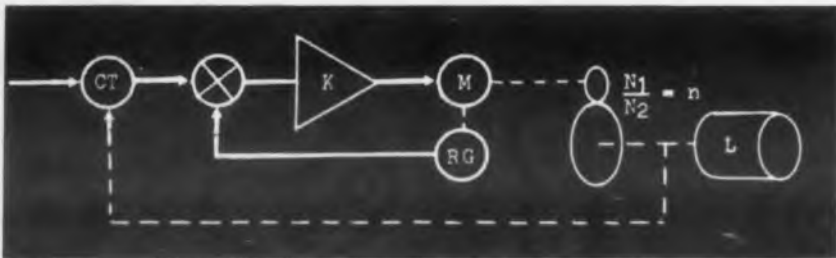


Fig. 1. Block diagram of basic position servo. The servo gear ratio is "n".

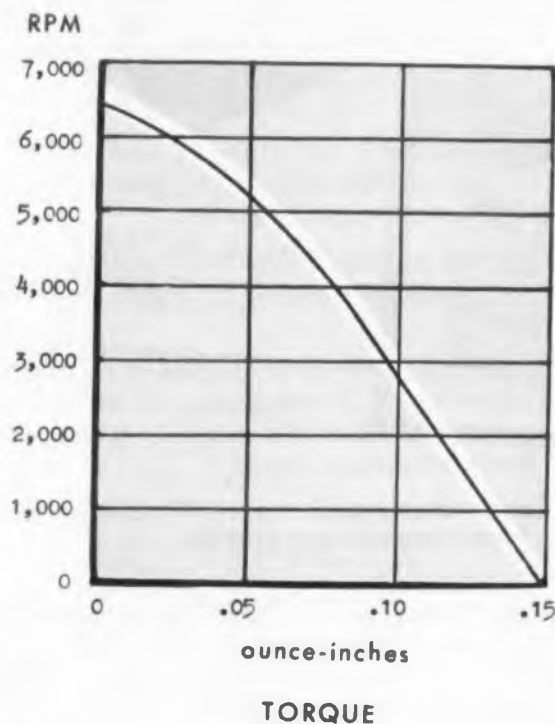


Fig. 2. Typical servo motor torque-to-speed curve.

Compatible Units Of Angular Momentum

Torque = Moment of Inertia \times Angular Acceleration

$$*lb-ft = slug-ft^2 \times \text{radians/sec}^2$$

$$lb-ft = lb-ft^2 \times 32.2 \text{ radians/sec}^2$$

$$*dyne-cm = gram-cm^2 \times \text{radians/sec}^2$$

$$gram-cm = gram-cm^2 \times \frac{\text{radians/sec}^2}{980}$$

*preferred

THE GEAR RATIO in the servomechanism is an impedance matching device, like an output transformer. An analytical look at the load specifications of a servomechanism will show how to choose the gear ratio that requires minimum driving torque.

The load specifications influence the servo's power requirements, which are:

- Overcoming friction and moving the load.
- Driving the load to a specified maximum velocity.
- Following a specified maximum rate of change of velocity (acceleration).

Motor torque required to do this depends on the gear ratio between the shafts of the driving motor and the load. To overcome the load friction (F_l), the torque required is:

$$T = F_l n$$

where n is the ratio of the motor shaft to the output shaft. It is normally less than 1.

The synchro control transformer must be included in the calculations as part of the load. See Fig. 1. The friction of the gearing adds to the torque required, but it can be measured from the input shaft and is:

$$T = F_s$$

Effects of Drag

Viscous drag (friction that is proportional to velocity) of the load also requires a motor torque proportional to gear ratio:

$$T = f_l \dot{\theta}_l n$$

Richard H. Parvin

Senior Systems Engineer

Minneapolis-Honeywell Inertial Guidance Center

St. Petersburg, Fla.

In the equation,

f_l = coefficient of viscous drag of the load

$\dot{\theta}_l$ = load shaft speed

This term is normally negligible if light lubrication is used and if the load shaft speeds are not high. The two-phase servo motor, however, characteristically delivers maximum torque at stall and no torque at maximum speed, as shown in Fig. 2. This torque-to-speed ratio is the electrical equivalent of viscous drag. Since the motor speed is $1/n$ times the load shaft speed, the torque required (or lost by the motor is

$$T = f_m \left(\frac{\dot{\theta}_l}{n} \right)$$

where f_m is the torque-to-speed ratio of the motor.

Acceleration Requirements

The torque required to accelerate the load shaft is proportional to the moment of inertia of the load and to the gear ratio:

$$T = J_l \ddot{\theta}_l n$$

But since the motor shaft is accelerating at $\ddot{\theta}_l/n$, the torque required to accelerate the motor (and the rate generator in the case shown in Fig. 1) is:

$$T = (J_m + J_{rg}) \frac{\ddot{\theta}_l}{n}$$

These terms are shown graphically in Fig. 3. The effect of gear ratio, n , is in each term.

(Continued on p. 52)

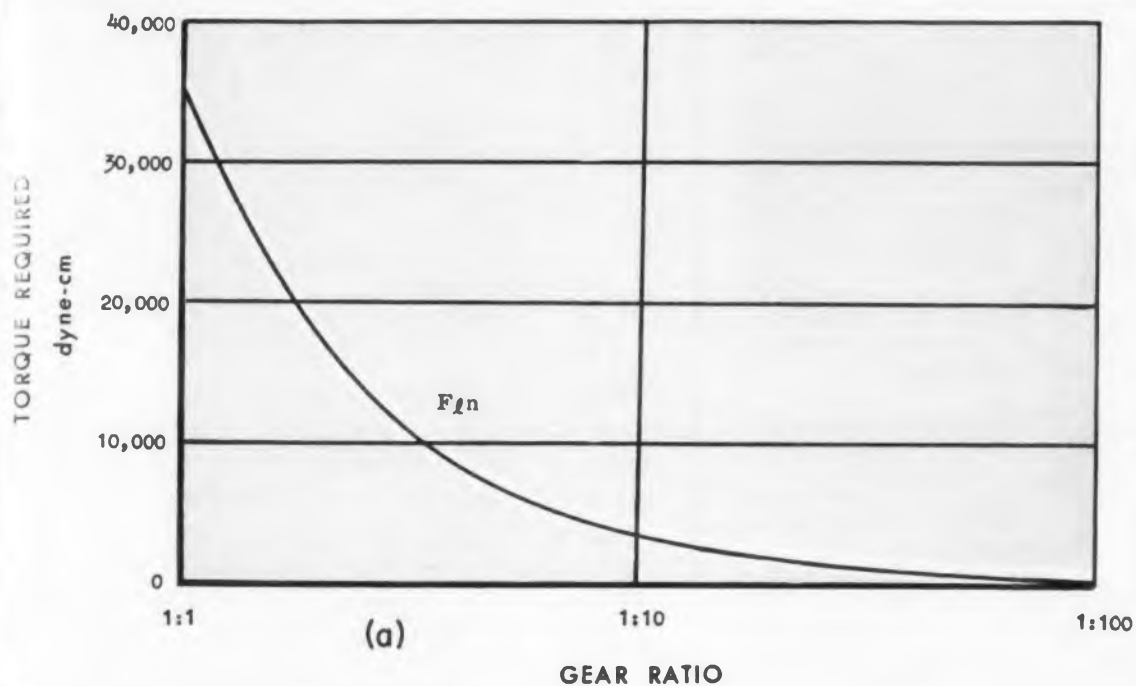


Fig. 3a. Torque required by friction.

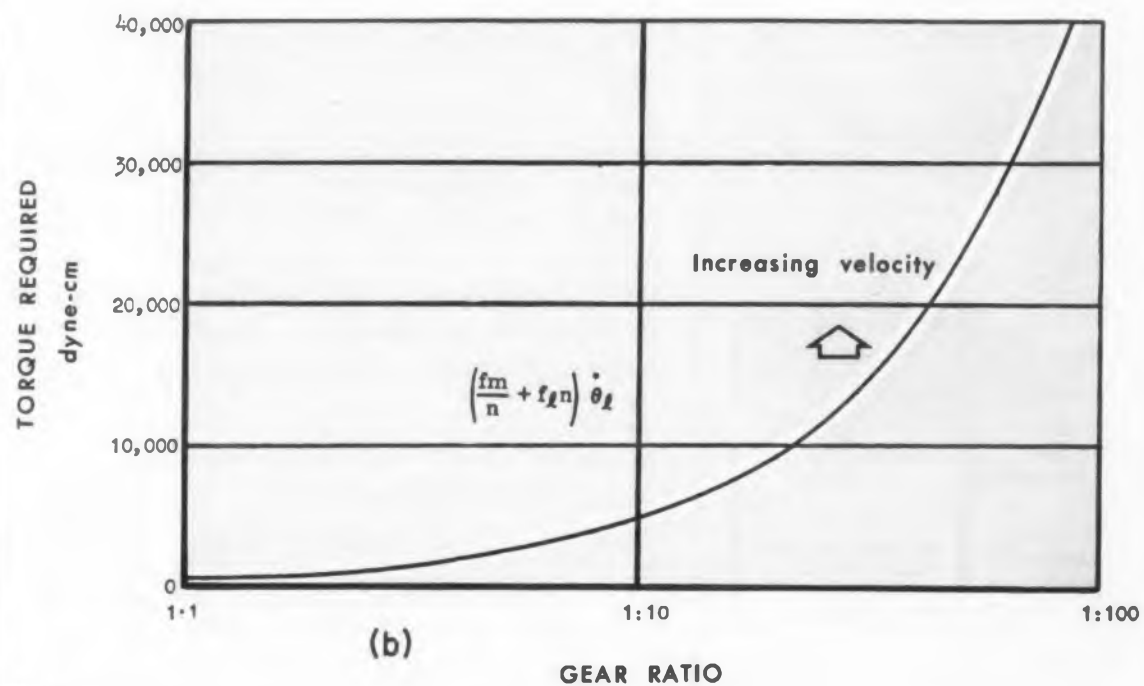


Fig. 3b. Torque required by viscous drag.

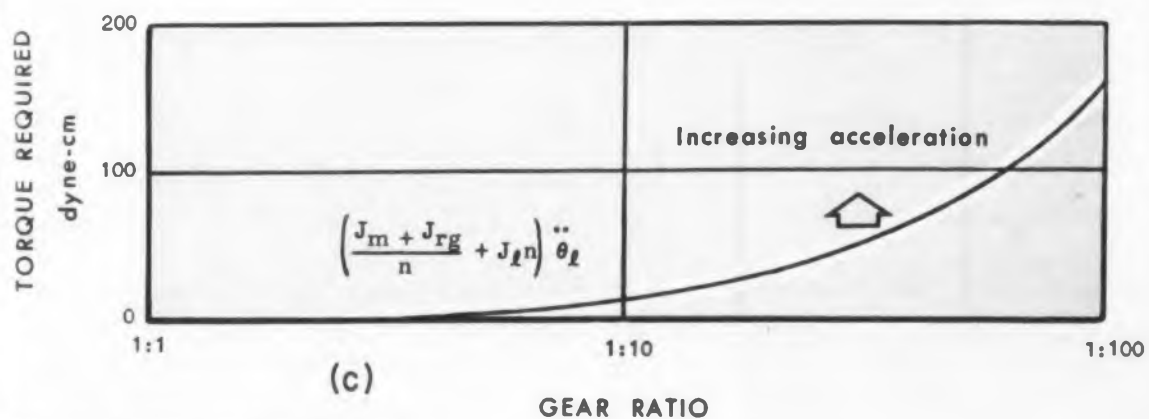
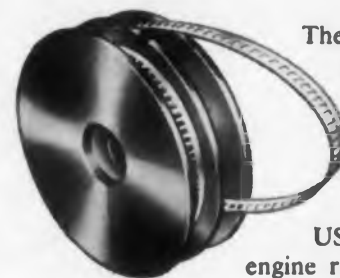


Fig. 3c. Torque required by inertia.

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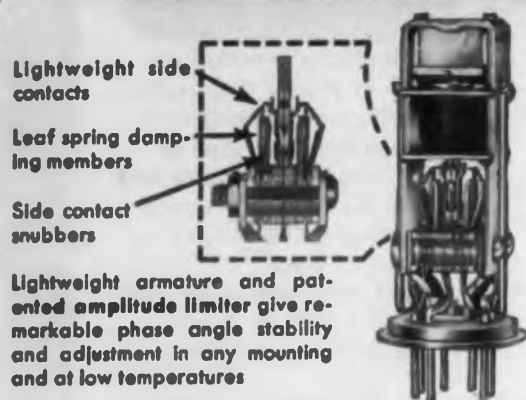


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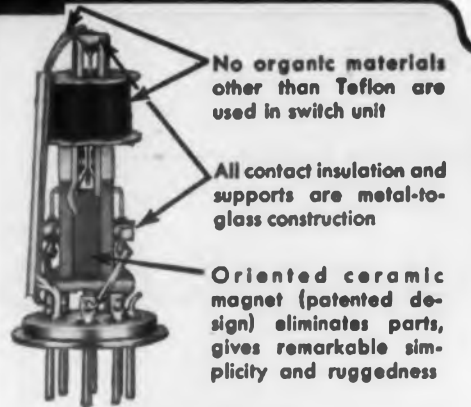
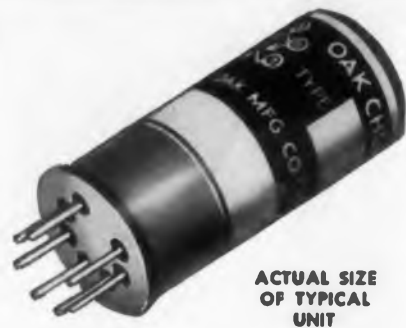
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Lightweight armature and patented amplitude limiter give remarkable phase angle stability and adjustment in any mounting and at low temperatures

MINIATURE SERIES 600—MOST STABLE IN ITS CLASS

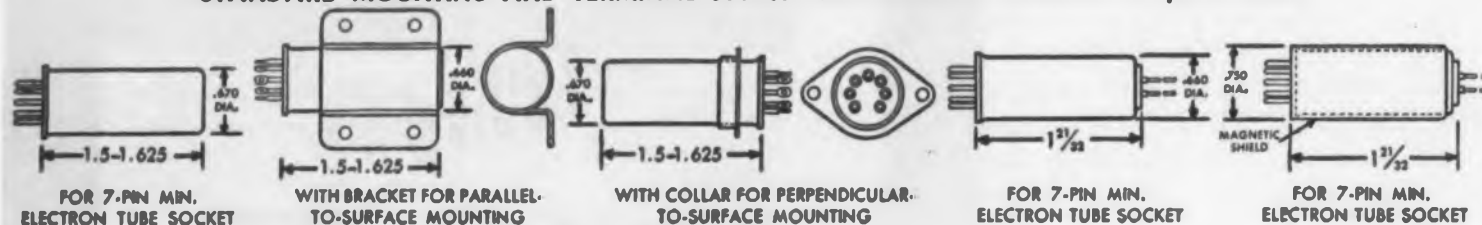
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Nominal Drive Freq. and Voltage	400 ± 20 cps at 6.3 v	400 ± 20 cps at 6.3 v	380-500 cps at 6.3 v	400 ± 20 cps at 6.3 v	400 ± 20 cps at 6.3 v	60 ± 5 cps at 6.3 v Aperiodic from 10-100 cps	4-8 Volts, 10-1000 cps. Aperiodic. Coil Current 60 ma at 400 cps Coil Res. 85 Ohms	
Phase Lag at Nominal Drive Freq. and Voltage	65° ± 5° at 400 cps (25° C)	65° ± 5° at 400 cps (25° C)	75° ± 10° at 400 cps (25° C)	90° ± 10° at 400 cps (25° C)	180° +10° -0° at 400 cps (25° C)	20° ± 5° at 60 cps (25° C)	10 cps: 10° ± 5° 60 cps: 15° ± 5° 400 cps: 55° ± 10° 1000 cps: 110° - 0° (25° C)	
Contact Dwell Time at Nominal Drive Freq. and Voltage	150° min (25° C)	140° max (25° C)	150° min (25° C)	150° min (25° C)	160° ± 10° (25° C)	165° to 170° at 60 cps	160° to 170° (25° C)	
Contact Rating Into Resistive Load (Maximum)	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 15 v at 2 ma INTERMITTENT: 50 v at 2 ma	CONTINUOUS: 10 v at 1 ma INTERMITTENT: 12 v at 2 ma	
Life Expectancy (Optimum Conditions)	Up to 5000 hours	Up to 1000 hours	Up to 5000 hours	Up to 5000 hours	Up to 5000 hours	Up to 10,000 hours	Up to 10,000 hours	
Switching Speed With DC in Cell	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 800 Microseconds	Less than 200 Microseconds	

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CIRCLE 39 ON READER-SERVICE CARD

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PACKAGED CIRCUITRY

Dynamic Equation For Torque Requirements

Total torque required of the servo motor is a combination of all these factors. It is:

$$T = \left[\frac{(J_m + J_{r0})}{n} + J_l n \right] \ddot{\theta}_l + \left[\frac{f_m}{n} + f_l n \right] \dot{\theta}_l + F_l n + F_0$$

Motor friction does not appear in the equation, because the torque required is the output of the motor. The maximum torque required of the motor is when the load shaft is at its maximum specified velocity and acceleration combined. By substituting known, specified or estimated values in the above equation, a value of n at which T is minimum can be found.

An Example

In the case of an instrument servo, such as in inertial navigation instrumentation, it is required that the servo motor drive the indicator at a maximum acceleration of two radians per second squared and at a maximum velocity of 300 rpm. The load friction is estimated to be less than 0.5 oz-in. A small motor/rate generator was selected for the first approximation.

It is here that calculations often get snarled in an attempt to make the units compatible. Several systems of compatible units are shown in the table. By converting specifications, manufacturer's data and estimated values to a common system:

$$\dot{\theta}_l = 30 \text{ rad/sec}$$

$$\ddot{\theta}_l = 2 \text{ rad/sec}^2$$

$$J_m + J_{r0} = 0.8 \text{ gm cm}^2$$

$$f_m = (\text{stall torque})/(\text{no-load speed}), \text{ or } = 15.5 \text{ dyne-cm/rad/sec}$$

$$J_l = 1 \text{ gm cm}^2$$

$$f_l = \text{negligible}$$

$$F_l = 35 \times 10^3 \text{ dyne-cm}$$

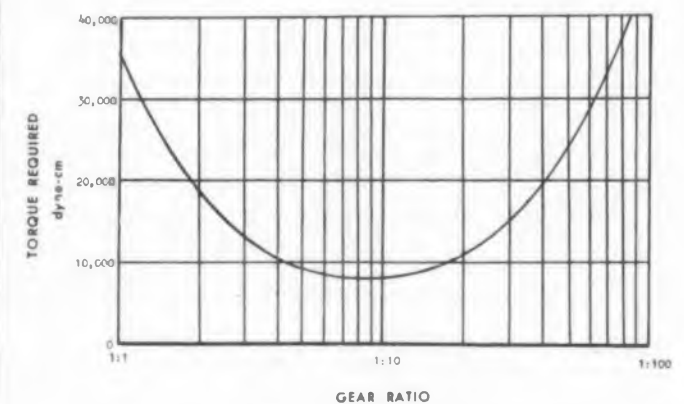


Fig. 4. Total torque required vs gear ratio.

Here's how to pick the best **DIODES** for your money

Price is no clue when diodes sell for about the same, and just looking at them tells nothing. But if you ask the right questions about the three key factors in the production of quality germanium gold bonded diodes, you have your clues to more long-term reliability for your money. Here they are:

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bear a direct relationship to long-term stability. You get a measure of the quality of diodes by asking: "How long do you bake, and at what temperature?" (All GT diodes are baked at 140°C for at least 96 hours—the highest and longest in the industry!)

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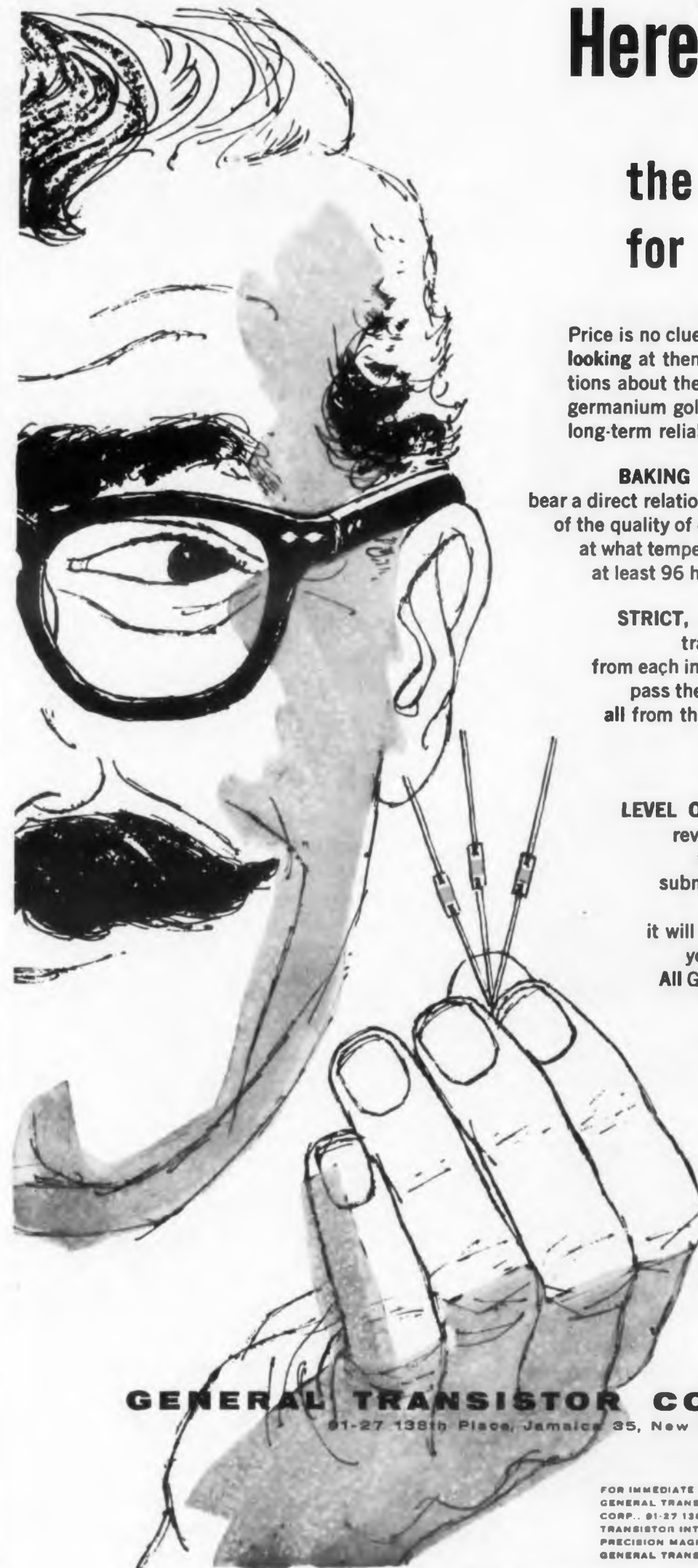
traces the progress of every single wafer made from each ingot of germanium. At GT, if a few wafers fail to pass the stringent GT quality tests along the way, then all from the ingot are suspect and can be identified and pulled out. There are no "stowaways" in a shipment of GT quality diodes.

LEVEL OF TESTING STANDARDS

reveals the level of quality. Ask about "everyday" test standards. (In the GT Seal Test, diodes are submerged in a penetrant-dye solution for 24 hours under 75 psi. This test is so sensitive that it will reveal a leak so small it would take over 300 years for 1 cc of gas to diffuse through the case.) All GT quality tests—100% electrical, 100% shock and vibration, and 100% temperature cycling—are at the highest industry level... and as a final mark of quality, the color bands on GT Germanium Gold Bonded Diodes are baked on to stay.

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Fig. 5. A splined output shaft reduces the inertia of the first mesh.

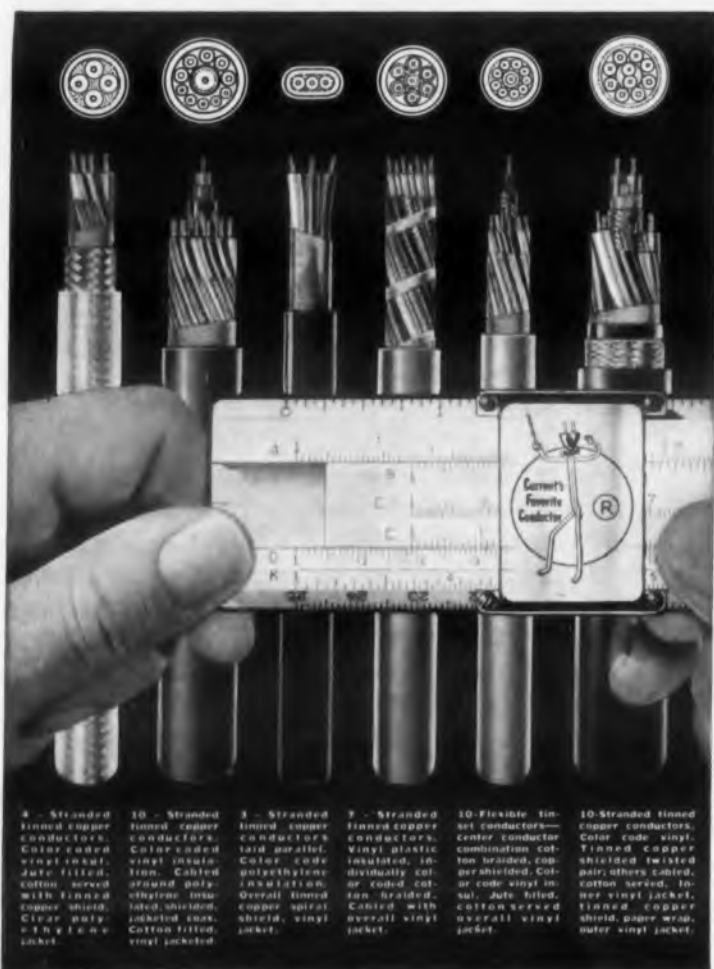
Gear inertia can be assumed to be negligible in comparison with motor inertia when a splined shaft is used for the first gear. The inertia of subsequent gears is reduced by the ratio of the preceding mesh. This is assuming that spur gears are used; worm gearing is usually avoided because of its much higher friction level.

The above values are substituted in the torque equation, and torque required vs. gear ratio is plotted as shown in Fig. 4. The rated torque of the selected motor, 10,600 dyne-cm, is seen to be adequate with any gear ratio between 4 and 25. By examining the effects of individual terms as shown in Fig. 3, it can be seen that this margin may be used to exceed the specs in acceleration or as insurance against higher-than-estimated friction levels by choosing a gear ratio near the high end of the range. Or the margin may be used to exceed the specs in velocity by selecting a gear ratio near the low end of the range.

Stock gear reducers are available in a wide range of gear ratios, with spline or spur gear input, and in a standard servo motor frame size. A larger or smaller motor would be selected if the motor torque were very far from the calculated torque required. ■ ■

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CIRCLE 41 ON READER-SERVICE CARD

Diode in Feedback Loop Makes Stable Transistor Bias Circuit

G. Franklin Montgomery

U.S. Department of Commerce
Washington 25, D.C.

By adding a constant-potential device to transistor amplifier bias networks, excellent stability is obtained without sacrifice in gain. Mr. Montgomery believes that this is a useful way to compensate for transistor variations. He is convinced the design should rely on circuit design rather than transistor type specifications.

BY INCLUDING a constant-potential device in a negative current-feedback loop, excellent operating-point stability is achieved in a direct coupled transistor amplifier. Ac amplification is not sacrificed and few components are needed.

Compromise in Bias Circuit

In any direct-coupled or resistance-coupled transistor amplifier, the choice of a bias circuit involves compromise. Bias currents for the transistor electrodes are supplied through resistors, some of which are shunts for the signal current. In general, as the bias resistances are chosen to improve the stability of the dc operating currents and voltages, a smaller fraction of the signal current is transferred from one stage to the next. Signal amplification is thus sacrificed for stability of operating point.

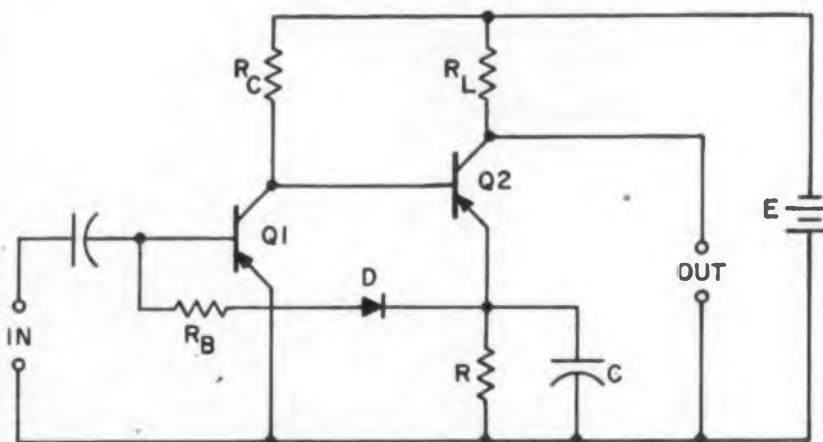


Fig. 1. Two stage direct-coupled amplifier with diode *D* providing a constant forward drop over a wide range of bias current.

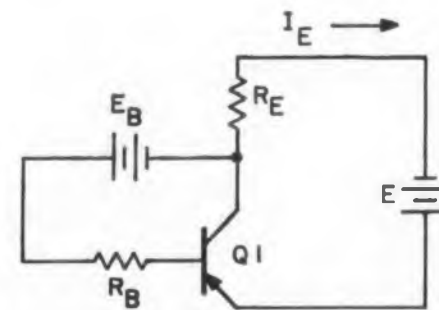


Fig. 2. Simplified schematic with E_B representing the constant potential of diode *D*.

The proper use of a constant-potential device in a direct-coupled amplifier makes this compromise less rigid. In addition, excellent stability can be achieved with few components.

A particularly useful circuit is shown in Fig. 1, where diode *D* is the constant-potential device. A silicon junction diode, for example, provides a nearly constant forward drop of about 0.5 v over a wide range of bias current. Several diodes may be connected in series if a greater potential is wanted. Alternatively, a Zener diode can be used, in which case the polarity would be the reverse of that shown.

Circuit Design Steps

The biasing action of Fig. 1 can be analyzed by using the simpler circuit of Fig. 2, where E_B represents the diode potential. The stability factor

S (more properly an instability factor¹, since it is desirable that S be as small as possible) is defined² by

$$S = \frac{dI_E}{dI_{CO}} \quad (1)$$

where I_E is the direct emitter current of Q_1 and I_{CO} is its collector-to-base leakage current. A good approximation for germanium transistors is

$$S = \frac{1}{\frac{E - V_{CB}}{I_{ERB}} + \frac{1}{1 + h_{FE}}} \quad (2)$$

where V_{CB} is the collector-to-base bias voltage, h_{FE} is the d-c common-emitter current amplification, and

$$E_B = V_{CB} + \left[I_{CO} - \frac{I_E}{1 + h_{FE}} \right] R_B \quad (3)$$

Given a supply voltage E and a transistor Q_1 for which I_{CO} and h_{FE} are specified, the stability factor is directly calculable from (2) in terms of three design parameters: the emitter current I_E , the collector-to-base voltage V_{CB} , and the base bias resistance R_B . The introduction of E_B permits independent choices for V_{CB} and R_B , allowing a smaller R_B and consequently greater stability than would be available otherwise.

A practical design for the circuit of Fig. 1 can be completed very quickly. Given the supply voltage E , a diode voltage E_B , and the direct emitter currents I_{E1} and I_{E2} for the two transistors, simply calculate

$$R = E_B / I_{E2} \quad (4)$$

$$R_C = \frac{E - E_B}{I_{E1}} \quad (5)$$

and chooses R_B to be several times the expected input impedance of Q_1 . The operating currents using these calculated resistances will be close to the design values for any germanium transistors having h_{FE} values greater than 10 or so. Of course the d-c resistance of R_L must not exceed $(E - E_B) / I_{E2}$. For maximum amplification, E must be sufficient to permit an R_C several times the input impedance of Q_2 for a reasonable I_{E1} . Capacitance C must be large enough to prevent degenerative a-c feedback to the base of Q_1 .

The equations given are not good approximations for silicon transistors; a design using these types must take into account their appreciable emitter-to-base potential. In the simplest case, the junction diode D can be considered "built-in" to the base electrode of Q_1 with a drop of about 0.6 v, and the design can proceed with R_B directly connected to the emitter of Q_2 . ■■

References

1. H. S. Armstrong, "A Straightforward Description of Temperature Effects on Transistor Stages," Proc. I. R. E., vol. 47, pp. 1002-1003; May, 1959.
2. R. F. Shea, Transistor Circuit Engineering, John Wiley & Sons, Inc., New York, p. 55; 1957.

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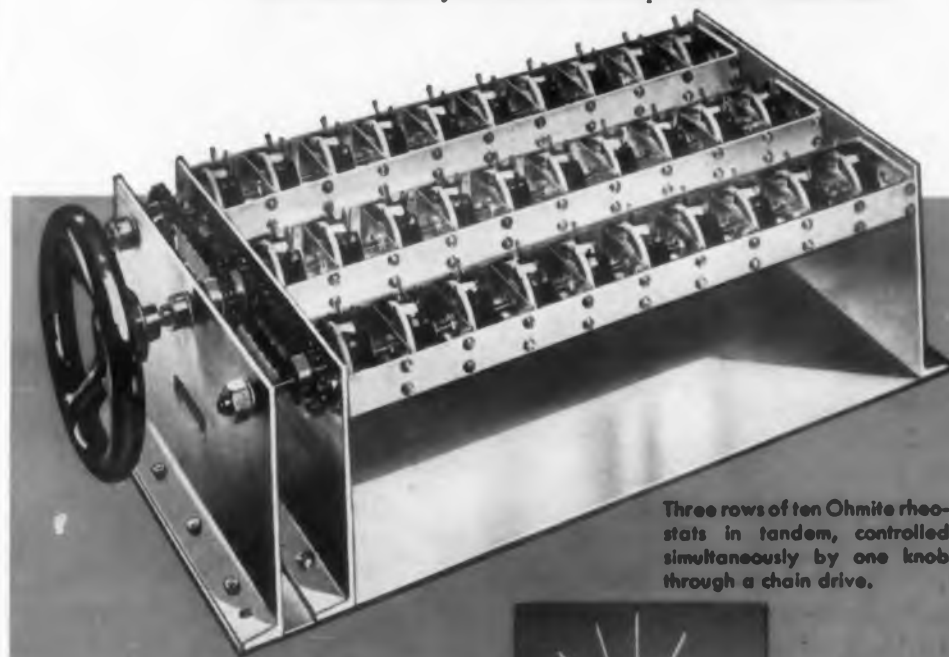
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CIRCLE 42 ON READER-SERVICE CARD

Making The Most of Flat Cables

G. E. Robert Smith,
William Richter
Tape Cable Corp.
Rochester, N.Y.

Part 1

FLAT CABLES for simple wiring systems can be handled in many ways. Some methods are new. Others have withstood the test of time in industry. Basic to working with the cables are procedures for stripping them and fashioning some method of strain relief.

Some of the stripping methods now used are: **By Hand.** Polyester, which is used as the insulation for some flat cables, melts without carbonizing in the temperature range of +525 to +600 F. A ball of solder on the tip of a hot soldering iron will strip and tin one conductor at a time. Wiping away molten insulation with a cloth speeds the process. This method is used to service polyester-

insulated cable in the field, and is handy for laboratory and prototype construction.

With a Solder Pot. Some thermoplastic insulations, such as polyester, can be stripped and the conductors tinned by dipping the cable end in a solder pot. After a few seconds of immersion, the cable is pulled from the solder through a clean folded rag, which removes the softened insulation. The cable end may be dipped again in the solder to remove any residual insulation and to tin the conductors, thus immediately protecting the conductors against corrosion and making subsequent soldering easy.

Hot Wire Stripping. Insulation can be removed

with a hot wire. Remaining traces of insulation disappear during tinning.

Machine Stripping. For production, stripping machines are very rapid. They remove insulation from as many as 300 conductor ends in a minute after one to three hours of operator training. These same machines have been used by industry for stripping magnet wire. (See Fig. 2.) Stripping action is the result of simultaneous frictional heat and brushing action caused by fine bonded glass fibers in the high-speed stripping wheels. The conductors are left clean, bright, free of oxides and ready for termination.

Chemical Stripping. Polyester and fluorocarbon

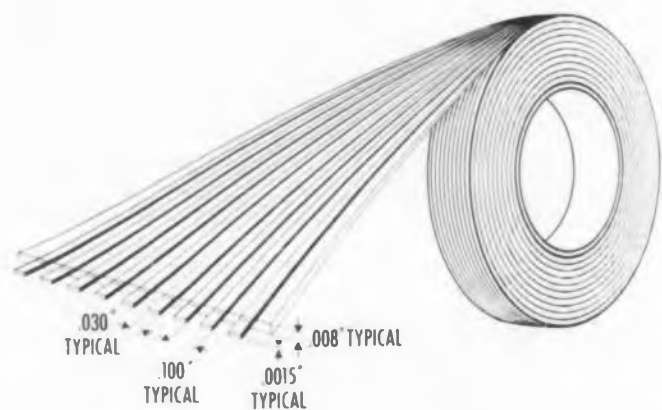


Fig. 1. Flat cable has thin, flat, parallel conductors embedded in tough, thin insulation. Shown are the dimensions of a cable made by the Tape Cable Corp.



Fig. 2. For production, stripping machines can be used to remove insulation from as many as 300 conductor ends in a minute.



In this article, the first of two, Robert Smith (right) and William Richter cover some of the handling techniques of flat cables. Because little is known about this subject, they say, electronic design engineers have been unable to take advantage of the unusual characteristics of flat cables.

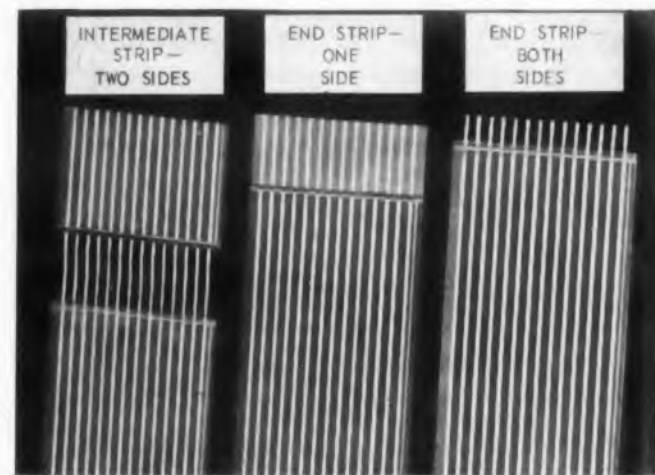


Fig. 3. Various types of stripping are used to perform varied functions.

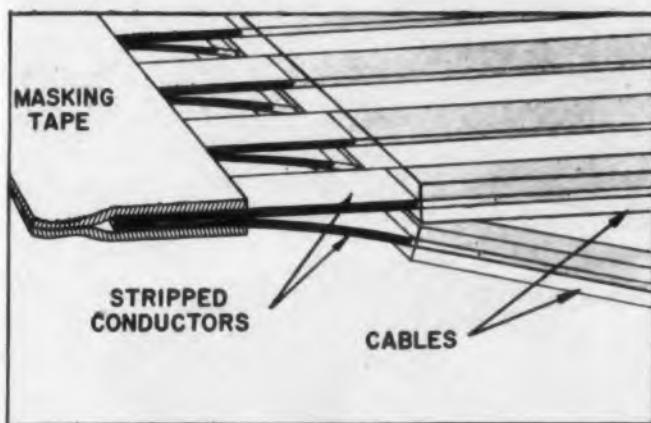


Fig. 4. Cables that have end stripped conductors are taped together for soldering.



Fig. 5. End-stripped cables can be either hand soldered or dipped in solder, as shown.

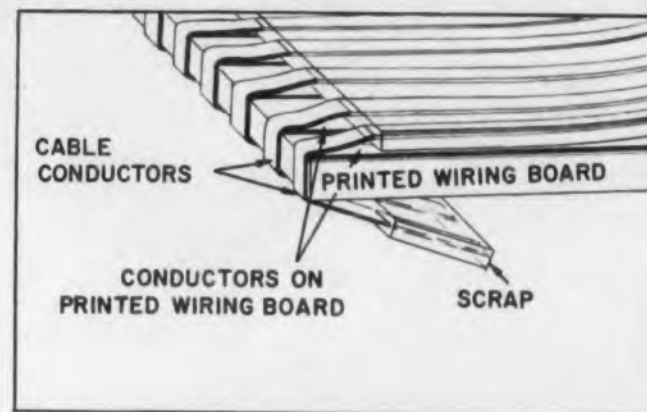


Fig. 6. Intermediate stripping is useful when the cables are attached to a printed wiring board.



Fig. 7. (above) Dip soldering can be used to attach flat cable to a printed wiring board.



Fig. 8. Excess cable is trimmed off with one pass of a file

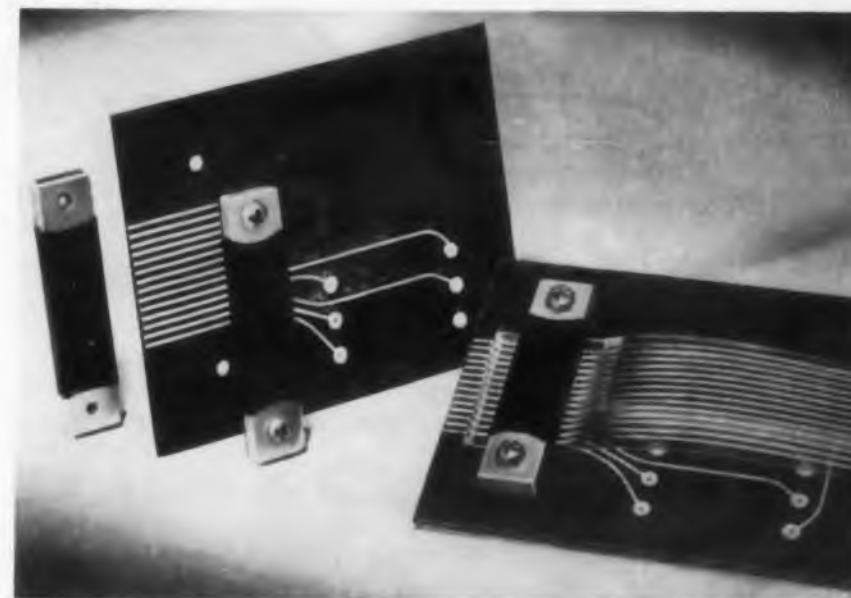


Fig. 9. (right) The "bar" strain relief can be used to distribute the mechanical load across the width of the cable.

insulations are inherently inert to chemical attack. No suitable chemical stripping method has been found.

Types of Stripping and Applications

Various types of stripping are used to perform varied functions. Among the types and applications are:

End Strip, Both Sides. Insulation may be removed from both surfaces of the ends of all conductors. (Splicing of some cables is easily done by stripping the cable end in this way.) The cables are then placed together, with the stripped ends pointing in the same direction, and held with masking tape or a special jig. (See Fig. 4.) After fluxing, the conductors are dipped in solder above the level of the masking tape, or they can be hand-soldered with flux-cored solder. The masking tape is then trimmed off with scissors. Flux residues may be removed with a solvent. The cable is then unfolded and encapsulated, or a suitable adhesive-coated insulating tape is applied to both sides of the splice to restore the mechanical and electrical strength of the cable.

Intermediate Strip, Both Sides. This method is used for dip-soldering some cables to printed wiring connectors. A short length of unstripped cable is left at the end, which helps position the conductors and keeps them parallel. The exposed cable conductors are matched with the printed wiring conductors at the edge of the board and then clamped to the board. (See Fig. 6.) The edge of the board is now dipped in a suitable printed

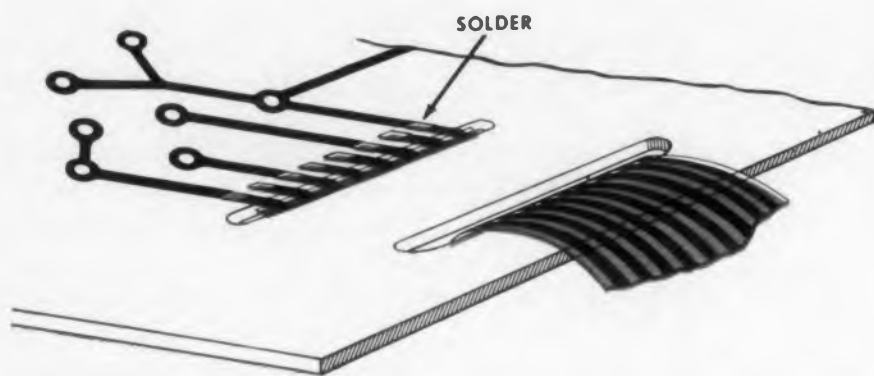


Fig. 10. (above) The double slot strain relief is made simply by providing two slots in a board or panel and weaving the cable through the termination.

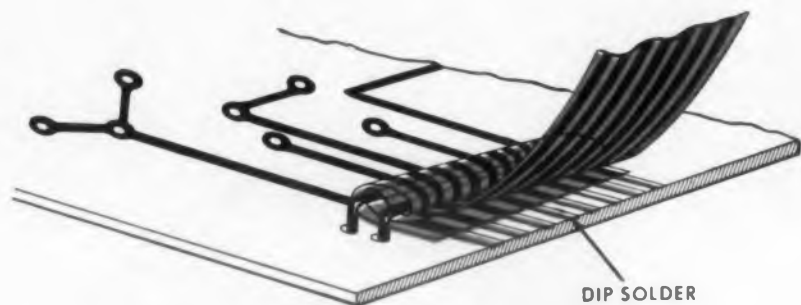


Fig. 12. Two staples in a board may be used as a strain relief.



Fig. 14. (right) Perforated Nylon strapping such as Weckesser No. N6-167, can be used as a strain relief.

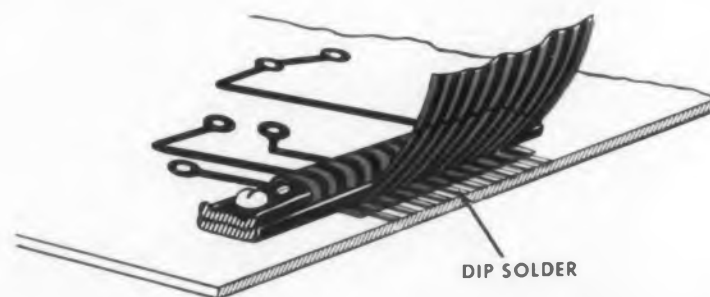


Fig. 13. (above) A wedge in a slot is a rapidly applied strain relief.

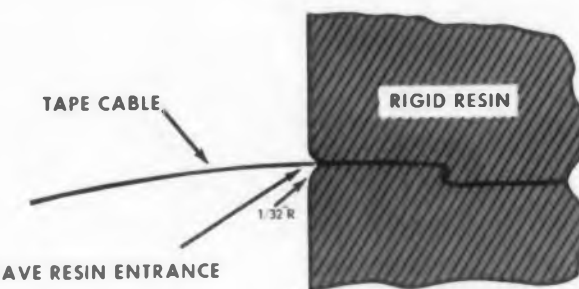


Fig. 15b. Where extremely high lateral forces on the cable are encountered, and a hard encapsulating resin is used, a radius is recommended at the resin entrance.

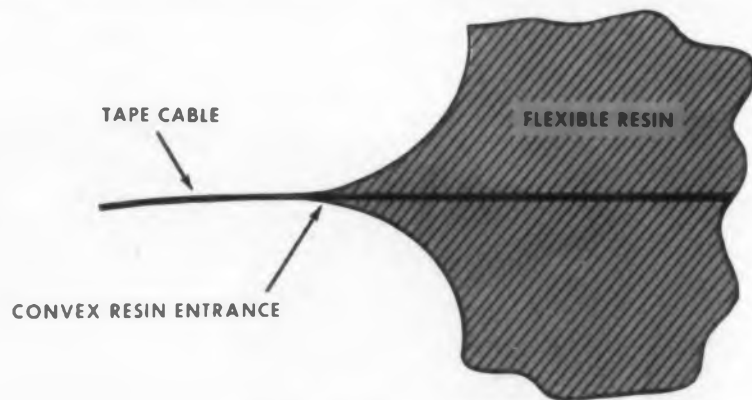


Fig. 15a. Encapsulation is an effective strain relief.

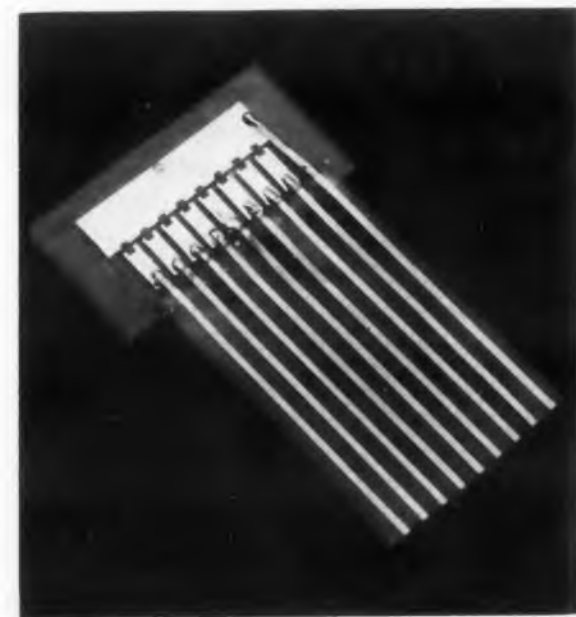


Fig. 15c. A bond is necessary between the cable and the resin if the encapsulation section is thin, such as an encapsulated splice, or if the encapsulation resin is flexible. Here a clear lacquer strain relief holds the insulation and conductors in place on some infra-red cells.

wiring flux and then in solder. Scrap cable is trimmed off the board with a file and residual flux can be removed with solvent, such as Xylol.

End Strip, One Side. Some cables can be stripped on one side by holding a piece of one or two-ounce copper foil on the bottom side of the cable as it is inserted in the stripper. The foil seems to act as a heat sink, as well as to prevent the generation of frictional heat on the bottom side of the cable, thus permitting insulation to be removed from only the top side. Copper foil employed for this purpose can be used for months, showing that there is practically no abrasive action on the copper conductors in the stripping process. Thus it is possible to remove cable insulation without materially reducing conductor thickness. Stripping one side is useful in making pressure connections of some cables to printed wiring, to other flat cables, or to connectors.

Selective Stripping. Individual conductors can be stripped at any point in the cable with narrow stripping wheels. "Programed" stripping is possible with this method. With a small soldering iron, individual conductors can be stripped and tinned at any point in the cable.

Strain Reliefs

A substantial part of a flat cable's strength is in its insulation. This means the cable should be terminated mechanically by its insulation. The greatest strength of a flat cable can be realized by stress distribution. A strain relief, therefore, should be designed to distribute the mechanical load across the width of the cable, avoiding very sharp edges or points if high stresses are involved. To be fully effective, a strain relief must withstand all mechanical stresses on the cable and must not permit any to reach the electrical termination area of the conductors. Strain reliefs are very important in cables with small conductor sizes, where the insulation represents the bulk of the strength of the cable. Some applications, though, need no strain relief, particularly in conductor sizes of 200 square mils or more, where vibration or destructive stresses are not present.

Various strain reliefs are shown in Figures 10 through 13. Reversing the direction of the cable is the basis for most of these reliefs, and in general, the greater the number of reversals, the more effective the relief.

Another strain relief is to use perforated nylon strapping (as shown in Fig. 14). If cables are potted, then two closely spaced opposing creases in the cable inside the resin serve as a strain relief and do not damage the cable or its conductors. (See Figures 15a and 15b.) In some applications some bond, such as clear lacquer, is necessary for strain relief. (See Fig. 15c).

Next Issue: Shaping flat cables and terminating them.

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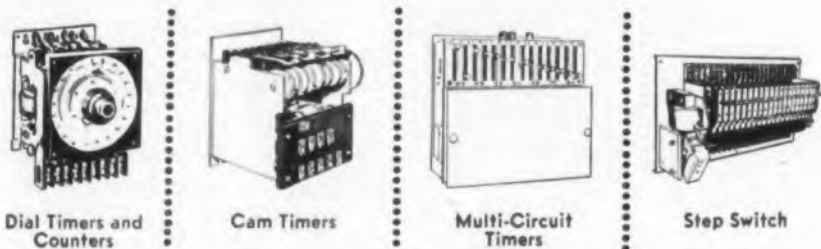


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A mock-up is made using yarn to outline the recorder rack. "Average man," right, assists in determining most comfortable operating positions.

How Full-Scale Models Aid Product Design

FULL-SCALE models are used to advantage by Ampex Corp., Redwood City, Calif. Ampex has found that a full-scale model offers these desirable features:

Ideal arrangements of components. An effective model can prohibit an unnecessarily awkward and costly package at a later date.

Increased safety factors. Clearances of doors and panels are readily apparent with a design model.

Service accessibility. If a machine is loaded with items that have to be re-

moved for servicing, or if design requires that the machine has to be moved for servicing, it will prove more costly to the owner.

Three-dimensional Breadboard. As the careful program of testing and developing a product continues, the performance characteristics of the machine are subject to qualitative and comparative tests.

Visual Aid. The model offers the designer an opportunity to try any number of colors, forms, and details to realistically find how they will affect the end product.

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This quarter-scale model was made up to determine ease of interchangeability of various sections of the machine.

product nears, the model is an aid to sales and advertising, because it is ready from three to six months before the prototypes are available.

Speeds Tooling and Production. As a manufacturing guide, the full-scale model illustrates to toolmakers and vendors what is desired.

To perform full-scale model construction, Ampex has its industrial design model shop within its Instrumentation Division. It includes varied types of tool and finishing facilities. Each Industrial Designer must be as experienced in building three-dimensional models as he is in

making two-dimensional illustrations. This allows the industrial-design team to work concurrently on the model which may be constructed from pattern-maker's pine, birch, Shena (an imported Japanese hardwood), a fine-grain oak, and aluminum.

Believing that isolation of industrial design from engineering results in unrealistic design, a strong liaison and exchange of information is a continual part of product design at Ampex. Through this close co-ordination, the preliminary and full-scale models become an effective medium for determining the best product design. ■ ■



Industrial designer fits dummy of oscilloscope portion of a tape recorder into a full-scale model.



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- Stop down time with plug-in components for fast timer replacement.

Flexibility

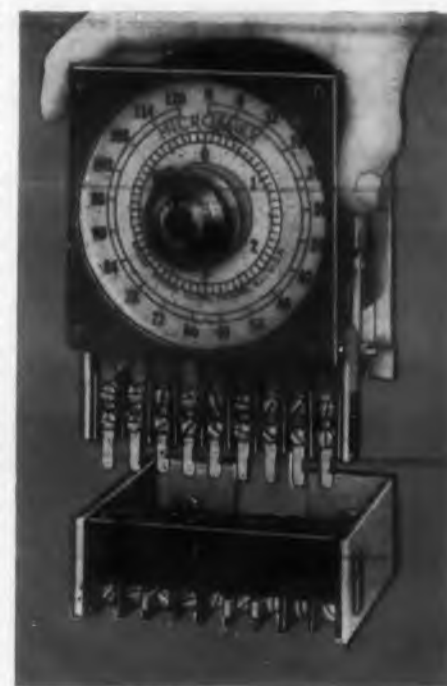
- Easy to set dial whether short or long timing.
- Choice of 9 actions available for each of 3 contacts. Select operation required for your circuit.

Accuracy

- Set dial to exact time required. No guessing at numbers.
- Accurate repeatability insures uniform production.

Reliability

- Proven reliability in thousands of industrial processes for more than 25 years.



Install timer in seconds with optional plug-in feature.



EAGLE SIGNAL COMPANY
Industrial Timers Division, Dept. ED-1059
MOLINE, ILLINOIS

Please send FREE Bulletin 110 containing complete data on Microflex Reset Timers.

NAME AND TITLE

COMPANY

ADDRESS

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CIRCLE 45 ON READER-SERVICE CARD

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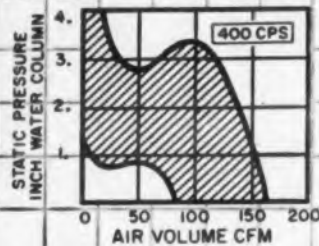
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SMALL!



AXIMAX 3... Fan measures 3 1/4" dia. X 2 3/4" and weighs 14 ounces. Available in 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets applicable military specs.



SMALLER!

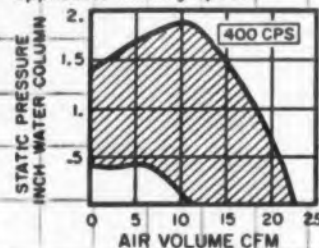
AXIMAX 2... Fan size only 2" dia. X 1 1/2" and weighs 4 1/2 ounces. 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets military specifications.



SMALLEST!



AXIMAX 1... Dimensions 1 1/2" X 1 1/2", weight only 4 ounces. Choice of motors from 115 or 200 VAC, 400 CPS, 1 Phase or 3 Phase. Meets applicable military specs.



MINIATURE

400 CPS FANS

for maximum cooling in minimum space



Write for detailed literature to...

ROTRON mfg. co., inc.

WOODSTOCK, NEW YORK

In Canada: The Hoover Co., Ltd., Hamilton, Ont.

CIRCLE 46 ON READER-SERVICE CARD

Improved Resistor Withstands More Heat and Humidity



Three lines of these resistors have had their wattage rating doubled. A smaller resistor can now do the job of a former larger unit.

MORE HEAT, more humidity, and more severe operating conditions—that's what a new type of deposited film resistor can withstand. The improved performance characteristics result from using a carbon alloy film. Also improved were the resistor's terminating paint, coating and mold material.

Made by the International Resistance Co., 401 North Broad St., Philadelphia 8, Pa., the improvements permit doubling the wattage rating of the film type resistor. For its electrical ratings, the unit comes in the smallest size known.

Wattage Ratings Doubled

The MDA (RN60) series, which was rated at 1/8 w at 70 C, is now rated at 1/4 w at 70 C and 1/8 w at 125 C. The MDB (RN65) series, which was rated at 1/4 w, is now 1/2 w at 70 C and 1/4 w at 125 C. And the MDC (RN70) series is now 1w at 70 C and 1/2 w at 125 C. Each unit meets all the requirements of MIL-R-10509C, Characteristic B, for its respective size.

This means that for a given wattage rating, a resistor can be had that is reduced in size and weight by more than 50 per cent.

The resistors are available with resistance values ranging from 10 ohms to 25 meg. Standard tolerance is 1 per cent. But 0.5 and 2 per cent types are also available.

Behind this improved resistor was the development of a new deposited carbon alloy. The film (which was pure carbon in the past) is now made from carbon and an unspecified silicon compound. In addition, the carbon is derived from the source by the evaporation of liquid rather than from gas.

The alloy film is created in a furnace consisting of a large ceramic cylinder at high temperature and in high vacuum. It is nearly impervious to moisture, temperature, and is extremely hard.



Exposed to a Bunsen burner's flame, the batch film (on left) has burned off, exposing the substrate. The new alloy film remains.

Diamond Cuts Film

This new film required a redesign of almost every element in the resistor and revamping the manufacturing process. An insulating spiral path, which determines the resistance value, is now diamond-cut in the much harder alloy film. The spiral path was sand-blasted in the previous resistors. Using the diamond results in a more precise incision with consequent improvement in stability and reliability.

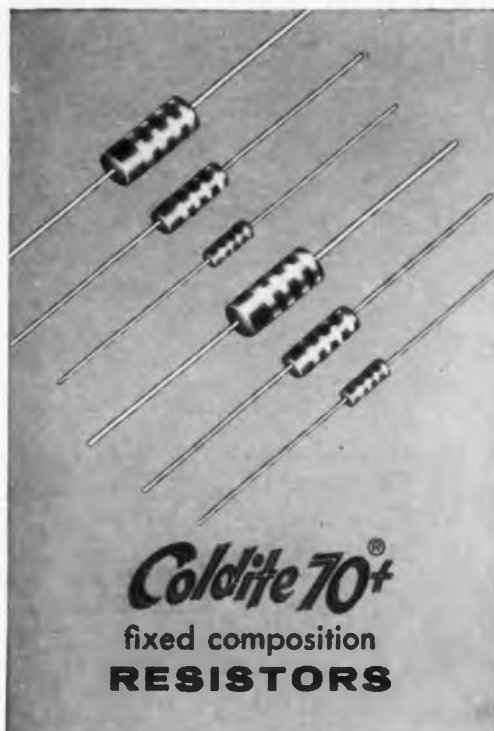
The silver terminating paint used to make contact between the film and the leads has also been improved. It has a higher temperature capability than before.

A new mold material is also being used in this resistor. The material is less susceptible to the effects of thermal shocks and is capable of withstanding high temperatures. It also conducts the internal heat away from the substrate more rapidly than the previous material used. In addition, the coefficient of expansion of the material is more compatible with the substrate than were the coefficients of expansion of other mold materials used in the past.

Especially developed for the resistors were two new types of moisture-resistant undercoats. The coatings serve two purposes. First, they give additional protection to the film from moisture. Second, they protect the film from shear or mechanical damage resulting from the forces exerted during molding.

The over-all improvement in the MDA series is 65 per cent. It is 62 per cent for both the MDB and MDC series. The improvement figure is based on tests made for load life, moisture, short time overload, temperature cycle, and low temperature operation.

For more information on this resistor, turn to the Reader-Service Card and circle number 102.



Coldite 70+
fixed composition
RESISTORS



SLIDE SWITCHES
the most complete line



Ceromag
FERRITE
cores

STACKPOLE

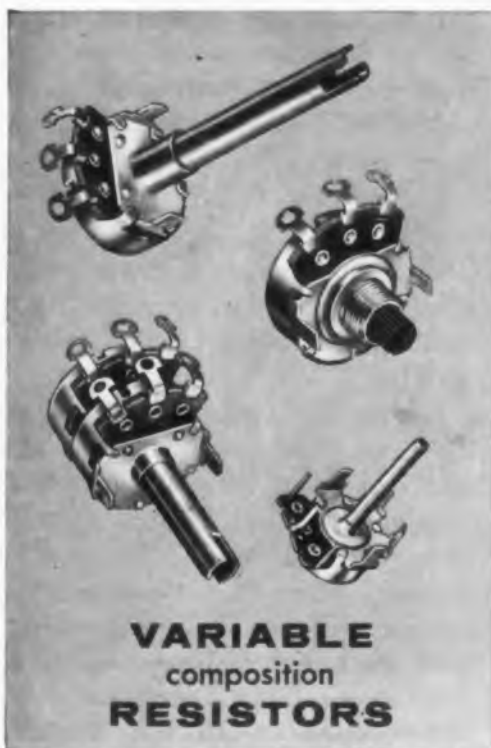
a dependable source of supply
for these 7 reliable component types

Write for details on any type

Electronic Components Division



STACKPOLE CARBON COMPANY, St. Marys, Pa.



VARIABLE
composition
RESISTORS



inexpensive fixed composition
CAPACITORS
0.1 to 10 μf

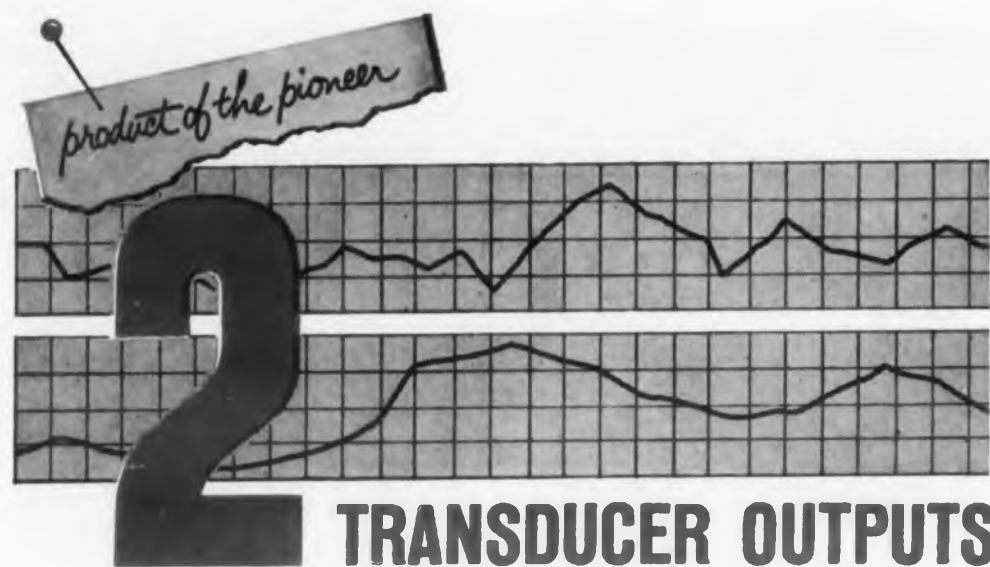


SNAP SWITCHES
... for record changers,
auto tuners, etc.



CeraMAGNET
CERAMIC
PERMANENT
MAGNETS

CIRCLE 47 ON READER-SERVICE CARD



displayed simultaneously without preamplification



TYPE 411

HIGH SENSITIVITY DUAL-BEAM SCOPE

The most sensitive dual-beam scope commercially available. The DuMont Type 411 will display low-level outputs from two transducers simultaneously, **without any external preamplification** — most important in electro-mechanical studies. Your transducer outputs can be displayed on common calibrated sweeps, or on a calibrated and an expanded sweep at the same time for simultaneous general and detailed studies. Each trace can be expanded 5 times full-scale horizontally and 3 times full-scale vertically for even greater resolution. Power supplies are regulated, and all critical amplifier circuits are transistorized for stability. The Type 411 Dual-Beam Oscilloscope is truly the most usefully-versatile laboratory instrument available for the electro-mechanical laboratory

Write for details...

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ELECTRONIC TUBES/INDUSTRIAL TV/MILITARY ELECTRONICS/MOBILE COMMUNICATIONS/SCIENTIFIC INSTRUMENTS/AUTOMOTIVE TEST EQUIPMENT

Allen B. DuMont

ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J., U. S. A.

INTERNATIONAL DIVISION • 515 MADISON AVENUE, NEW YORK 22, N. Y. • CABLES: ALBEEDU, NEW YORK

CIRCLE 48 ON READER-SERVICE CARD

FEATURING

- 1 millivolt full-scale sensitivity
- Identical Y-amplifiers
- Common calibrated sweeps, or simultaneous calibrated and expanded sweeps
- Large variety of true dual-beam displays
- Transistorized for stability
- Each signal channel independently controlled
- X-Y plots available through front panel switching

Tach Feedback For Size 5 Servo Loop

FOR THE first time, the designer of size 5 servomechanisms can enjoy the design flexibility of tachometer feedback. Reported to be the smallest servomotor-generator in the industry, the size 5 unit halves the weight and volume of the size 8, presently the workhorse of miniature motor-tachs.

Until development of this motor-generator, designers working with size 5 components had to content themselves with inertial or viscous damping. While these methods have their own advantages for some applications, the rigidity of the design is intolerable for others. Changes in amplifier gain and other loop parameters can be accommodated in a tachometer feedback servo much more readily.

Developing a practical size 5 generator represents an engineering achievement considerably more than a simple "scaling down" of existing larger units. Daystrom Transicoil, Worcester, Montgomery County, Pa. took advantage of the control versatility of a tachometer feedback servo loop to permit use of a four-pole motor stator instead of the more usual six-pole construction. With a tach-



One-ounce size 5 motor-generator is dwarfed by its size 8 counterpart.

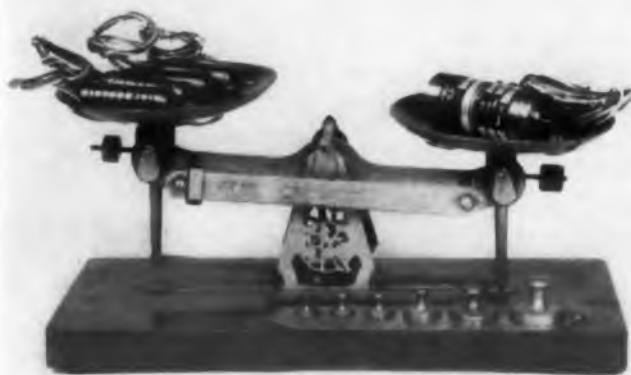
ometer feedback, a four-pole design is completely suitable, since the no-load speed is not dictated by the number of poles. High no-load speed, often cited as an objection to four-pole design, is no problem here. A four-pole stator design helps prevent structural weakness, that might otherwise be a problem in so small a unit.

Transicoil employs epoxy encapsulation to keep stator windings in their slots dependably. In order to prevent the epoxy encapsulating material from seizing the



Four-pole design avoids structural weakness in the tiny laminations of this unit.

5 motor
by its s



Cutting out $\frac{3}{4}$ the weight of a size 9 motor-generator is the basis of a chain of weight-saving steps in the system design.

ign is
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is no
design
that
small

rotor or shaft during operation, centrifugal encapsulation is used. In this process, the stator is spun rapidly while the epoxy is setting. The centrifugal force throws the epoxy outward away from the rotor aperture, producing a clearance that makes seizure impossible.

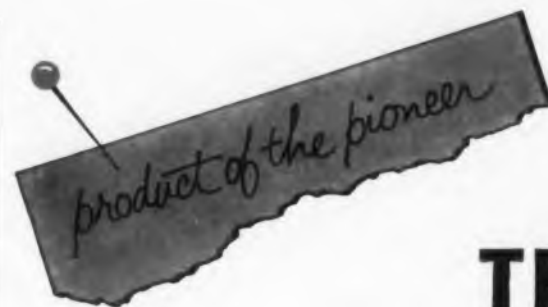
The one-ounce unit has a no-load speed of 10,000 rpm. The motor requires 1.7 w of 400 cps power and develops 0.1 in.-oz stall torque. Moment of inertia is 0.33 g-cm.² Rated voltage for both motor phases is 26 v. In intermittent applications, the unit has been submitted to 33 v and more with no damage.

The tachometer generator output is 0.1 v per 1000 rpm, with a tolerance of ± 5 per cent and a maximum null of 12 mv. Input requirements is 1.5 w at 26 v 400 cps.

Length of the unit to the mounting flange is 1.5 in. maximum. Overall diameter is 0.5 in. Integrally mounted gear heads, providing speed reductions up to 360 to 1, will be available with these units.

For more information on the servo motor-generator, turn to the Reader-Service Card and circle 103.

ackness



OPERATION FROM TRANSISTOR OUTPUTS IN SMALL PLACES



*A complete line of low power
and space-saving tubes...
available in practically
any size you specify*

FEATURES

- * Designed for transistor operation
- * Low grid drive
- * Low heater voltage
- * High light output
- * Excellent for high altitudes
- * Eliminates bulky power equipment
- * Compact and rugged
- * Potted base for operation in all environments
- * Resistant to thermal shock
- * Available in virtually all standard sizes

Low-powered enough to operate directly from transistor outputs, small enough for any space-hungry application, yet provides extra-high light output for use in high altitudes or any high-ambient light level. The low grid-drive and heater requirements of these tubes economize on space and weight by eliminating bulky accessory power equipment. Potted bases and high-voltage connectors, plus rugged construction, permit the utmost performance over wide temperature ranges and in the toughest of environmental conditions. Infinite in available sizes, shapes and ratings, infinite in capabilities.

Write for complete technical details

DU MONT[®]

precision electronics is our business

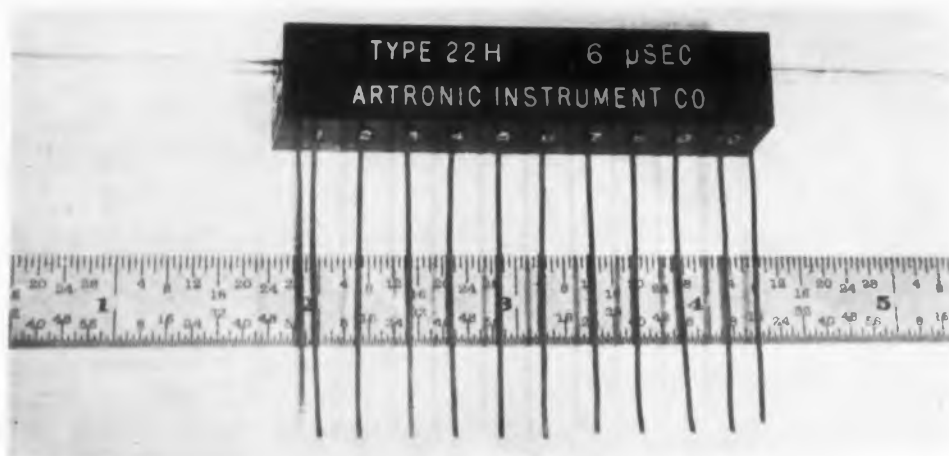
ELECTRONIC TUBES/INDUSTRIAL TV/MILITARY ELECTRONICS/MOBILE COMMUNICATIONS/SCIENTIFIC INSTRUMENTS/AUTOMOTIVE TEST EQUIPMENT

ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J., U. S. A.

INTERNATIONAL DIVISION • 515 MADISON AVENUE, NEW YORK 22, N. Y. • CABLES: ALBEEDU, NEW YORK
CIRCLE 770 ON READER-SERVICE CARD

NEW PRODUCTS

Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.



Delay Lines Have 3% Tolerance

Designed with a delay tolerance of $\pm 3\%$, the type 22H and 22L tapped delay lines come with delay times ranging from 0.05 to 15 μsec . They measure $1/2 \times 1/2 \times 2.5$ in. and the rise time is 20% of the delay time. They have 10 taps, equally spaced. Working voltage is 300 v dc, pulse voltage is 300 v peak, and the temperature range is -65 to $+125$ C. The units are encapsulated in an epoxy casting resin and meet MIL-STD-202A.

The Artronic Instrument Co., Dept. ED, 11232 Triangle Lane, Silver Spring, Md.

CIRCLE 49 ON READER-SERVICE CARD

Voltmeter's Accuracy Is 1% From DC to 100 mc

Having an accuracy of 1% or better from dc to 100 mc, this voltmeter was designed for use as a laboratory standard instrument to check all types of vtvm's. The instrument is of the thermocouple type. Five different units are available from a low range of 0 to 1 v to a high range of 0 to 100 v, at reduced frequency response. Calibration is essentially permanent and it may be certified by the Bureau of Standards.

Rawson Electrical Instrument Co., Dept. ED, 130 Potter St., Cambridge, Mass.

CIRCLE 50 ON READER-SERVICE CARD



Knob Potentiometer Measures 1/2 in.

This $1/2$ in. knob potentiometer, model K-050, is a wirewound unit. It is completely encased in a sealed watertight metallic housing. The unit is constructed to meet Mil specs, and has an operating temperature range of -55 to $+55$ C. Mechanical and electrical rotation are 340 deg. Resistance values to 20,000 ohms are available on order. Overall length is $5/8$ in.

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

CIRCLE 51 ON READER-SERVICE CARD

Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 1, No. 5

NEW RAYTHEON MICROWAVE TUBE DEVELOPMENTS



Indicator Lamps Have 0.05 in. OD

Models M-1 and M-2 incandescent lamps are designed for microminiature modules. They have an 0.05 in. OD and a length of about 0.09 in. They operate in the range of 1 to 1.5 v and draw from 25 to 35 ma. The filament is wound from 0.0005 and 0.00025 in. tungsten wire over a 0.0015 mandrel.

The Meninger Co., Dept. ED., P.O. Box 243, West Caldwell, N.J.

CIRCLE 52 ON READER-SERVICE CARD

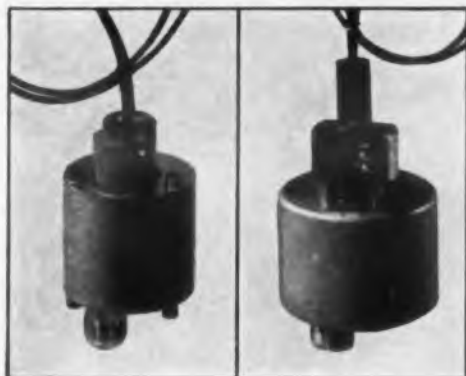
Commutators Mounted in Modular Packages

The Scanalog series of mechanical commutators are mounted in modularized packages which interlock to give mechanical strength to the total assembly. The interlocking modules allow from 24 to 90 contacts in one to six poles to be assembled in one of the two basic frame sizes (1.5 in. and 1.875 in. diameters). Built to conform to military environmental specifications, the commutators may be used in: airborne PAM and PDM telemetering; data sampling in fixed ground or shipboard installations; and data sampling in vehicles.

Fifth Dimension Inc., Dept. ED, Princeton Research Park, North Ewing St., Princeton, N.J.

CIRCLE 53 ON READER-SERVICE CARD

Miniature pulsed magnetrons for missile beacon applications are ruggedly constructed with integral magnets. The RK-7461 is tunable from 9,300 to 9,500 mc and has minimum peak power output of 60 watts. It is 1½" in diameter and 2½" long, and weighs only 6 ounces.



RK-7461

QK-735

The QK-735 is tunable from 5,400 to 5,900 mc with minimum peak power output of 400 watts. 1½" in diameter and 3¼" long, it weighs 8 ounces.

CIRCLE 771
Reader Service Card

* * *

Designed for electronic countermeasures and FM/CW operations, the QK-625 BWO provides a minimum CW power output of 180 watts and a nominal CW power output of 250 to 350 watts over the 2,500 to 3,000 mc band. The tube is voltage tunable over the entire range with tuning sensitivity of approximately 0.4 mc/volt. Liquid-cooled, the QK-625 BWO is equipped with an integral



permanent magnet, and can be mounted in any position.

CIRCLE 772
Reader Service Card

* * *

Small-signal gain of up to 35 db in microwave relay links is achieved by means of a new compact traveling wave tube amplifier -- the QK-542. This permanent-magnet focused CW tube has nominal saturated power output of 5 watts over 5,900 to 7,400 mc. An integral UG 344/U waveguide-type flange is supplied as standard. With an optional coaxial output coupler the QK-542 covers 4,000 to 8,000 mc.

CIRCLE 773
Reader Service Card



Ideal for linear accelerators and high-power radar systems. The QK-783 and QK-622 Amplitrons operate over the 2,700-2,900 mc and 2,900-3,100 mc bands, respectively, at a peak power of 3 megawatts and a typical efficiency of 75%. Because no heater is required, these tubes are capable of exceptionally long life. RF gain is 8 db under rated conditions, and as high as 12 db at lower peak power outputs. Phase pushing figure is less than 0.5 degrees for a 1% variation of anode current.

CIRCLE 774
Reader Service Card



* * *

Compiled as a Raytheon service to the field, new Consolidated Data Booklet contains comprehensive information about principal unclassified magnetrons, klystrons, backward wave oscillators and special purpose tubes manufactured by Raytheon. Characteristics presented include maximum ratings, typical operating values, band or frequency ranges and other essential data for microwave engineers and purchasing departments.

CIRCLE 775
Reader Service Card

A Leader in Creative Microwave Technology





HOW TO PRODUCE

33 UNIFORM MINIATURE WELDS OF 4 DIFFERENT METALS

COLLINS RADIO ACHIEVES PRODUCTION GOALS WITH WELDMATIC WELDING

A new, exceptionally reliable mechanical filter — key component in the Collins version of the highly strategic Single Sideband Radio — is now in production using an all-welded construction provided by Weldmatic equipment. This advanced filter makes possible improved selectivity characteristics and better utilization of the radio spectrum. Unvarying uniformity of the weld nugget and absolutely no displacement of the positioned parts are required specifications. Electrical characteristics are extremely critical...each of 33 connections must be identical in production quantities! After extensive evaluation, Collins selected Weldmatic's 1032 Miniature Welding Head and Model 1026 Power Supply...the combination that has enabled Collins to meet its production goals. They're a real team for precision welding: the miniature head with perfect vertical electrode motion and accurate repeatable pressure — the power supply with ultra-short current flow (0.001 second) over a continuously variable heat range. Why not consider Weldmatic for your metal-joining problems? WRITE for our free 20-page brochure describing techniques, applications, and Weldmatic's sample welding service.



Weldmatic pressure gage reads firing force...calibrated from 0 to 50 lbs., insures exact weld pressures from job to job. (Right) Welded filter cartridge and completed miniaturized Collins filter.

WELDMATIC

370 NORTH HALSTEAD AVENUE, PASADENA, CALIFORNIA

DIVISION OF UNITEK CORPORATION

CIRCLE 55 ON READER-SERVICE CARD

NEW PRODUCTS

Microwave Equipment

G-band and F-band types

This complete line of G- and F-band instruments has frequency ranges of 90 to 140 kmc and 140 to 220 kmc. Included are waveguides and flanges, slotted sections, variable attenuators, detector mounts, phase shifters, frequency meters, standard gain horns, and harmonic generators.

FXR, Inc., Dept. ED, 26-12 Borough Place, Woodside 77, N.Y.

CIRCLE 56 ON READER-SERVICE CARD

Digital Plug-In Circuits

Have input and output buffering



For digital systems and computer applications, these transistorized plug-in circuits have complete input and output buffering which allows going directly from logic diagrams to circuitry. Modules for binary and linear counter stages, pulse shapers, pulse generators, multiple coincidence gates, and relay or neon drivers are provided as shelf items.

Vitro Labs, Dept. ED, 200 Pleasant Valley Way, W. Orange, N.J.

CIRCLE 57 ON READER-SERVICE CARD

Data Recording System

For missile tracking

This missile tracking system records dynamic radar data that is correlated to 0.001 sec. The data can be entered in the IBM-704 computer. The servo repeater units drive shaft position encoders for encoding range, azimuth, and elevation. The range resolution is 1 yd per 10⁶ yd; azimuth and elevation is 0.2 mils per 6400 mils. Data is recorded at rates to 10 samples per sec, by means of an IBM-523 card punch. The unit is suited to industrial as well as military applications.

Datex Corp., Dept. ED, 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 58 ON READER-SERVICE CARD

DC Power Supply

Solid state



This completely solid state dc power supply delivers ± 100 to ± 250 v with a 6-amp continuous load. This unit is designed for mounting in a standard 19 in. relay rack.

Dynatronics, Inc., Dept. ED, Box 2566, Orlando, Fla.

CIRCLE 59 ON READER-SERVICE CARD

Indicator

Zeros synchros and resolvers

The EZ indicator is for system manufacturing operations where large quantities of synchros and resolvers must be rapidly zeroed. Required power is 115 v 60 cps; excitation voltage is 7 to 115 v; and the excitation frequency is 30 cps to 5 kc. The unit conforms to MIL-S-20708A and measures 9-1/2 x 5-1/4 x 5 in.

Theta Instrument Corp., Dept. ED, 520 Victor St., Saddle Brook, N.J.

CIRCLE 60 ON READER-SERVICE CARD

Audio Output Tubes

Come in matched pairs



Types 7189 and 6L6GC audio output tubes have matched critical audio characteristics to help minimize the harmonic distortion in push-pull amplifiers. Distortion is lower than that attained by the use of controls for balancing plate currents. Other tubes in matched-pair line are types, 6BQ5, 6X6GT, 5881, and 6550.

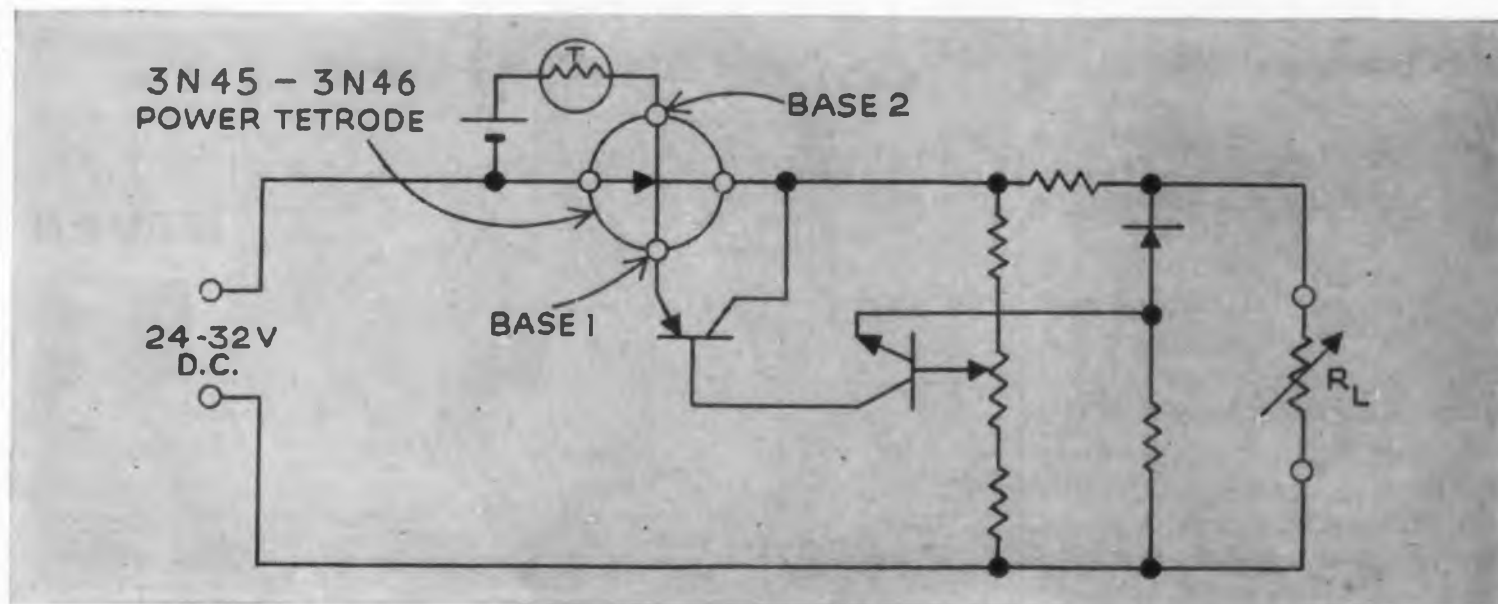
CBS Electronics, Dept. ED, Danvers, Mass.

CIRCLE 61 ON READER-SERVICE CARD

Open Circuit Regulation Maintained at 71°C.



—with Honeywell's Power Tetrode



Shown above is a voltage regulator circuit using Honeywell's 3N45 and 3N46 Power Tetrode. This circuit is designed to supply 22 volts output with 1% regulation, with inputs of 24 to 32 volts and load currents of zero to 3 amperes. The system has short circuit protection.

Circuit values can easily be adjusted to maintain regulation at other voltages and through other current ranges. The base 2 circuitry can be modified to give varying degrees of leakage current stability.

The Tetrode makes possible an improved series

voltage regulator for systems where current requirements are apt to vary widely. It offers overload protection, improved high temperature operation, and controlled regulation characteristics. Its second base connection provides control of the total system leakage.

For complete voltage regulator circuit description along with component values, write Honeywell, Dept. ED-10-145, Minneapolis 8, Minnesota. Regional representatives may be reached in Union, New Jersey, (MURdock 8-9000), Boston (ALgonquin 4-8730), Chicago (IRving 8-9266), and Los Angeles (RAYmond 3-6611 or PArkview 8-7311).

Honeywell



First in Control

CIRCLE 62 ON READER-SERVICE CARD

NEW PRODUCTS

Circuit Board

Has 352 contact cells

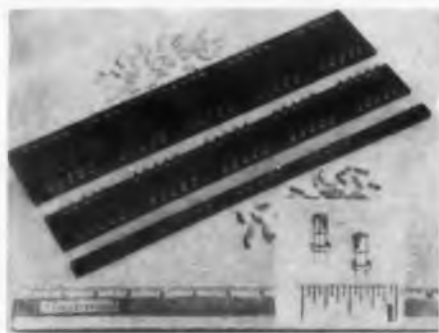
Model 24 circuit board contains 352 separate contact cells for the rapid assembly of experimental circuits using standard components and subsystems. Wires and component leads are electrically connected by inserting their ends into individual cells. Two bus bars are also provided. Solderless connections are used throughout.

Plastic Associates, Dept. ED, 185 Mountain Rd., Laguna Beach, Calif.

CIRCLE 63 ON READER-SERVICE CARD

Terminal Boards

Have castellated terminals



Equipped with type 1010 castellated terminals, types 1411, 1416, 1421, 1426, and 1431 terminal boards have widths of 1/2, 1-1/2, 2, 2-1/2, and 3 in. and are 13-1/8 in. long. The boards are available in laminated phenolic as required in MIL-P-15035B, laminated nylon phenolic as required in MIL-P-15047B, and laminated thermosetting glass cloth as required in MIL-P-18177B. The terminals are mounted on 3/8 in. centers. All boards are sectioned into five 2-5/8 in. sections for convenient breaking into suitable lengths. Each section is drilled for 14 terminals with 10 mounted. The hole size is 0.12 in. Conforming to QQ-B-626a, the terminals are brass. Terminals are supplied in six shank lengths from 5/64 to 19/64 in.

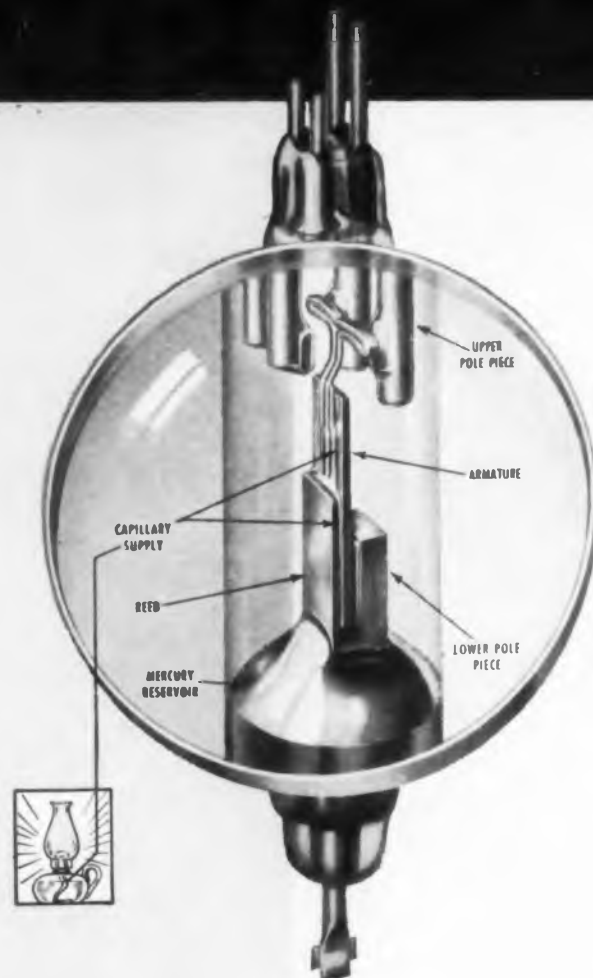
Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 64 ON READER-SERVICE CARD

Over 8 billion* operations

CLARE Mercury-Wetted

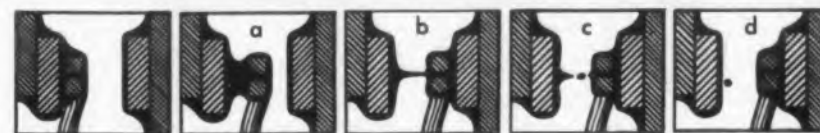
*with contact load of 250 volt-amperes.



NEVER WEAR OUT

Longevity is built into these relays. The basic magnetic switch is sealed in a glass capsule filled with pressurized hydrogen. With every make and break the mercury-film contact surface is renewed . . . by capillary action, like a lamp wick. These contacts never get dirty, never lock or weld and *NEVER WEAR OUT*.

NEVER CHATTER OR BOUNCE



Contact closure between the two liquid surfaces bridges any mechanical chatter and prevents its appearing in the electrical output. (a) Filament of mercury forms between the contacts as they separate. (b) This becomes narrower in cross section and (c) finally parts at two points, allowing a globule of mercury to fall out. (d) The extremely fast break minimizes the arc and adds greatly to contact load capacity.

NO MAINTENANCE REQUIRED



HG Relay cutaway to show magnetic switch surrounded by operating coil and encased in a metal housing.



HGS Relay cutaway to show biasing magnets attached to the ends of the side plates.



HG6F Relay printed circuit panel showing six in-line mercury-wetted contact switches mounted in minimum space.

With all working parts sealed and switches and coils enclosed in metal housings, these relays are tamper-proof and always in constant adjustment. They require no maintenance whatsoever.

S - with no maintenance!

Contact Relays on test 4 years

A FULL LINE OF THE MOST RELIABLE, MOST DURABLE RELAYS EVER MADE



single form D

Type HG. Capable of up to 100 operations a second. Load-handling capacity to 5 amperes and up to 500 volts. (250 va max. with proper contact protection.)



single form D

Type HGP. Can be factory adjusted to provide single stable, bi-stable or chopper characteristics.



single form D

Type HGS. Biased with permanent magnets. Speed up to 200 cps. Sensitivity as low as ± 2.5 milliwatts. Handles up to 2 amperes, up to 500 volts (100 va max. with proper contact protection.)



four form D

Type HQ4. Four form D switches enclosed in a single housing with coil. Plug-in assembly (shown) is standard. Other mountings available.



two or three form D

Types HG2 and HG3. Two or three form D switches enclosed in a single housing. HG2 has 8 or 11-pin octal style plug. An 11-pin base is standard for HG3.



six in-line flat pack

Type HG6F. Six switches mounted in line on printed circuit panel surrounded by single coil. Flat, compact assembly. Over-all dimensions: 3.640" x 3.125" x 1.048". Uses standard 32 or 36 terminal printed circuit socket.



For complete information on CLARE Mercury-Wetted Contact Relays or on the entire CLARE line of superior relays and electronic components address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Limited, P. O. Box 73, 2700 Jane Street, Downsview, Ontario. Cable Address: CLARELAY.

CLARE RELAYS

FIRST in the Industrial Field

Inductors and Transformers

Toroidal type



These toroidal inductors and transformers operate at temperatures to 105 C. Type 2A10E inductors have a distributed capacity of 3 μf and inductance is 10 mh. At a frequency of 100 kc the figure of merit is 130. Type 2A4ET transformer has a distributed capacity of 7.8 μf . The inductance at terminals 1 and 3 is 4 mh and the inductance at terminals 4 and 5 is 100 μh . The figure of merit at terminals 1 and 3 is 120. At a frequency of 455 kc the coefficient of coupling is 0.88.

Universal Toroid Coil Winding, Inc., Dept. ED, 171 Coit St., Irvington 11, N.J.

CIRCLE 65 ON READER-SERVICE CARD

IF Amplifier

Center frequency is 30 mc

Made to meet Mil specs, this if amplifier has a center frequency of 30 mc, a bandwidth of 2 mc, and a maximum noise figure of 1.5 db. The source impedance is 400 ohms shunted by 10 μf and the gain is 90 db. The unit operates from a 150 v, 130 ma source. It has a linear-logarithmic response with 15 db gain in the linear section followed by 75 db gain in the logarithmic section. The dynamic range of the logarithmic section is 70 db and the dynamic range of the linear section is 10 db. The unit measures 15-1/8 x 2-7/8 x 3-1/2 in. Modified versions which meet special physical and electrical requirements are also available.

RS Electronics Corp., Dept. ED, 435 Portage Ave., Palo Alto, Calif.

CIRCLE 66 ON READER-SERVICE CARD

CIRCLE 67 ON READER-SERVICE CARD

Send
for Catalog
201

NEW PRODUCTS

Accelerometer

Angular type



This angular accelerometer is used in missile and aircraft applications, ground support equipment, and various industrial applications. Operating as a miniature servo system, the basic unit consists of a seismic system and associated position-error detector, a restoring mechanism, and a servo error signal. Pitch, yaw, and roll accelerations can be monitored. The ranges available are from ± 1 radian per sec² to ± 50 radians per sec². The output, full scale, is ± 20 v across a 12,500 ohm load. Resolution is 0.01% full scale, linearity is 0.1% full scale, and hysteresis is less than 0.01% full scale. The unit measures 3.7 in. in diameter and 3.7 in. high and weighs 2 lb.

Donner Scientific Co., Dept. ED, Concord, Calif.

CIRCLE 68 ON READER-SERVICE CARD

Vacuum System

For below-atmospheric pressures

Model 702EY vacuum system is for laboratory testing of devices and materials at below atmospheric pressures. It obtains a pressure of 5×10^{-6} mm Hg in two minutes and a pressure of 5×10^{-7} mm Hg in ten minutes. It operates from a 220 v, 60 cps, three-phase, 500 w power supply. The system is demountable, measures 66 x 41 x 29 in., and weighs 1200 lb. No special precautions are required when cleaning and handling parts to be placed in the test chamber.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 69 ON READER-SERVICE CARD

CIRCLE 70 ON READER-SERVICE CARD



for: MISSILE, ELECTRONIC
and INDUSTRIAL CONTROLS

NEW modular mounting lighted push-button panel switch

Simplifies Control Panels; Saves Space, Cuts Cost.
May be used singly or in "stacked" arrangement.

3 UNITS IN 1 COMPACT MOUNTING



NAME-PLATE + PILOT-LIGHTS + PUSH-BUTTON SWITCH UNIT

In one compact assembly, this unit provides new space and cost economy whether used individually or in "stacked" arrangement. You get quality appearance with "thumb-size" operation.

TWO-PIECE, PLASTIC NAME-PLATE
PROVIDES EASY COLOR-CODING;
SIMPLIFIES OPERATION IDENTIFICATION

SLIP IN
NAME-PLATE
(clear
plastic)



CLEAR
"SEE THROUGH"
PLASTIC

COLORED PLASTIC
(red, green,
blue, yellow
and white)

Virtually any operating condition can be identified with this push-button name-plate arrangement. The snap-in button is easily removed for insertion of slip-in name-plate. Use of various colored button bases, or various colored lamps, permits wide range of codings and monitoring.

This new Electro-Snap push-button panel switch efficiently combines a name plate, pilot light assembly and a switching unit in one compact modular design permits easy "stacking" on control panels or consoles. It eliminates congestion by replacing three individual units (nameplate, pilot light assembly and switch unit). You can achieve greater operating efficiency and quality appearance while making substantial savings in space and cost. A wide variety of configurations is available in:

- circuit arrangements of switch and pilot lights
- colored buttons for color coding

- colored lights for color monitoring

The operating and indicating combinations possible through the variation of arrangements provides almost unlimited applications for sequencing, movement-limit, start-and-stop, position-indicating and similar control operations.

Check the design and construction advantages of this significant advance in panel switches for your own applications. For further details contact your local representative or write to:

ELECTRO-SNAP
CORPORATION
4216 W. Lake St. • Chicago 24, Ill.
Tel. VA 6-3100 TWX CG-1400

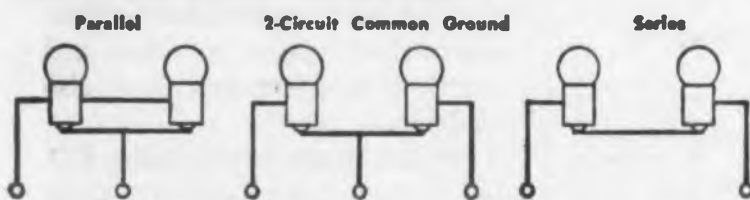
- Snap-in button permits easy lamp replacement from front of panel
- Barrier can be color-anodized to your specification



The lighted push-button switch assembly is also available without the switch unit for use where only pilot light duty is required.

VARIETY OF CIRCUIT ARRANGEMENTS PERMITS WIDE RANGE OF INDICATING AND SWITCHING COMBINATIONS

- Lamp circuit can be wired independently of switch circuit—or through switch unit.
- Since two lamps are provided, independent external circuits can be indicated on single unit with different lamp colors and white push-button.
- Complete push-button switch unit or pilot-light assembly can be supplied in any of the three following circuit arrangements.



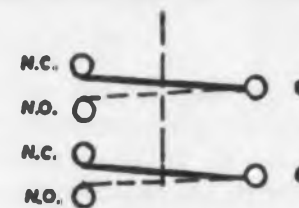
• 6V. or 28V. lamps may be used (solder terminals on lamp assembly)

Switch terminals available

- Solder
- Turret
- Double Turret
- AMP quick-disconnect

Switching Circuits to Meet Your Needs

The double-pole, double-throw switching unit may be wired normally-open or normally-closed.



a standard
ELECTRO-SNAP
UNIT

- Compact
- Space Saving
- Precision-Engineered
- Low Cost

for immediate
delivery of
**General
Instrument
semiconductors**
at factory prices
call your
stocking distributor

The authorized distributors listed below carry a full stock of all General Instrument semiconductor — and can give you immediate delivery from stock:

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SILICON DIODES
GERMANIUM
DIODES**



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Shanks & Wright, Inc.
2045 Kettner Blvd., San Diego
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Silberne Industrial Sales Corp.
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2115 Second Ave., Seattle

WISCONSIN

Radio Parts Co., Inc.
1314 N. 7th St., Milwaukee

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

JAN TYPE

RADIO RECEPTOR
**SILICON
DIODES**

**1N457
1N458
1N459**

When JAN type diodes are required, you can be certain that General Instrument's engineering skills and manufacturing facilities will enable us to deliver them at prices that reflect years of volume production experience.

The Radio Receptor line of silicon and germa-

num diodes is the most complete available to the industry — with the widest possible range of characteristics. You'll find them at authorized distributors across the country. Complete information and data sheets are available upon request.

Code No.	Min. Fwd. DC Cur. @ +1V	Max. Rev. DC Cur. @ Test V.		Test Voltage	Max. Inv. Voltage	Min. Breakdown Voltage*	Avg. Fwd. DC Cur. (Max.)
		25° C.	150° C.				
1N457	20 mA	.025 μ A	5 μ A	60V	60V	70V	75 mA
1N458	7 mA	.025 μ A	5 μ A	125V	125V	150V	55 mA
1N459	3 mA	.025 μ A	5 μ A	175V	175V	200V	40 mA

*Reverse voltage at which a reverse current of 100 μ A flows.
All ratings and characteristics are at 25° C. unless otherwise noted.
Operating temperature range —80° C. to +200° C.



Semiconductor Division

GENERAL INSTRUMENT CORPORATION

65 Gouverneur Street, Newark 4, N. J.



GENERAL INSTRUMENT CORPORATION INCLUDES F. W. SICKLES DIVISION, AUTOMATIC MANUFACTURING DIVISION, RADIO RECEPTOR COMPANY, INC. AND MICAMOLD ELECTRONICS MANUFACTURING CORPORATION (SUBSIDIARIES)

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CIRCLE 71 ON READER-SERVICE CARD

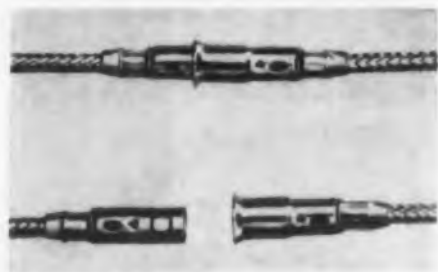
ELECTRONIC DESIGN • October 14, 1959

CIRCLE 72 ON READER-SERVICE CARD

NEW PRODUCTS

Connectors

For coaxial and shielded cable



These coaxial and shielded cable disconnects fit cables having an OD to 1/4 in. The interchangeable contacts permit a variety of inner conductor diameters in solid or stranded types.

Amp, Inc., Dept. ED, Harrisburg, Pa.

CIRCLE 73 ON READER-SERVICE CARD

Temperature Alarm Readout

Monitors to 100 temperature points

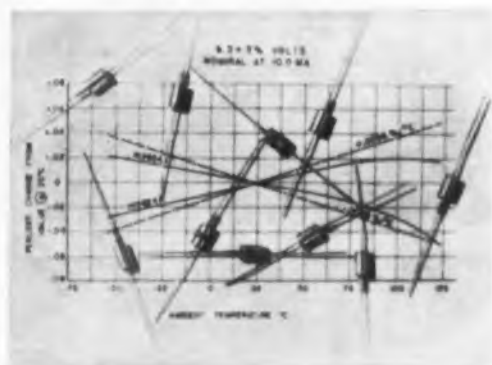
This temperature alarm readout monitors up to 100 temperature points, depending upon the number of 10 unit panels used. It operates by sounding an alarm and indicating the critical point by a numbered light on the control panel. Each channel operates independently. Over-all accuracy is ± 3 deg F. The unit is transistorized and uses printed circuit cards. The construction is standard relay rack type and the weight is 125 lb.

Fischer & Porter Co., Dept. ED, 303 Jacksonville Rd., Hatboro, Pa.

CIRCLE 74 ON READER-SERVICE CARD

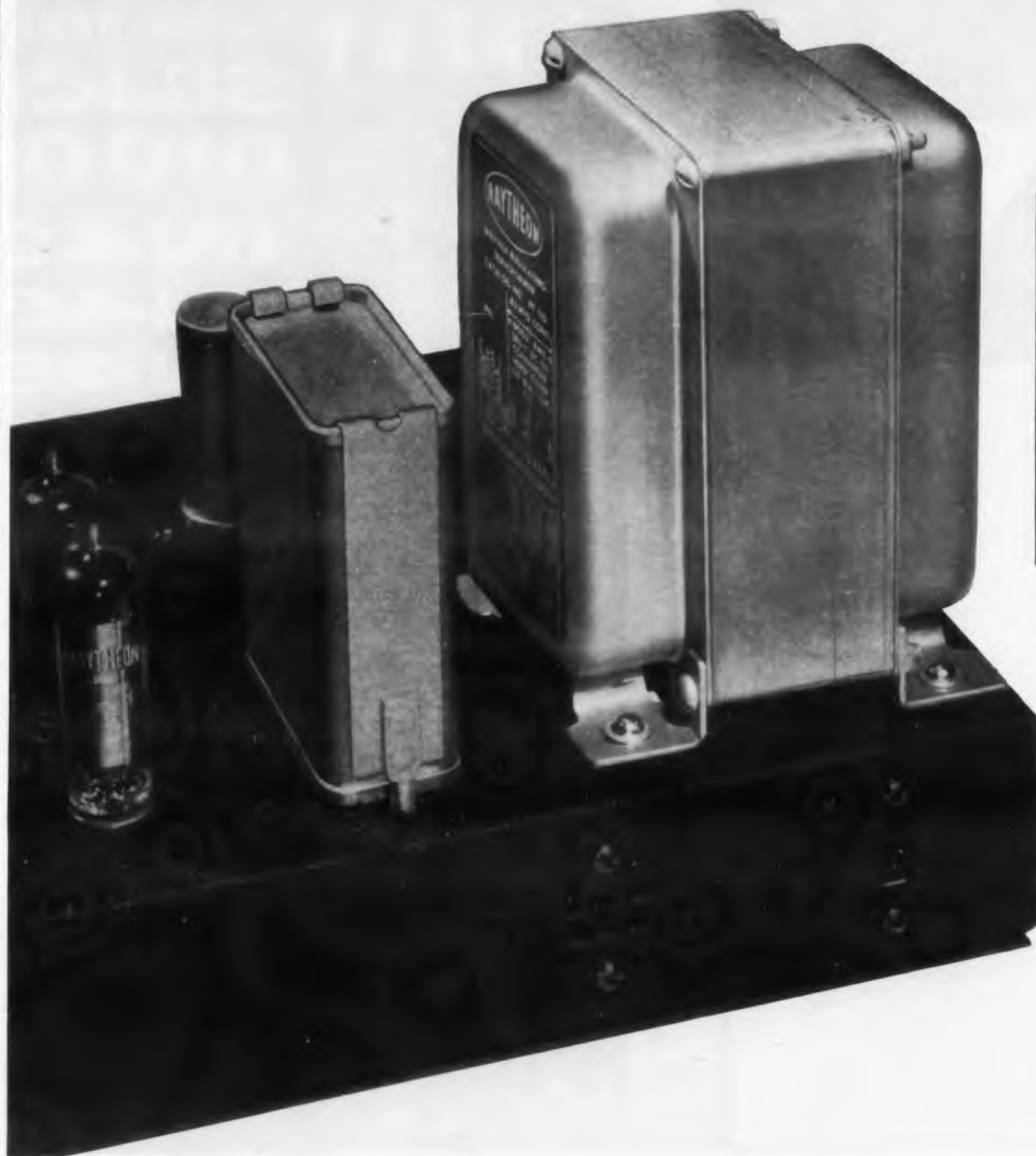
Zener Reference Diodes

Measure 1/4 x 1/3 in.



These Zener reference diodes are in axial-lead, flangeless packages measuring about 1/4 x 1/3 in. and can be easily inserted in printed circuit boards. They serve as a stable 9.3 v reference source over temperature ranges of 0 to 75 C, -55 to +100 C, and -55 to +150 C. Designated types 1N2620 through 1N2624, they have tem-

Raytheon Voltage Regulating PLATE-FILAMENT



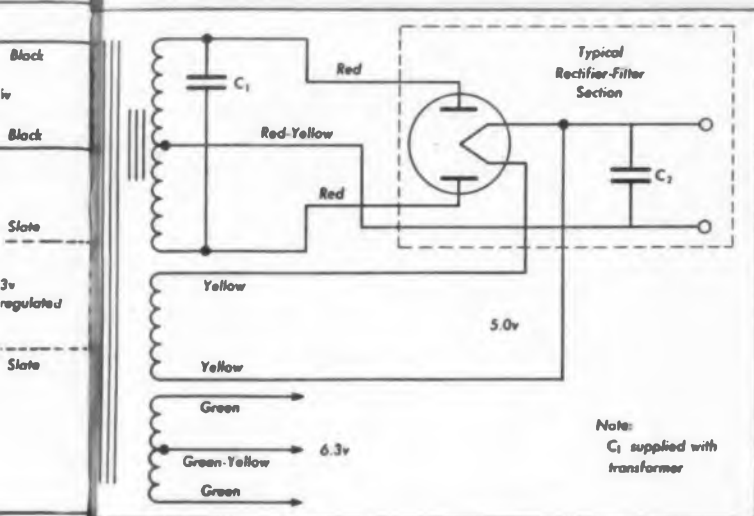
TRANSFORMERS

Transformers that regulate voltage to within $\pm 3\%$

This versatile Raytheon unit looks like a transformer, but does the combined job of transformer plus voltage regulator.

In a conventional power supply circuit, the voltage regulating transformer maintains a dc output voltage within $\pm 3\%$ with line variations of $\pm 15\%$.

For custom requirements, please write our Applications Engineering Group for an answer to your particular need. Raytheon Company, Manchester, New Hampshire.



CIRCUIT DIAGRAM shows Raytheon Voltage Regulating Transformer in typical full-wave rectifier circuit. Three standard models with ratings up to 380 VDC @ 250 MA are immediately available from stock.

THIS BOOKLET GIVES YOU COMPLETE SPECIFICATIONS. For your copy plus a companion data booklet, write Raytheon, Manchester, N. H.



RAYTHEON COMPANY
Industrial Apparatus Division



CIRCLE 78 ON READER-SERVICE CARD

perature coefficients of 0.01, 0.005, 0.002, 0.001, and 0.0005% per deg C. At 10 ma they have a dynamic impedance of 15 ohms max.

Motorola Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.

CIRCLE 75 ON READER-SERVICE CARD

IF Amplifiers

For use at 30 and 60 mc



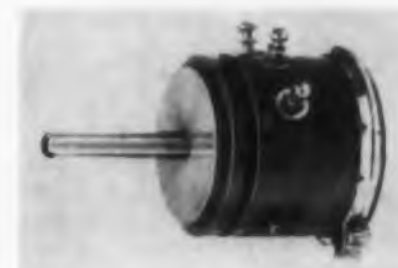
Using silicon tetrode transistors, these five models of if amplifiers are used at 30 and 60 mc. Incorporating a 7077 ceramic triode front end, hybrid units type T610 and T615, shown, yield 3.5 db of noise. Type T35 has a noise figure of 2 db. These units may be ordered with a self-contained transistorized power supply to power the tube. Completely transistorized units with the front end designed for a minimum vswr are types T35M and T61M with vswr ratios of 1.3:1. Suitable for missile and airborne applications, all units measure 7-1/8 x 2-3/4 x 1-1/8 in. and withstand temperatures to 85 C. Special models for use at any center frequency to 80 mc can be supplied.

Remanco, Inc., Dept. ED, 1630 Euclid, Santa Monica, Calif.

CIRCLE 76 ON READER-SERVICE CARD

Potentiometer

Linearity is $\pm 3\%$



Having a linearity of $\pm 3\%$, this 1-1/16 in. potentiometer is available with resistances from 100 to 500,000 ohms. It is rated at 3 w, has a temperature range of -55 to $+165$ C, and has a rated life of over 1000 hr. Bushing or servo configurations are available. Special units with closer linearity, also nonlinear and multi-gangs can be supplied.

Acc Electronics Assoc., Inc., Dept. ED, 99 Dover St., Somerville, Mass.

CIRCLE 77 ON READER-SERVICE CARD



*boil it
bounce it*



New fusion-sealed resistor from Corning with zero moisture absorption

When your work borders on the exotic and your components all have to be *ultra*, take a look at this new glass-enclosed, fusion-sealed resistor.

The glass enclosure lets this 1/4-watt resistor defy all environmental conditions... exceeding MIL-R-10509C, Characteristic B. We've even boiled it in salt water for days without altering electrical characteristics. The glass enclosing the resistor has zero moisture absorption.

The glass-to-metal seal is comparable to that in a vacuum tube... and is even more resistant to physical shock.

The Dumet leads, sealed to a thermally compatible

glass case, create a true hermetic seal. The leads are fused directly to the resistance element.

The tin oxide film resistance element is similar in design and performance to that of a Corning N-style resistor. Resistance ranges from 10 ohms to 360 K ohms; full rating at 70°C. with derating to 150°C. Temperature coefficient is less than 300 ppm/°C.

For the complete story, write for data sheet to **Corning Glass Works**, 540 High Street, Bradford, Pa. Or contact our sales offices in New York, Chicago, or Los Angeles.



CORNING ELECTRONIC COMPONENTS

CIRCLE 79 ON READER-SERVICE CARD

NEW PRODUCTS

Potentiometer

Resistance range is 10 to 100 K



Having a resistance range of 10 to 100 K, model 200 Trimpot potentiometer dissipates 0.25 w at 70 C. The operating temperature range is -55 to +105 C, resolution is 0.17%, and mechanical life is in excess of 25,000 revolutions of the shaft. The unit meets or exceeds Mil specs for shock, vibration, and acceleration. Three terminal types are available: stranded insulated leads, solder lugs, and printed circuit pins.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 80 ON READER-SERVICE CARD

Germanium Transistors

Junction temperature is 100 C

These germanium transistors, including units meeting Mil specs which call for 1000 hr storage at 95 C, are rated at 100 C junction temperature. They are capable of withstanding temperatures to 125 C.

Motorola Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.

CIRCLE 81 ON READER-SERVICE CARD

Rectifiers

For printed circuits



Series 160, 160-C, and 160-ERM rectifiers, either copper oxide or selenium, are available with flat nickel silver filiform leads. These leads match No. 23 AWG solid wire and can fit printed conductors or turret terminals, or be used in mounting.

Conant Labs., Dept. ED, 6500 O St., Lincoln 5, Nebr.

CIRCLE 82 ON READER-SERVICE CARD

Vacuum-Rectifier Tubes

Stand 26,000 v piv

For use as rectifiers of high-voltage pulses in scanning systems of black and white TV receivers, types 1J3 and 1K3 half-wave vacuum-rectifier tubes use a coated filament. Both types withstand a maximum piv plate voltage of 26,000 v. They supply a maximum peak plate current of 50 ma and a maximum average plate current of 0.5 ma. Both have glass-octal design. Type 1K3 is like type 1J3 but has a shorter bulb.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 83 ON READER-SERVICE CARD

Lumped-Constant Delay Line

Delay is 200 μ sec



Model 61-34 lumped-constant delay line has a delay of 200 μ sec and a rise time of 1.16 μ sec. The attenuation is less than 2 db; frequency response at 3 db is 325 kc. The unit has 50 taps with an accuracy of ± 0.2 μ sec at each tap. It measures 6 x 9 x 13-1/2 in.

ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.

CIRCLE 84 ON READER-SERVICE CARD

Parabolic Reflector And Antenna Cover

Stands windloading of 50 lb per sq ft

This parabolic reflector and antenna cover is molded of fiberglass reinforced resin and withstands windloading of 50 lb per sq ft. There is no signal attenuation through the 10,000 mc range. It offers protection against ice and the accumulation of several inches of snow and debris. Available for 4, 6, 8, and 10 ft diameter antennas, the cover is furnished with mounting clamps.

Redman Pattern Works, Dept. ED, Kansas City, Mo.

CIRCLE 85 ON READER-SERVICE CARD

CIRCLE 86 ON READER-SERVICE CARD



Lockheed's endless-loop tape recorders

DEVELOPED FOR SPACE COMMUNICATIONS, the recording capabilities of Lockheed's new endless-loop tape recorders are creating interest wherever the need exists for stored data in a critical environment. The original design is now operational in delayed and continuous recording and playback of stored data. Its endless-loop mechanism records and plays back in the same direction of tape travel... without rewind.

Variations of this lightweight, small size, low power consumption unit are available in a wide range of tape speeds and multiplicity of tracks. For more information on advanced recording techniques to meet your recording needs, write Marketing Branch, Lockheed Electronics and Avionics Division, 6201 East Randolph Street, Los Angeles 22, California.

Look to Lockheed for LEADership in Electronics

LOCKHEED ELECTRONICS & AVIONICS DIVISION

REQUIREMENTS EXIST FOR STAFF AND SUPERVISORY ENGINEERS

NEW PRODUCTS

Annunciator

Has 2 lamps per point

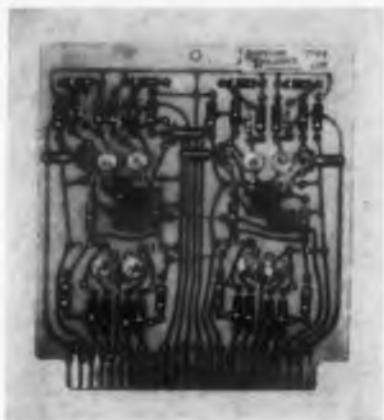
Utilizing 2 lamps per annunciator point, series 50FS annunciator enables the operator to differentiate between failure of component in the unit and an off-normal field condition. It also instantly identifies the position of the failure and informs the operator when a point is in the alert condition despite annunciator component failure. The unit provides optional lock-in, remote alarm, and auxiliary contacts, a flashing alert signifying field abnormalities, and a trouble lamp test with an acknowledgment push button.

Panellit, Inc., Panalarm Div.,
Dept. ED, 7401 N. Hamlin Ave.,
Skokie, Ill.

CIRCLE 87 ON READER-SERVICE CARD

Flip-Flops

Two circuits packaged as one card



For use in computer and control systems, type 2HX flip-flop consists of two independent 1 mc flip-flop circuits packaged as one plug-in printed circuit card. Each of the flip-flops uses two transistors. A transistor amplifier provides the output and two transistors at the input provide for gating of the input signals. Noise discrimination of 3 v is provided at the input gates. The unit has a 1-mc clock pulse for timing. Set 0 and 1 levels of ± 5 to ± 12 v are accommodated. Outputs are common ± 12 v unloaded for 0 levels and ± 12 v unloaded common for 1 levels. Output rise time is less than 0.5 μ sec; fall time is less than

surpassing even military specifications

the new Fansteel

GOLD-CAP

TRADE MARK

TANTALUM CAPACITOR

*the world's
most reliable
capacitor*

INDIVIDUALLY TESTED

INDIVIDUALLY NUMBERED and REGISTERED

INDIVIDUALLY CERTIFIED

each conforming to the most complete
and rigid specifications ever prescribed for
any production component.



only Fansteel dares offer

PROOF OF RELIABILITY!

The Gold-Cap Tantalum Capacitor is Fansteel's solution to one of today's really critical problems—the urgent need for a tantalum capacitor of absolute, unquestioned reliability. It is the first capacitor ever to be offered with *proof in writing* of pre-tested reliability.

This proof is based upon a series of the most uncompromising tests ever devised for checking reliability in a tantalum capacitor. Each Gold-Cap is assigned a registered serial number and all test results are recorded by this individual number.

Thus, every Gold-Cap shipped to you has gone through exhaustive testing . . . meets all Gold-Cap Specifications No. 6CA-101 . . . and is accompanied by its own certified record of test results—written proof of its pretested reliability.

Only Fansteel dares take the responsibility of pre-testing for you . . . and certifying the results!

THE FANSTEEL CERTIFICATION OF RELIABILITY makes any further inspecting or testing for reliability unnecessary.

THE GOLD-CAP TESTS FOR CERTIFIED RELIABILITY

GROUP A TESTS

Sample Lot Inspection:

Material / Dimensions / Marking /
Workmanship
Design and Construction

Note: All Group A Tests shall be in accordance with MIL-STD-105.

GROUP B TESTS

100% Inspection:

Performance check
Stability Tests at reduced and high temperatures (25°C. to -55°C. to 25°C. to 125°C. and back to 25°C.) for:

1. Capacitance
2. DC Leakage
3. Equivalent Series Resistance (ESR)
4. Impedance

GROUP C TESTS

Sample Lot Inspection:

Reduced Barometric Pressure (tested to equivalent of 100,000 feet). / Lead Tensile Test / Vibration / Shock / Salt Spray / Temperature and Immersion Cycling / Surge Voltage / Moisture Resistance / Lead Bend Test

Sample units selected from those meeting Group A and B Test requirements.
Continuing 2000-Hour Life Test

If you want to learn more about what makes the Fansteel Gold-Cap the world's most reliable tantalum capacitor, write to the Publications Department, Fansteel Metallurgical Corporation, North Chicago, Illinois and ask for Gold-Cap Tantalum Capacitor Specifications No. 6CA-101.



C5910

0.2 μ sec. The operating temperature range is 0 to 50 C. The unit is assembled on a 4-1/2 x 5 in. circuit card and has a 22 pin PC connector.

Ransom Research, Dept. ED, 323 W. 7th St., San Pedro, Calif.

CIRCLE 88 ON READER-SERVICE CARD

Linear Amplifier

Recovery time is less than 7 μ sec



Designed for scintillation spectrometry and proportional counting applications, model 851, DD-2 linear amplifier has a recovery time of less than 7 μ sec for up to 200 times overload. Recovery time is better than 20 μ sec with an overload to 1000. The unit is built to ORNL Q-1593-8. Model 851 A, has, in addition, a differential and integral pulse height analyzer.

The Victoreen Instrument Co., Dept. ED, 5806 Hough Ave., Cleveland 3, Ohio.

CIRCLE 89 ON READER-SERVICE CARD

High-Vacuum Pumps

Operate at 0.7 liter per sec

Able to pump 0.7 liter per sec, the series 110 high-vacuum pumps are used on microwave, storage, display, and X-ray tubes and other devices to extend cathode life by removing gas liberated during operation. Other uses include vacuum-jacketed vessels. The pump unit and the magnet weigh 1.6 lb; the magnet has a 2 in. OD. They have cold-cathode discharge and stainless steel construction. Four designs are available: two are arranged so that the tube is evacuated directly through the pump unit with no tube exhaust required.

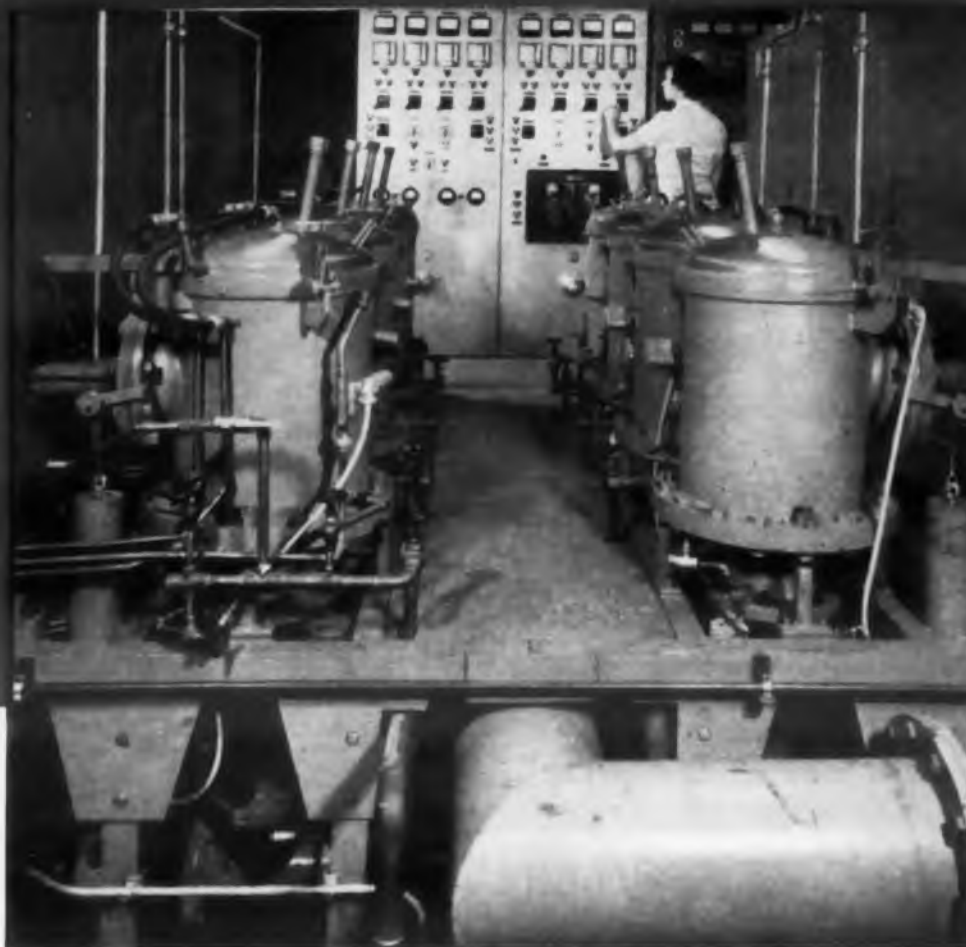
Ultek Corp., Dept. ED, 920 Commercial St., Palo Alto, Calif.

CIRCLE 90 ON READER-SERVICE CARD

TANTALUM ...

From
Experience
Gained
by
37 Years
of Doing

Part of a group of special vacuum furnaces for producing sintered porous tantalum anodes for both wet and solid electrolytic tantalum capacitors.



ALL TANTALUM starts with the same types of ore. To get them, all you need is money. Other ingredients and equipment are equally easy to acquire—all but the prime ingredient of *production experience itself*. That's a lot harder to come by. You can't order it by the ton, nor pay for it with a check.

It has taken us (and we've been concentrating on metallurgy for almost a half century) almost forty years to acquire our present fund of experience in tantalum production. And, year by year, we are constantly improving.

Our own experience in making the first tantalum capacitors quickly revealed that a special grade of tantalum is necessary for greatest capacitor reliabil-

ity. So we developed this grade, exclusively for capacitor use.

Capacitor Grade Tantalum is the only tantalum used in our own capacitors. And since it is freely available to other manufacturers, it is used by all other leading tantalum capacitor producers. No one factor can insure overall quality, but, regardless of all other requisites, reliable tantalum capacitors *must start* with reliable tantalum.

And it is gratifying to us that capacitor manufacturers are proud to point out that "Fansteel Capacitor Grade Tantalum" is used in their product. Fansteel Metallurgical Corporation, Rectifier-Capacitor Division, North Chicago, Illinois.

FANSTEEL®

CAPACITOR GRADE
TANTALUM

A Premium Grade of Tantalum available to capacitor manufacturers in these forms:

FOIL • SHEET • STRIP • WIRE • ROD • FABRICATED WIRE LEADS
SINTERED POROUS ANODES • METAL POWDER

2396

CIRCLE 92 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supplies

Respond in less than 10 μ sec



Made for use in computers, telemetering, and automation systems, series T-200B transistorized dc power supplies respond in less than 10 μ sec. Eight models are available, with output ratings from between 0 and 10 v to between 0 and 150 v, and current ratings from between 0 and 0.75 amp to between 0 and 30 amp. The output voltage is regulated with a total envelope of uncertainty of $\pm 0.08\%$.

Armour Electronics Div. of Cardinal Instrumentation Corp., Dept. ED, 4201 Redwood Ave., Los Angeles 66, Calif.

CIRCLE 93 ON READER-SERVICE CARD

Silicon Diodes

Have forward-current to 200 ma

These silicon diodes, types 1N837 through 1N845, have a minimum forward-current, at 25 C and 1 v, of 100 to 200 ma. Maximum recovery time is 0.3 to 0.5 μ sec. Their typical capacity at -2 v is less than 4 μ mf. They have a reverse resistance of 400 to 2000 meg and an operating temperature range of -65 to $+150$ C. Hermetically sealed in one-piece glass envelopes with glass to metal seals at the leads, the diodes are 0.265 in. long and 0.107 in. in diameter.

Hughes Products, Semiconductor Div., Dept. ED, P.O. Box 278, Newport Beach, Calif.

CIRCLE 94 ON READER-SERVICE CARD

Indicator Lights

Rated at 1/25 w



The 1/25 w neon indicator light is enclosed in a translucent urea plastic case. It can be used alone or as part of a larger unit. Self-adjusting mounting clips permit insertion on 0.031 to 0.093

gage metal; the light also fits the perforations of most standard switchplates. Standard units have 1/8 in. stranded copper, plastic covered leads with 1/2 in. stripped ends. Lights can be provided for 125 or 250 v operation, with white or red cases, and with a choice of imprints. Nonstandard leads or special wording can be ordered.

Westmoreland Plastics Co., Inc., Dept. ED, Gertrude St., Latrobe, Pa.

CIRCLE 95 ON READER-SERVICE CARD

DC Amplifier

Transistorized



Model DA-12 transistorized dc amplifier has 5 μ v noise, peak-to-peak, a response time to a step function input of 7 μ sec, and an overload recovery time of 50 μ sec. The heat control system insures low drift. The unit is supplied with both differential input and differential output circuits which function with either or both the input and the output single-ended.

United ElectroDynamics, Dept. ED, 200 Alledale Rd., Pasadena, Calif.

CIRCLE 96 ON READER-SERVICE CARD

Miniature Power Supply

Provides 900 to 1200 v



Measuring 1-1/2 x 1-7/8 x 2-7/8 in., model 61-R transistorized power supply operates from 6 v dc and delivers 900 to 1200 v. A Zener bridge used for reference regulates the output by means of a closed-loop servo system. The unit can operate in high altitudes and in temperatures to 85 C. Its applications include operating photomultipliers used in infrared detection systems and nuclear scintillation counters. It weighs 6-1/2 oz.

Components Corp., Dept. ED, Denville, N.J.

CIRCLE 97 ON READER-SERVICE CARD

IN DELAY LINES... ALL ROADS LEAD TO ESC

ESC was the first company devoted exclusively to the design and manufacture of custom-built and stock delay lines... for all military and industrial applications. ESC was also the first to provide complete laboratory reports with each delay line prototype... containing submitted electrical requirements, photo-oscillograms (which indicate input and output pulse shape and output rise time), the test equipment used, and an evaluation of the electrical characteristics of the prototype.

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CIRCLE 98 ON READER-SERVICE CARD



Amazing New **WEE-DUCTOR**

The R. F. Choke that's so small
you can pack 200,000 to a cubic foot

Tiny, new WEE-DUCTOR covers a full range of inductances from 0.10 μH to 1,000 μH , yet it measures only 0.150" x 0.375" and occupies a volume of less than 0.0066 cubic inch!

Unique, new, ferrite sleeve and core construction provides 10,000 to 1 inductance range in a tiny package . . . yet it still allows for a high current rating at 125°C operating temperature.

WEE-DUCTOR is the latest addition to the Essex Electronics line of standard R.F. Choke Coils . . . write today for detailed data sheet describing this amazing new miniature choke with the expanded range of inductances!



Essex Electronics Standard Line of R.F. Chokes

Essex Part Number	L μH	Max. Res. Ω	I Max. ma	Dia.	Length
WEE-DUCTOR	0.10 - 1,000	0.035 - 14.9	3000 - 150	0.157	0.375
RFC-S	0.10 - 100	.02 - 6.0	4000 - 220	0.188	0.44
RFC-M	1.0 - 1,000	.04 - 21.0	2700 - 125	0.25	0.60
RFC-L	1.0 - 10,000	.03 - 80.0	4000 - 80	0.31	0.90



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CIRCLE 105 ON READER-SERVICE CARD

NEW PRODUCTS

Automatic Time Reader

For magnetic tape



Model 1060 automatic time reader compares the timing track of a magnetic tape with switches set to designate the beginning and the end of tape sections of interest. Control signals are generated to effect print-out or other action. Generation of the start and stop signals occurs precisely at the beginning of a frame of interest and before reading time by means of a presensing device. The unit is composed of transistorized plug-in modules mounted with a power supply on a chassis 16 in. deep. A 7 x 19 in. front panel holds the operating controls.

Vitro Labs., Dept. ED, 200 Pleasant Valley Way, W. Orange, N.J.

CIRCLE 106 ON READER-SERVICE CARD

Secondary Frequency Standard

Provides 400 cps sine wave



For airborne and missile use, model U secondary frequency standard provides a 400 cps sine wave source with an accuracy of ± 0.009 cps at 25 C. The output power is 55 mw; required input is 28 v dc. The total harmonic distortion is 10% max. The operating temperature range is 0 to 60 C. The unit has three unijunction countdown stages, one binary divider stage, and a tuned power output stage. It comes in a square envelope 1-3/4 x 1-3/4 x 3-1/16 in. and its over-all weight is 8 oz.

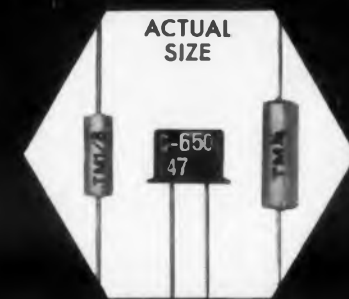
Designers for Industry, Dept. ED, 4241 Fulton Parkway, Cleveland 9, Ohio.

CIRCLE 107 ON READER-SERVICE CARD

TEXAS INSTRUMENTS

sensistor *

SILICON RESISTORS



Immediately Available
Off-the-shelf

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STANDARD AVAILABLE RESISTANCES 25°C; 100, 120, 150, 180, 220, 270, 330, 390, 470, 500, 560, 680, 820, and 1000 ohms.

Type No.	Watts	Resistance Tolerance %
TM 1/4	1/4	± 10
TM 1/8	1/8	± 10
TC 1/8	1/8	± 10

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MA 2-1661

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100 6th Ave.
WO 6-5300

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CIRCLE 108 ON READER-SERVICE CARD

Laminates

Epoxy-impregnated

Types GB-16EV-2 and GB-28EV-2 epoxy-impregnated, glass-base laminated plastics are available as plain sheets or as copper-clad sheets for printed circuit use. Sheet sizes are 38 x 42 in. and 38 x 38 in. Type GB-16EV-2 is from 1/100 to 1/8 in. thick. Type GB-28EV-2 is from 1/32 to 1 in. thick and is also available as rolled tubing in sizes from 2 to 12-3/4 in. OD and 2-1/2 to 13-1/2 in. OD with a minimum wall thickness of 1/4 in. Both types meet the requirements of MIL-P-18177B; type GB-16EV-2 is more suitable for close tolerance machining.

Continental-Diamond Fibre Corp., Dept. ED, Newark, Del.

CIRCLE 109 ON READER-SERVICE CARD

Film Potentiometer

Has 1/2 in. diam



Designed for use in servo systems, model 50 single-turn, precision potentiometer has a case diameter of 1/2 in. It has a film resistance element, operates over the temperature range of -55 to +150 C, and is treated to resist corrosion. The linearity is 0.2% and operation life is over 30,000,000 revolutions at 100 rpm. Nonlinear outputs, tapped elements, and ganged units can also be supplied.

Computer Instruments Corp., Dept. ED, 92 Madison Ave., Hempstead, L.I., N.Y.

CIRCLE 110 ON READER-SERVICE CARD

CIRCLE 111 ON READER-SERVICE CARD

STABLE
VOLTAGE
FOR LIFE...



NEW ULTRA-STABLE ZENER DIODES

Type	SPECIFICATIONS			RATINGS		
	Voltage Range at I _Z = 7.5 ma at 25°C (Volts)		Temp. Coefficient ² (-55°C to +100°C) at I _Z = 7.5 ma (%/°C)	Maximum Dynamic ¹ Resistance at 25°C at I _Z = 7.5 ma (ohms)	Operating and Storage Temperature Range (°C)	Max. Operating Temp. at I _Z = 7.5 ma (°C)
	Min.	Max.				
1N821	5.9	6.5	±.01	15	-65 to +150	+125
1N822 ¹	±5.9	±6.5	±.01	15	-65 to +150	+125
1N823	5.9	6.5	±.005	15	-65 to +150	+125
1N824 ¹	±5.9	±6.5	±.005	15	-65 to +150	+125
1N825	5.9	6.5	±.002	15	-65 to +150	+125
1N827	5.9	6.5	±.001	15	-65 to +150	+125

¹Double anode types.

²Determined by measuring a change of voltage from -55°C to +25°C and a change of voltage from +25°C to 100°C.

³The Dynamic Resistance is measured by superimposing a small A.C. signal upon the test D.C. current. (I_{AC} RMS = 1/10 I_{DC} Test)

1N822 and 1N824 types meet all specifications, including temperature coefficient, in both directions.

This new line of subminiature silicon voltage references features a combined lower dynamic resistance and voltage stability exceeding that of any standard cell.

Manufactured by diffusion, these devices offer temperature coefficients as low as 0.001% /°C. Unique single piece construction enables the reference to maintain excellent voltage stability when subjected to severe thermal shocks. Axial lead design and hermetically sealed glass encapsulation insure a rugged unit capable of providing long term reliability over wide ranges of environmental conditions.

These new subminiature references are also available in double anode types for symmetrical clipping applications.

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Select from the nation's
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Rating
250 MW
250 MW
400 MW
750 MW
1 WATT
10 WATT

Type Number
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VR-607 (illustrated) — portable, 5 decade switches plus vernier and divider
VR-607B — portable, 17 binary-coded toggles plus vernier and divider
VR-608 — rack-mounting, 5 decade switches plus vernier and divider, and front panel null meter

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NEW PRODUCTS

Variable Speed Controls

Instantly reversed

These variable speed controls can be instantly reversed whether running or stopped by means of a bell crank mechanism controlled by a lever. Instant reversing is possible to a torque limit of 450 lb-in. Models 54 and M54 have 0.5 hp max, and models 24 and M24 have 0.75 hp max. These controls are designed for power feeds, positioners, conveyors, and machine tools in metal working, mixing, blending, and measuring.

Zero-Max Co., Dept. ED, 1900 Lyndale Ave. S., Minneapolis 5, Minn.

CIRCLE 113 ON READER-SERVICE CARD

Transistors

Have ratings of 3 and 10 amp



These two types of power transistors are for both linear and switching applications. Type 2N1011, similar to the 2N297A, has a 3-amp collector current rating. Type 2N1120 has a 10-amp rating. Both units have copper strap internal construction and meet Mil specs.

Motorola, Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell Rd., Phoenix, Ariz.

CIRCLE 114 ON READER-SERVICE CARD

Laminated Forms

Shells, cases, and cups

These thin-wall, glass laminated shells, cases, and cups are for encasing transformers, delay lines, and other magnetic components. The materials available include glass silicone, melamine, polyester, epoxy, and phenolic. The glass cloth reinforcement provides rigidity and a high dielectric. The laminated forms are tooled to the customer's specifications; lengths of tubing are available as stock items.

Stevens Products, Inc., Dept. ED, 86-88 Main St., E. Orange, N.J.

CIRCLE 115 ON READER-SERVICE CARD

10 mc to 44,000 mc with ONE tuning head



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BAND	RF SENSITIVITY
• 10 — 420 MC	—95 to —105 dbm
• 350 — 1000 MC	—90 to —100 dbm
• 910 — 2200 MC	—80 to —95 dbm
• 1980 — 4500 MC	—70 to —90 dbm
• 4.5 — 10.88 KMC	—80 to —95 dbm
• 10.88 — 18.0 KMC	—60 to —85 dbm
• 19.0 — 26.4 KMC	—55 to —85 dbm
• 26.4 — 44.0 KMC	—55 to —85 dbm

*measured when signal and noise equal 2x noise

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ELECTRONIC DESIGN • October 14, 1959

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CIRCLE 104 ON READER-SERVICE CARD



Potentiometer-Clutch

Linearity is to 0.15%

Model 120 potentiometer-clutch consists of an electro-magnetic clutch and rotary film potentiometer. The 1 in. diam unit pictured here is available with linearities to 0.15% and resistances of 1 to 200 K. Resolution is better than 1 part per 40,000 and guaranteed life is in excess of 10,000,000 revolutions. Engagement time is under 20 μ sec and running speed is to 1000 rpm. Having a volume of 1-1/2 cu in., the unit weighs 3-1/2 oz.

Computer Instruments Corp., Dept. ED, 92 Madison Ave., Hempstead, L.I., N.Y.

CIRCLE 127 ON READER-SERVICE CARD

Miniature Power Connectors

Have up to 52 contacts

For heavy duty applications in guided missiles, aircraft, and electronic equipment requiring high dielectric and mechanical strength, four types of miniature power connectors are available. Type GA has spring action center screwlock and is available in 10, 32, 35, 40, 48, and 52 contacts. Chassis mounted units are pressurized, and contacts are individually spring loaded. Types 14 and 15 are compact, heavy-duty rectangular power connectors with a current rating of 10 amp and a voltage breakdown of 4500 to 4700 rms. They are available in 7, 9, 10, 15, 18, 19, and 20 contacts with turret, solder cup or taper pin terminations. Type E-Z connectors have individually spring-loaded pin contacts, polarizing screwlocks, and aluminum hoods.

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

CIRCLE 128 ON READER-SERVICE CARD



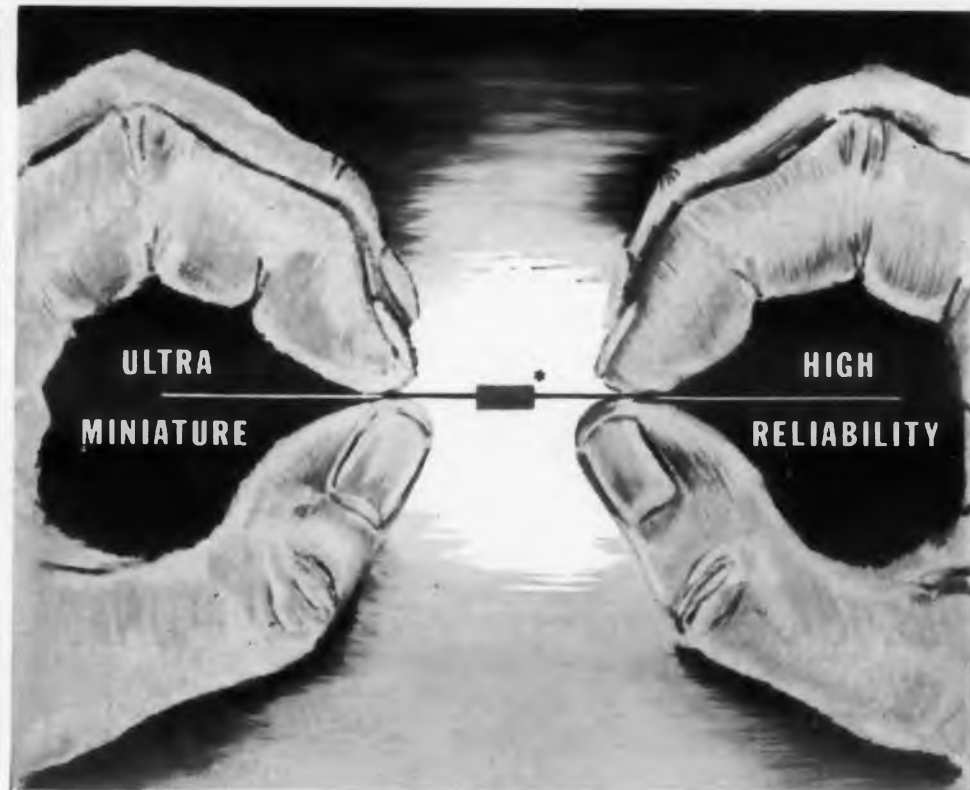
Transistor Inverter

Has 2000 va output

Model 4311 transistor inverter is an airborne power supply with a 2000 va, 3 p, 4 wire output. Voltage regulation is $\pm 1.0\%$ from one-half to full load. Output frequency is 400 cps $\pm 0.1\%$; efficiency is 75% at full load and power factor is 0.9. This unit weighs 35 lb and measures 16.1 x 9.75 x 7.5 in. It is designed for continuous operation with air cooling during pre-launch checkout; it operates without cooling during missile flight.

Varo Manufacturing Co., Inc., Dept. ED, 2201 Walnut St., Garland, Tex.

CIRCLE 129 ON READER-SERVICE CARD



*Actual size of Type C89 unit rated at 1000 mmf.

Hi-Q® CERAFIL® Capacitors†

The smallest ceramic capacitors available anywhere. Cerafil capacitors are remarkably ultra-miniature units designed specifically for airborne and missile equipments, transistorized circuits and other critical applications where space and weight are at an absolute premium.

Exclusive new design and construction feature of Cerafil Capacitors make it possible to obtain extremely high capacities per unit volume. These tiny capacitors are the answer to the many problems arising from complete miniaturization of electronic assemblies and equipments.

Cerafil Capacitors are available in capacities from 10mmf to 100,000mmf. Type C80 of this rugged ceramic unit of exceptional reliability is rated at 100 VDC at 85° and derated to 50 VDC at 125°C. Type C80 units will meet or exceed all the applicable requirements of MIL-C-11015A.

†A 10% price reduction effective September 1, 1959 on all standard Type C80A units.

CAPACITY (MFD)	C80-DIMENSIONS	
	DIA.	LENGTH
10 mmfd thru .001 mfd.	.090	.320
.005	.120	.500
.01	.180	.500
.02	.200	.500
.05	.240	.650
.1	.310	.750

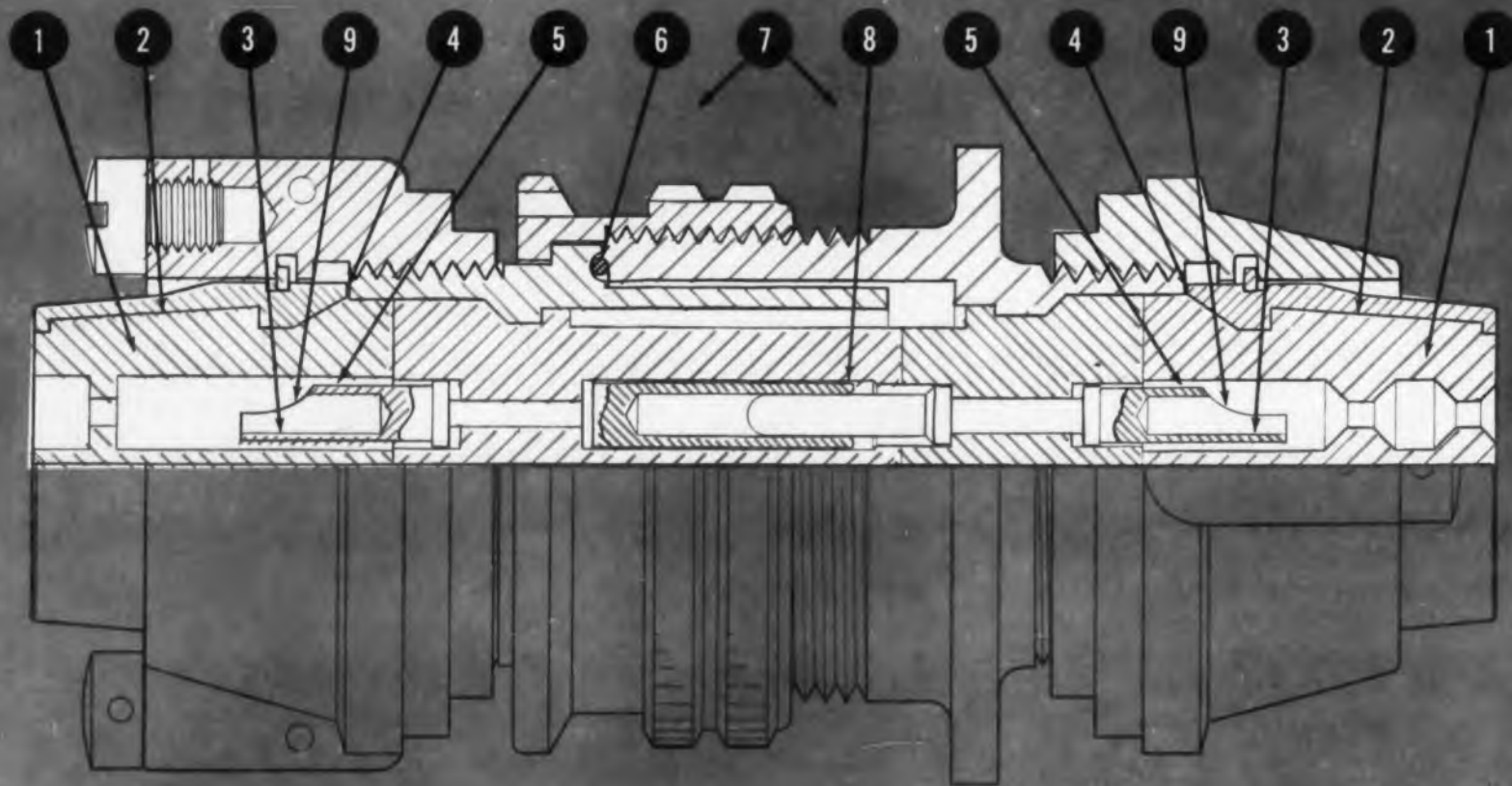
ELECTRICAL SPECIFICATIONS			
Working Voltage DC	Test Voltage DC (Flash)	Capacitance Change Over Temperature Range of -55°C to +85°C	Capacity Tol. (%)
100	300	+10% -15% with no voltage applied +10% -35% with 100 volts applied	± 20 +50 -20 GMV
Power Factor: 2.5% Max. Insulation Resistance: 100 mfd.-megohms or 10,000 megohms whichever is smaller.			

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SECTION OF MATED MS 3100R & MS 3106R

STUB^ER

Check the PLUS features of the NEW Amphenol "R"!

Stub R is the newest member of AMPHENOL's family of fully approved MIL-C-5015D environmentally resistant connectors. The "R" construction is a recent addition to this Specification and is described as "environment resistant-light weight". Like AMPHENOL's superior Stub E, the Stub R offers plus features above and beyond the minimums established by the Specification. Together, these connectors provide users with a complete selection of the shortest, lightest, finest environmentally resistant AN/MS connectors available to MIL-C-5015D. AMPHENOL Stub R connectors offer the following plus features:

- 1 **Slippery Grommet Material** A special neoprene material that allows easy slippage over wires. A cost-saving advantage that speeds up assembly.
- 2 **Unitized Rear Grommet** Grommet, clamp nut, clamp shell and retainer ring form a *single* sub-assembly, making assembly and disassembly easier and quicker than with any other "E" or "R" connector.
- 3 **Uniformly Tinned Solder Pockets** Uniform and complete distribution of solder tinning on the inside of the solder pockets, assuring the user of producing the best electrical and mechanical connection.
- 4 **Metal-to-Metal Bottoming** The unitized rear grommet provides metal-to-metal bottoming to the front shell when the grommet is fully engaged, assuring pre-determined, controlled sealing and minimizing the possibility of compression "set".

- 5 **Ease of Soldering** Solder pockets are exposed for easy wiring and soldering, providing fast, low cost and high quality assembly.
- 6 **"O" Ring** The Stub R incorporates an "O" ring on the shoulder of the MS 3106 plug for additional sealing protection.
- 7 **Shorter Length, Lighter Weight** Both Stub E and Stub R are the shortest and lightest types available, allowing for more compact equipment that saves money where weight = money, as in aircraft.
- 8 **Closed Entry Socket Contacts** Resistant to test prod damage, female contacts are machined of a copper alloy and provided with a closed entry.
- 9 **Positioned Contact Pockets** All solder pockets face in the same direction, accelerating wiring and substantially reducing assembly costs.



AMPHENOL CONNECTOR DIVISION 1830 S. 54th Ave., Chicago 50, Illinois
Amphenol-Borg Electronics Corporation

NEW PRODUCTS

Relays

Mechanically-held

These 25 amp, mechanically-held ac relays have up to 24 poles. Standard control voltages are: 24, 110 to 120, and 208 to 240 v at 25, 50 or 60 cps; and 440 and 550 v at 60 cps. Electrical spacings are adequate for 600 v. These units can be used as primary relay devices controlling contactors, solenoid valves, and similar equipment, or as branch circuit devices to control electric ovens, furnaces or lights.

Automatic Switch Co., Dept. ED, Florham Park, N.J.

CIRCLE 131 ON READER-SERVICE CARD

Amplifier

Miniature

This amplifier unit is approximately the size of two cigarette packs. It is used for high accuracy data reporting devices to act as a preamplifier between low level signals and direct writing type oscillograph pens. This unit is adaptable to any oscillograph data recording units.

Leach Corp., Dept. ED, 18435 Susana Rd., Compton, Calif.

CIRCLE 132 ON READER-SERVICE CARD

Gyro

Floated rate type

This floated rate gyro operates during and after exposure to temperatures from -40 to +200 F. The natural frequency ranges from 30 cps for a low rate to 100 cps for a high rate. The instrument withstands steady state acceleration of 60 g along each of the three major axes and transient accelerations to 100 g along each axis. It withstands vibration to 15 g and shock to 60 g. It has 1 deg of freedom and achieves vibration and shock isolation by flotation of the gimbal structure.

Telecomputing Corp., Dept. ED, 16217 Lindbergh St., Van Nuys, Calif.

CIRCLE 133 ON READER-SERVICE CARD

← CIRCLE 134 ON READER-SERVICE CARD

Servomotors

Operating range from
-54 to +150 C

These size 11 servomotors operate effectively at temperatures ranging from -54 to +150 C. The R133-003 pinion shaft and the R133-004 plain shaft motors have a no load speed of 6200 rpm, a stall torque of 0.45 in.-oz, and weigh 4.5 oz. These motors are constructed of advanced temperature-resistant parts and impregnating materials, and have high torque-to-inertia ratios.

Kearfott, Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 135 ON READER-SERVICE CARD

Radar Beacon

C-Band and S-Band

Radar beacon type 149 is used as an air-borne, pulse-type tracking aid for long-range missile or space applications. Completely transistorized except for the local oscillator and the transmitter, it is small and light-weight. A transistor power supply develops regulated operating voltages from a 24 to 28 v dc power source. The beacon operates in the C-Band or S-Band and responds to coded or uncoded pulse interrogations from radars.

ACF Industries, Inc., Avion Div., Dept. ED, 11 Park Place, Paramus, N.J.

CIRCLE 136 ON READER-SERVICE CARD

Thermocouple Wire

Metal sheathed

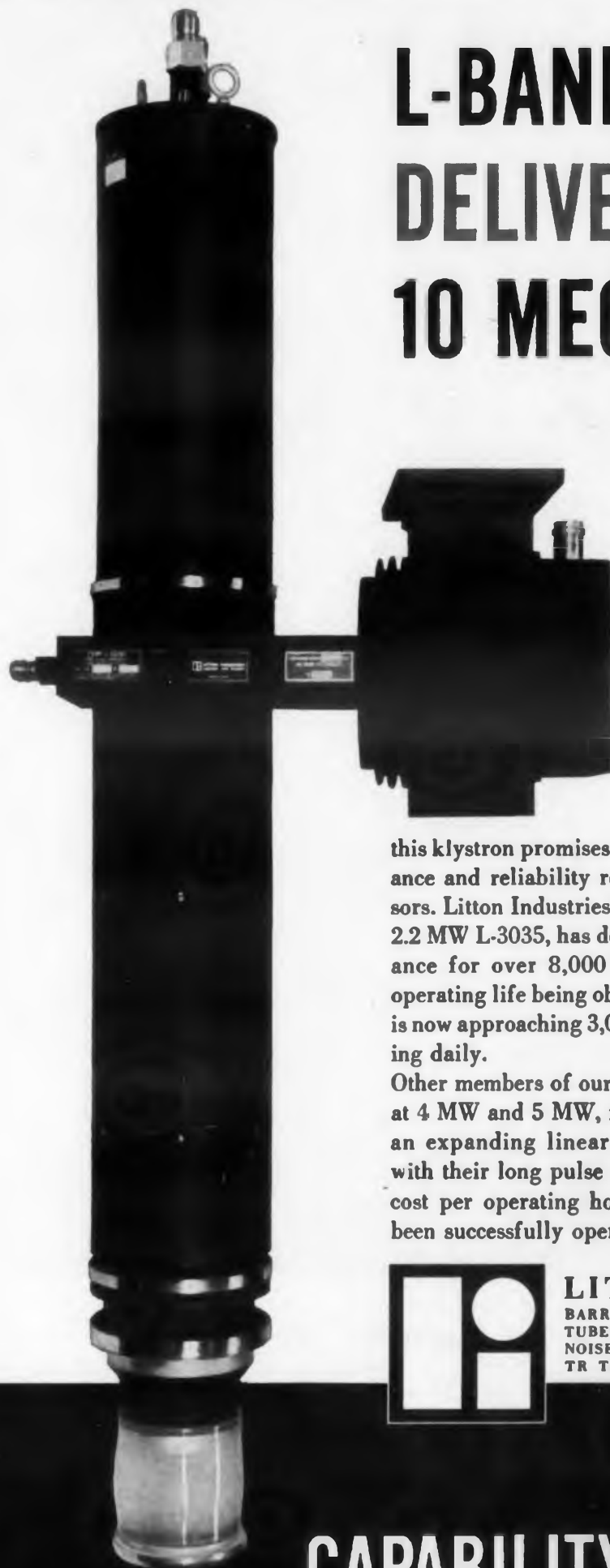
Pycopak thermocouple wire is magnesium oxide packed, with metal-sheathed construction. It is available in seven sizes ranging from 5/16 to 1/40 in. sheath OD, with standard materials of 304 stainless steel, Inconel and platinum. The wire may be supplied in lengths up to 50 ft. Complete thermocouple assemblies, consisting of wire with integral, insulated or exposed junctions, together with head and block or quick-connect plug, are also standard items.

Pyrometer Company of America, Inc., Dept. ED, Penndel, Pa.

CIRCLE 137 ON READER-SERVICE CARD

CIRCLE 138 ON READER-SERVICE CARD

L-BAND KLYSTRON DELIVERS 10 MEGAWATTS (minimum!)



This member of Litton Industries' klystron family is indeed a big brother. The L-3250 produces a peak power output of 10 MW at an average power output of 15 kw. Now in production for a major early warning radar system,

this klystron promises to equal the performance and reliability record of its predecessors. Litton Industries' generic klystron, the 2.2 MW L-3035, has delivered full performance for over 8,000 hours. The average operating life being obtained in field service is now approaching 3,000 hours and increasing daily.

Other members of our L-band family, rated at 4 MW and 5 MW, form the backbone of an expanding linear accelerator activity with their long pulse performance and low cost per operating hour. These units have been successfully operated at pulse lengths

up to 30 microseconds. The technical problems associated with operation at much longer pulse length are well in hand.

The long life obtained in these tubes provides low cost per operating hour which, combined with low initial cost, places linear accelerators within reach of many new users. New developments now approaching production include tubes with higher power output, wide bandwidth, longer pulse length, modulating electrodes, and other features which will provide major improvements in systems where electronic tuning and shaped pulses are important.

The performance of our L-band klystron family has made Litton Industries the leading supplier of high powered klystrons in this range. Soon comparable families at other frequencies will enhance the reputation gained at L-band.

For your present needs, whatever your requirements for high power, be they radar, linear acceleration, or others, Litton Industries is the supplier. For your future needs, it's best to get our thinking early in your planning. Write to Litton Industries, Electron Tube Division, Office E20, 960 Industrial Road, San Carlos, California.



LITTON INDUSTRIES Electron Tube Division

BARRATRON TRANSMITTING TUBES • MAGNETRONS • KLYSTRONS • TRAVELING WAVE TUBES • BACKWARD WAVE OSCILLATORS • CARCINOTRONS • GAS DISCHARGE TUBES • NOISE SOURCES • CROSSED FIELD AMPLIFIERS • MICROWAVE FILTERS • DUPLEXERS • TR TUBES • DIRECT-WRITING CRT • HIGH DEFINITION CRT • STORAGE TUBES

CAPABILITY THAT CAN CHANGE YOUR PLANNING





NATO SELECTS EIMAC KLYSTRONS TO POWER EUROPE'S LARGEST TROPO-SCATTER NETWORK

One and ten kilowatt amplifiers in NATO's continent-spanning tropo-scatter system will be Eimac Amplifier Klystrons. Since Eimac Klystrons first made large-scale tropospheric communications possible in 1954, they've become famous for reliability in all major tropo-scatter networks: Pole Vault, Dew Line, Texas Towers, White Alice, Florida-Cuba TV. Individual Eimac Klystrons have logged more than 35,000 hours continuous air time in tropo-scatter service.

Exclusive design features make Eimac Klystrons outstanding for tropo-scatter. Extra-wide frequency tuning is achieved with one set of tuning cavities. Inductive tuning achieves uniform bandwidth plus greater broadbanding by external cavity loading. Eimac's external cavity design lowers original cost, and replacement cost is lower since tuning circuitry is purchased just once.

One wide range load coupler covers the entire frequency range. Eimac's

series connected body magnets permit use of one power supply, one control for body magnets.

Eimac Klystrons will be used in NATO installations. Proved Eimac reliability will aid in safeguarding the security of all free European nations.

EITEL-McCULLOUGH, INC.



San Carlos • California

NEW PRODUCTS

Resistors

Wire wound

Series S.AL precision wire wound resistors are available in the following standard sizes: 1, 2, 3, 5, 7, 10, 15, and 20 w. Resistances are 1 to 90,000 ohms. These axial-lead resistors are made with all welded construction and have silicone coating.

Tru-Ohm Products, Div. of Model Engineering & Manufacturing, Inc., Dept. ED, 2800 N. Milwaukee Ave., Chicago 18, Ill.

CIRCLE 139 ON READER-SERVICE CARD

Tetrode

High-frequency, sharp-cutoff type

Type 6EV5 tetrode is used as an rf amplifier in vhf tuners. With a plate voltage of 250 v and a screen voltage of 80 v dc, it has a transconductance of 8800 μ mhos for a plate current of 11.5 ma and a screen current of 0.9 ma. This tube is similar in construction to the 6CY5, but has higher gain, high input impedance and a noise figure 1.3 db below that of the 6CY5. The 6EV5 can be operated directly from a 250-v supply without use of a dropping resistor.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 140 ON READER-SERVICE CARD

Indicator Light

Is 15/64 in. in diam. and
35/64 in. long

Series L10000 indicator lights are 15/64 in. in diam and 35/64 in. long. They have a 60,000-hr life at 5 v dc and 0.060 amp. The lamp-lens assembly is molded to the mounting stem, making this light moisture proof. These units will mount in a clearance hole for a No. 10 screw, and extend behind the panel 13/64 in.

Hetherington Inc., Dept. ED, 1420 Delmar Drive, Folcroft, Pa.

CIRCLE 141 ON READER-SERVICE CARD
CIRCLE 142 ON READER-SERVICE CARD

Phase Sequence Indicators

For use with three-phase power systems

These portable phase sequence indicators, designed for use in three-phase power systems, have three insulated test leads connected at random to the three-phase conductors. Model 40 is for 60 cps systems and is adjustable to 120, 240 or 480 v. It measures 3 x 5 x 2 in. and has no moving parts or batteries. Model 44, for use with 400 cps systems, is also available.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 143 ON READER-SERVICE CARD

Silicon Rectifiers

Are rated at 25 amp

These silicon rectifiers are rated at a forward current of 25 amp in a single-phase circuit at a stud temperature of 145 C. Maximum one-cycle surge current rating is 300 amp. Seven conventional types, 1N2154 through 1N2160, have the stud as the cathode; seven reverse-current types, 1N2154R through 1N2160R, have the stud as the anode. These units are rated at from 50 to 600 piv.

General Electric Co., Semiconductor Products Dept., Dept. ED, Liverpool, N.Y.

CIRCLE 144 ON READER-SERVICE CARD

Motor Alternators

Rated to 10 kva

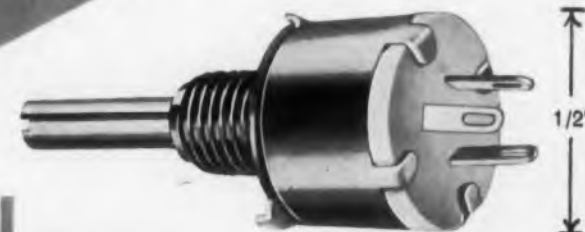
These two-bearing, common-shaft 400 cps motor alternators are rated from 500 w to 10 kva. A one-piece rotor with cast windings and a brushless design make this inductor type alternator almost maintenance free. The 10 kva unit has a power factor of 0.9 and is available with either an electronic exciter or a magnetic amplifier voltage regulator. Other inductor alternators, in four-bearing designs, rated as high as 30 kva, can be supplied.

American Electronics, Inc., Dept. ED, 1025 W. Seventh St., Los Angeles 17, Calif.

CIRCLE 145 ON READER-SERVICE CARD
CIRCLE 146 ON READER-SERVICE CARD

STABILITY & HEAT BARRIER BROKEN

with Metal-Ceramic Variable Resistor



HIGH
RELIABILITY
STABILITY
TEMPERATURE

Miniature
CERATROLS
with new metal-ceramic element

New Series 600 Characteristics:

- Infinite resolution.
- 100 ohms thru 5 megohms (linear taper) resistance range.
- 1/2" diameter; interchangeable with Style RV6 MIL-R-94B.
- Power ratings: 3/4 watt @ 85°C, 1/2 watt @ 125°C, zero load @ 175°C.

CeraTrolS' rugged, hard-surfaced metal-ceramic element, having been fired at temperatures exceeding 600°C, meets temperatures up to 500°C with high safety factors at ratings listed below.

COMPARATIVE TEST DATA: No carbonaceous variable resistors (either film or molded) can equal Series 600 performance. Ideal for critical applications requiring high stability and reliability. Far exceeds MIL-R-94B.

Tests	MIL-R-94B (Style RV6, Char. Y) Requirement	Series 600 CTS Maximum	Series 600 CTS Average
Load life 1000 hrs.			
1/2 watt @ 125°C, 350 V max.	±10% @ 70°C	±7% @ 125°C	±4% @ 125°C
3/4 watt @ 85°C			
Thermal Stability (1000 hrs. @ 175°C no load)	No test in MIL-R-94B	±5%	±3%
Temperature Co-eff.* (Room to -63°C; room to +175°C)	No test in MIL-R-94B		
25K and over		±250 PPM/°C	±150 PPM/°C
under 25K		±500 PPM/°C	±300 PPM/°C
Moisture Resistance	±6% avg. ±10% max.	±2% avg. ±4% max.	±1.3%
Low Temp. Storage	±2%	±1%	±.5%
Low Temp. Operation	±3%	±2%	±1%
Thermal Cycling	±6%	±3%	±2%
Voltage Co-efficient	No test in MIL-R-94B	±.01%/volt	±.005%/volt
Rotational Life	±10% (after 25,000 cycles)	±10%	±7.5%
Acceleration	±3%	±2%	±1%
High Freq. Vibration	±2%	±2%	±1%
Shock	±2%	±2%	±1%

* Lower temperature coefficient can be developed for specific applications.

Note Exceptional Stability. Note extent that MIL-R-94B is exceeded.

Complete Series 600 CeraTrolS electrical and mechanical specs and dimensional drawings will be sent upon request.

CTS manufactures a complete line of composition and wirewound variable resistors for military, industrial and commercial applications. CTS specialists are willing to help solve your variable resistor problems. Contact your nearest CTS office today.



Newly developed 500°C Metal-Ceramic Resistance Element is separately available for other applications than variable resistors. Because the element is very stable to 500°C, it is extremely reliable at the elevated temperatures currently demanded and anticipated in military requirements. Ceramic bases can be made in a wide variety of shapes and sizes; the metal resistance film can be made to cover an entire surface or an accurately defined pattern. Consult CTS engineers on your requirements.

BURTON BROWNE ADVERTISING

Founded  1896

Factories in Elkhart & Berne, Indiana, South Pasadena, California, Asheville, No. Carolina and Streetsville, Ontario. Sales Offices and Representatives conveniently located throughout the world.

CHICAGO TELEPHONE SUPPLY
Corporation

ELKHART • INDIANA

THE BIG LOOK



2 1/2-inch size

ACTUAL SIZE—Although they look bigger, these a-c and d-c units are actually 2 1/2- and 3 1/2-inch sizes. Mounting is interchangeable with JAN, MIL and ASA (round) specifications. Widest range of scales and face-plate colors are available.



3 1/2-inch size

General Electric small panel meters

BIG LOOK styling of General Electric's new small panel meters adds *functional beauty* to your products and equipment. Distinctive design creates the illusion of bigness, yet these new meters fit into the same panel space as old style meters. You get big border-to-border scale . . . *modern, clean-line design* . . . *your choice of seven attractive colors* . . . and widest selection of scales.

Up to 28% longer scales allow accurate readings. Tough neoprene gaskets provide *complete protection* of internal parts and movements from dirt, dust or water. Best of all, General Electric BIG LOOK meters are *competitively priced*. And you can plan on *fast delivery*, too, from a national network of authorized stocking distributors and G-E Apparatus Sales Offices.

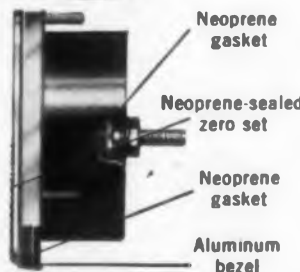
Let G.E.'s BIG LOOK in panel meters help you improve the appearance and reliability of your equipment at low cost. Get the full story. Just contact your G-E Apparatus Sales Engineer, or write for bulletin GEA-6678, Sect. 593-303, General Electric Co., Schenectady, N. Y.



SELF-SHIELDED CORE-MAGNET, used in d-c milliammeters below 5 MA and all microammeters, permits mounting of meters on magnetic or non-magnetic panels without special calibration.



ALL A-C METERS utilize moving-iron mechanisms—plus magnetic damping to settle the pointer quickly and accurately.



COMPLETELY SEALED CASES protect internal parts of instrument from harmful contaminants. Even zero-set is sealed with a neoprene O-ring.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW PRODUCTS

Wiring Ducts

Modular

This modular panel wireway system has independent top, bottom and sides for adaptability. This system eliminates wire lacing and bundling, and permits wire inspection. Constructed of flame-resistant plastic, the units can be disassembled at any time and converted to a different size.

ECP Corp., Dept. ED, 4726 Superior Ave., Cleveland 3, Ohio.

CIRCLE 147 ON READER-SERVICE CARD

Antenna Mount

Manually-controlled

Type HM-2 manually operated antenna mount is for azimuth and elevation positioning. It has a 5 in. diam mast and a heavy base for bolting to the supporting foundation. Especially designed for easy focusing and locking, the mount can be used with parabolic reflectors up to 10 ft in diameter and with helical antennas for telemetry applications.

Technical Appliance Corp., Dept. ED, Sherburne, N.Y.

CIRCLE 148 ON READER-SERVICE CARD

Relays

Impulse totalizing type

For multiunit metering of power distribution systems, these impulse totalizing relays use semiconductor devices to combine demand impulses from as many as seven sources and to retransmit them over a single output circuit. Available with capacities of 3, 5, or 7 input channels, they have a common maximum output rate of 450 impulses per min. The maximum input rate depends on the number of input channels to be totaled. The three units are available in output-impulse to input-impulse ratios of 1:1, 2:1, or 4:1. These WT relays measure 16 x 6 x 8 in.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 149 ON READER-SERVICE CARD

← CIRCLE 150 ON READER-SERVICE CARD

Accelerometers

Operate from -65 to +350 F

Models 2232 and 2235 hermetic sealed accelerometers operate in the temperature range of -65 to +350 F. Model 2235 provides a nominal sensitivity of 25 mv per g; model 2232 provides 6 mv per g. The resonant frequency for model 2232 is 50 kc and for model 2235, 40 kc. Both units offer a frequency range response of 1 cps to 10 kc $\pm 5\%$ with 1000 meg load. Nominal capacity is 1800 μf . These units weigh less than 1.1 oz and measure 0.71 in. in length x 0.61 in. diam with a 5/8 in. hex base.

Endevco Corp., Dept. ED, 161 E. California Blvd., Pasadena, Calif.

CIRCLE 151 ON READER-SERVICE CARD

Refrigerated Blower

Has 36,000 Btu capacity

The BR-36 refrigerated blower maintains a pre-set temperature within from four to six completely equipped cabinets. This unit may be pre-set from 60 to 100 F. It has a 36,000 Btu capacity, and operates from a 220 v ac source. Humidity within the cabinets is reduced to less than 50%. This blower is 66-1/2 in. high, and mounts in a standard 19 in. insulated cabinet.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood 1, Calif.

CIRCLE 152 ON READER-SERVICE CARD

Stalo Exciter-Driver

Output of 5 to 10 w

Model 86 stalo exciter-driver provides a stable frequency power source in radar systems; it may also be used as a klystron driver source. It is used where 5 to 10 w cw or pulsed rf are required over the S-Band. This unit consists of an L-Band cavity oscillator, cavity doubler to S-Band and cavity rf amplifier. The amplifier stage may be pulsed at any repetition rate. IFM is less than 150 cps throughout the frequency range.

BJ Electronics, Borg-Warner Corp., Dept. ED, 3300 Newport Boulevard, Santa Ana, Calif.

CIRCLE 153 ON READER-SERVICE CARD

CIRCLE 154 ON READER-SERVICE CARD

There is
No Substitute
for
Reliability —

miniaturized




Magnetic Modulators

All Magnetic Modulators strictly conform to MIL-T-27A. Some typical circuit applications for Magnetic Modulators are algebraic addition, subtraction, multiplying, raising to a power, controlling amplifier gains, mechanical chopper replacement in DC to fundamental frequency conversion, filtering and low signal level amplification.

FASTER RESPONSE TIME
NEGLIGIBLE HYSTERESIS
EXTREME STABILITY
(Ambient Temp. Range from -65°C to +135°C)
COMPACT SIZE
LIGHTWEIGHT
INFINITE LIFE
COMPLETE RELIABILITY

Miniaturization of the new Magnetic Modulator makes it possible to incorporate this component into wafer type structures and transistorized printed circuit assemblies without sacrificing ruggedness or reliability.

CONSULT GENERAL MAGNETICS on magnetic amplifier components for automatic flight, fire control, analog computers, guided missiles, nuclear applications, antennas, gun turrets, commercial power amplifiers and complete control systems. Call or write for Catalog B on miniature and standard components.

	 Magnetic Input Modulator	 Magnetic Input Modulator	 Magnetic Thermocouple Converter
TYPE NUMBER	IMM-436-2	IMM-436-3	MTC-435-2
Excitations Frequency—Carrier	400 cps	400 cps	400 cps
Signal Winding DC Resistance	1000 ohms $\pm 15\%$ each signal winding	1000 ohms $\pm 15\%$ each signal winding	10 ohms $\pm 15\%$
AC Excitation Volts	5.5 V. @ 400 cps	2.5 V. @ 400 cps	6 V. RMS
Input DC Signal Range	0 to $\pm 100 \mu\text{a}$.	0 to $\pm 80 \mu\text{a}$.	0 to $\pm 10 \text{mv}$.
AC Output Range	0 to 2.2V. @ 400 cps (sine wave)	0 to 1.5V. @ 400 cps (sine wave)	0 to 2.7V. @ 400 cps (sine wave)
Overall Dimensions (Inches)	27/32x27/32x1 5/16	27/32x27/32x1 3/16	1 1/4x7/8x5/8
Null Amplitude (Noise Level)	20 mv. RMS	15 mv. RMS max.	25 mv. RMS max.
Output Impedance	7000 ohms	7000 ohms	10,000 ohms
Null Drift (In terms of input signal) -65°C to +100°C	$\pm 0.5 \mu\text{a}$. max.	$\pm 0.5 \mu\text{a}$. max.	$\pm 0.1 \text{mv}$. max.
Hysteresis — % of maximum input signal	0.5% maximum	0.5% maximum	0.5% maximum
Type of Mounting	Male Stud	Female Insert	Male Stud
Maximum % Distortion in Output	25%	15%	20%
Weight Ounces	1.3 oz.	1.2 oz.	1.5 oz.



HIGH VOLTAGE OIL-INSULATED TRANSFORMERS

From electrical power to electronic power is quite a switch! Fact is that a high KVA electronic transformer needs to be a bit more sophisticated than a comparable distribution transformer. The electronic unit usually needs to be more compact ...to weigh less...to perform reliably in specific environments ...in short, to be designed for a specific *electronic* application. It takes experience to meet these needs. Not many companies have it. Electro does. We specialize in *electronic transformers*

WE BUILD



120 KV 2 A DC power supply installed at Eitel-McCullough, Inc. for klystron testing

THE BIG ONES

Opportunities for Experienced Transformer Engineers. Write to Personnel Manager

ELECTRO

high reliability transformers

ELECTRO ENGINEERING WORKS, 401 PRED A STREET, SAN LEANDRO, CALIFORNIA



CIRCLE 155 ON READER-SERVICE CARD

NEW PRODUCTS



Power Supply
Rated at 100 v dc
at 2 amp

Model ME 100-2FM fixed voltage power supply is rated at 100 v dc at 2 amp. Regulation is 0.5% for line variations and 0.1% for load changes. Ripple is 0.01%, recovery time is less than 50 μ sec, and overshoot is less than 1% of voltage setting. Required input is 105 to 125 v ac, 60 cps, single phase.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 156 ON READER-SERVICE CARD

Magnetic Shield

For cathode ray tubes

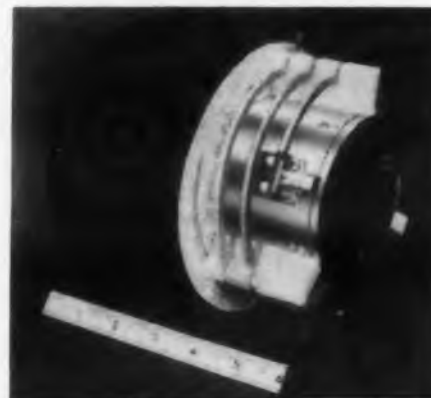
Designed for cathode ray tubes 20 in. or larger, this Netic Co-Netic magnetic shield has a shielded enclosure for electromechanically driven yoke assemblies. The enclosure prevents interference from the driven yoke assembly from affecting the performance of companion circuitry. The shield diverts stray magnetic fields by allowing them to be mounted near the tube without upsetting the display. Possible uses are in tracking systems and in radar telescope applications.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 157 ON READER-SERVICE CARD

Delay Lines

Microwave type



These S-Band helical microwave delay lines provide a time delay of 0.1 μ sec for signals in the 2.2 to 4.2 kmc range. Made of a ceramic material with a high dielectric constant, these delay lines weigh 25 oz and can replace 100 ft of coaxial cable.

Thompson Ramo Wooldridge Inc., Dept. ED, P.O. Box 90534 Airport Station, Los Angeles 45, Calif.

CIRCLE 158 ON READER-SERVICE CARD

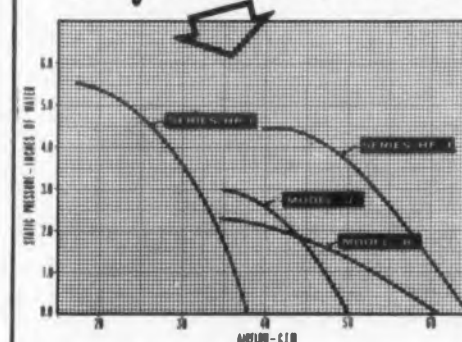
PERFORMANCE BEYOND THE STATE OF THE ART!



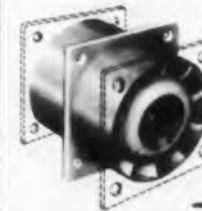
With
Dean & Bensons

POW AIR

Series HP & HF
Standard 2" Blower
Performance Rated!



- Greater operating efficiency resulting in increased performance.
- Up to 200% greater performance for new design approaches.
- Slip out AC or DC Motor allows for easy and inexpensive maintenance without replacing entire unit.
- 400 Cycle or 28 V. DC units available without design change.



Flange location
anywhere at
no additional
cost.

DEAN & BENSON

RESEARCH

Division of Benson Manufacturing Co.
Kansas City 1, Mo.

CIRCLE 159 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Diodes

High power

This line of high power, light-weight diodes includes a 35 w Zener diode and single diffused junction Zeners with voltages ranging from 8.2 to 100 v and rectifiers with 50 to 600 piv. The rectifiers have high forward conductance, forward currents up to 40 amp at 1 v, and 1 ma saturation current at rated piv. Resistant to vibration, these hermetically sealed diodes have plated copper heat sinks and provide good thermal conduction.

U.S. Semiconductor Products, Dept. ED, 3540 W. Osborn Rd., Phoenix, Ariz.

CIRCLE 160 ON READER-SERVICE CARD

Converter

Has frequency range of 50 cps to 250 kc

Model 710 ac to dc converter has $\pm 0.25\%$ accuracy over the frequency range of 50 cps to 10 kc, $\pm 0.5\%$ over the range of 30 cps to 50 kc, and $\pm 1\%$ at 250 kc. It covers an input voltage range of 1 mv to 1000 v ac, divided into six decades. For every decade range the dc output varies from 0.1 to 1 v. The input impedance has a resistive component of 2 meg shunted by 15 to 25 μf .

Ballantine Laboratories, Inc., Dept. ED, Boonton, N.J.

CIRCLE 161 ON READER-SERVICE CARD

Power Supply

Has magnetic control elements

Model RSS-1 current regulated power supply uses magnetic control elements. The current range is 3.2 to 5.1 amp dc into a 20 ohm load. Regulation is better than 2% for line variations of $\pm 10\%$ and load variation of $\pm 20\%$. Ripple is less than 1%. Input requirements are 110 v ac, 60 cps, single phase. The unit measures 19 x 7 x 15 in.

Menlo Park Engineering, Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 162 ON READER-SERVICE CARD

CIRCLE 163 ON READER-SERVICE CARD

CLEVITE SILICON JUNCTION DIODES

ACTUAL SIZE

250 MW Package . . .
Fast Switching and JAN Types
Featuring . . .

- **MECHANICAL RELIABILITY** — Rugged, hermetically sealed, subminiature packages. Designed to meet both military and commercial requirements.
- **ELECTRICAL SUPERIORITY** — Excellent high temperature operation . . . thermally stable . . . high forward conductance . . . efficient rectification.
- **JAN TYPES**—IN457, IN458 and IN459
Conforming to JAN specifications.

For details, write for Bulletin B217A-1 B217A-2

CLEVITE
TRANSISTOR PRODUCTS
241 CRESCENT ST., WALTHAM 54, MASS.
Twinbrook 4-9330

A DIVISION OF

CLEVITE

TECHNICAL DATA

Type	Max. DC Inver. Oper. Voltage	Forward Current @ Specified Voltage	Max. Inverse Current		
			@ 25°C	@ 150°C	Test Volts
IN457	60 V	20 ma @ 1.0 V	0.025 μa	5.0 μa	60 V
IN458	125 V	7 ma @ 1.0 V	0.025 μa	5.0 μa	125 V
IN459	175 V	3 ma @ 1.0 V	0.025 μa	5.0 μa	175 V
1N662	90 V	10 ma @ 1.0 V	20 μa	100 μa (@ 100°C)	50 V
1N663	90 V	100 ma @ 1.0 V	5.0 μa	50 μa (@ 100°C)	75 V
1N778	100 V	10 ma @ 1.0 V	0.5 μa	30 μa (@ 125°C)	100 V
1N779	175 V	10 ma @ 1.0 V	0.5 μa	30 μa (@ 125°C)	175 V

OTHER CLEVITE DIVISIONS:

Cleveland Graphite Bronze • Brush Instruments
Clevite Electronic Components • Clevite Harris Products
Clevite Ltd. • Clevite Ordnance • Texas Division
Clevite Research Center • Intermetall G.m.b.H.



Silicon Junction Diodes Germanium Diodes Power Transistors Solder Lug Power Transistors

NEW PRODUCTS



Servomotors

Have temperature range of -54 to $+200$ C

Model P112-001 size 10 servomotors are designed to operate at temperatures from -54 to $+200$ C. The stall torque is 0.035 oz-in. No-load speed is 3800 rpm. The unit weighs 1.45 oz.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 164 ON READER-SERVICE CARD

Permanent Magnets

High-energy type

Type V-7 permanent magnet, having a high degree of crystal orientation, has a residual induction of 12,750 gauss and a coercive force of 765 oersteds. This material is suited to applications requiring high energy-per-unit weight or volume. Typical applications include lightweight ground and airborne generators and alternators.

Indiana Steel Products Co., Dept. ED, Valparaiso, Ind.

CIRCLE 165 ON READER-SERVICE CARD

Frequency Monitor

Accuracy is 0.0035%



Model 660 frequency monitor provides low frequency measurement and control to an accuracy of 0.0035%. Direct digital readout from the in-line display unit is in cycles per second. Continuous frequency indication without blur or roll of digits is maintained with an integral memory unit. A digital to analog conversion provides an error voltage of proper sense and magnitude for frequency control with an error less than 0.005%. The unit can be adapted to monitor any frequency from 20 to 1600 cps with 5 digit resolution.

Erie-Pacific Div. of Erie Resistor Corp., Dept. ED, 12932 S. Weber Way, Hawthorne, Calif.

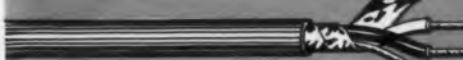
CIRCLE 166 ON READER-SERVICE CARD

Plastic Microphone and Shielded Power Supply Cables



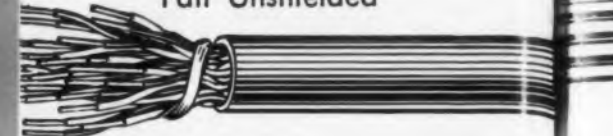
Low capacitance, lightweight, small diameter. Oil and ozone resistant. Long flex life, high tensile strength.

Shielded PA and Call System Cables



Two-conductor, twisted pair. Variety of gauges, insulations, shieldings, and jackets. Uniform quality and dimensions.

Intercom Cables—Multiple Pair Unshielded



Conductors paired with short lay twist. No crosstalk. Offers high dielectric strength, free stripping, small diameter. Vinyl jacket resists water, sun, oil, grease, and ozone.

Belden . . . the most complete Electronic Wire and

Strain Gauge Cables



100% Shielded with conductors under BELDFOIL® aluminum-mylar shield. Low capacitance, small diameter, extremely flexible. Vinyl jacket resists water, sun, oil, grease, and ozone.

*Belden Trademark, Reg. U.S. Pat. Off. Patent Pending

Unshielded Sound, Alarm System, and Speaker Extension Cables



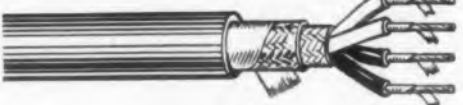
Two-conductor twisted pair. All insulations and sizes. Uniform quality and dimensions for dependable service and installation.

Special Intercom and Sound Cables



For wiring systems requiring shielded lines cabled with unshielded control lines. Wide variety of types and conductor groupings.

Rubber Microphone and Shielded Power Supply Cables



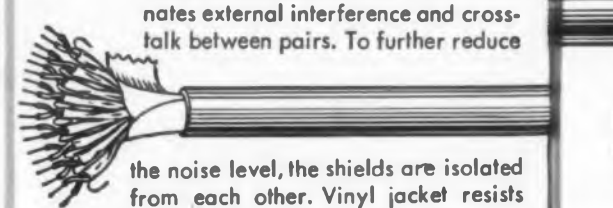
Maximum abrasion and impact resistance. Limp—lies flat on stage or studio floor. Long flex life, high tensile strength.

Shielded Sound, PA, and Intercom Cables



Variety of gauges, number of conductors, and shields for every application.

Intercom Cables—Multiple Pair Individually Shielded



BELDFOIL® aluminum-mylar tape eliminates external interference and crosstalk between pairs. To further reduce

the noise level, the shields are isolated from each other. Vinyl jacket resists water, sun, oil, grease, and ozone.

TV Camera Cables



For all color, and black and white TV transmission. Lightweight, small diameters, low friction coefficient, maximum flexibility.

Juke Box Cables



For speaker and control cables in all types of commercial music systems. Variety of shield types for every application.

Broadcast Audio Cables



Drain wire and shield isolation eliminate current loops. Free stripping jackets, fast shield termination, small diameters.

Hi-Fi, Stereo, and Phonograph Cables



Shielded connector cords and pick-up arm cables. Extremely light, flexible—small diameter. Excellent dielectric strength.

Transmission Line Cables

Variety of types and impedances for every application. Resistant to whipping, twisting, and weather; for long-lasting installations.



Antenna Rotor Cables

Vinyl insulated for optimum resistance to sun and weather. Provides longer trouble-free service.

Mil-Spec Hook-Up and Lead Wire

Exceed rigid requirements of all military specifications. Wide variety of sizes, insulations and jackets.

High-Voltage Cathode Ray Tube Lead

High dielectric strength. Small diameter with maximum flexibility.

UL Inspected Hook-Up and Lead Wires

Widest variety of sizes, insulations, and jackets for all electronic and electrical applications.

Portable Cordage and Rubber Multiple Conductor Cables

Two to five conductors for power supply, speaker lines, and unshielded control cable. Abrasion and impact resistant, limp and flexible—always lie flat. Also complete cord sets.



Precision Potentiometers

Two types available

These two types of side-actuated precision potentiometers are suitable for control surface feedbacks on missiles because of their long life and low noise characteristics when subjected to high-frequency dithering. Type 3063 has a stroke length of 2.85 in. They withstand shock, acceleration, and vibration in excess of 50 g without opening or discontinuity. Linearity is better than $\pm 0.5\%$.

Markite Products Corp., Dept. ED, 155 Waverly Place, New York 14, N.Y.

CIRCLE 167 ON READER-SERVICE CARD

Gauss-Flux Meter

Measures to 20,000 gauss

This instrument includes a gaussmeter ranging from 0 to 50 gauss through 0 to 20,000 gauss with a small generator and ranging from 0 to 200 milligauss with a field concentrator. Combined with the gaussmeter is a ballistic flux meter having a sensitivity of 500 Maxwell turns per division. The galvanometer has an 8 in. dial and a time constant of 2 sec. Zero can be shifted to either end of the dial or can be suppressed for gradient measurements.

GRH Halltest Co., Dept. ED, 157 S. Morgan Blvd., Valparaiso, Ind.

CIRCLE 168 ON READER-SERVICE CARD

Cathode Ray Tube

For hf oscilloscopes



Type K1546 cathode ray tube for high frequency oscilloscopes records single millimicrosecond transients. It has linear post-acceleration for low pattern distortion and for obtaining high deflection sensitivity. Separate pattern adjustment and astigmatism electrodes are provided for use with oscilloscope controls. Post-accelerator voltage is 24,000 v and accelerator voltage is 4000 v. The tube has a 5-1/4 in. diam.

Allen B. Du Mont Labs, Inc., Electronic Tube Div., Dept. ED, 750 Bloomfield Ave., Clifton, N.J.

CIRCLE 169 ON READER-SERVICE CARD

te line of nd Cable

RG/U Transmission Line Cables

Wide variety of RG/U sizes and types. Approved under Mil-C-178. Cables manufactured with strict adherence to government specifications.

Community and Multiple Set TV Antenna Cables

Provide clear picture reception on all multiple TV set hook-ups. Sweep tested.

These and many more
AVAILABLE from Stock

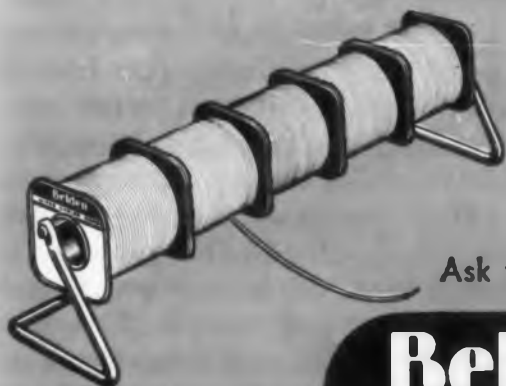
Test Prod Wire

Extremely limp and flexible. High dielectric strength. Long-life rubber jacket.

Unshielded All-purpose Sound and Intercom Cables

Solid & stranded conductors for speaker lines, unshielded control lines, and low voltage circuits of all types.

Belden Electronic Wire and Cable is available in many different packages



This handy Workbench Hook-Up Dispenser Kit is an example of how Belden's packaging program helps minimize waste . . . makes stock maintenance easy. Each kit contains an assortment of Hook-Up Wire colors and types. The dispenser is designed for workbench or wall mounting.

Ask your Belden jobber

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

One wire source for everything electronic and electrical.

magnet wire • lead wire • power supply cords • cord sets • portable cordage • electronic wire • automotive replacement wire and cable • aircraft wire • electrical household replacement cords

Belden wires, cords and cables mean the lowest over-all cost from your assembly line to field operation

8-29



Meter Relays: 2" and 3"; AC and DC



Edgewise: Vertical, DC



Wide-View: 2½", 3½", 4½"; AC and DC

These are *Simpson* panel instruments...



Round: 3", DC



Rectangular: 4", 4½", 5½", AC or DC, RF; 7" and 9", DC or RF



Front Adjust Relay: 2½", 3½", 4½"; DC. Rectangular also.

engineered and built to stay accurate...



Elapsed Time: 3½", 60-cycle AC



Fan Shape: 4½", AC or DC



Modernistic: 2½", 3½", 4½", 5½"; AC, DC, RF

available from stock or custom-built

METERS FOR EVERY NEED
Simpson
ELECTRIC COMPANY

5205 W. Kinzie St., Chicago 44, Ill.
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd., London, Ontario

CIRCLE 170 ON READER-SERVICE CARD

NEW PRODUCTS

Detector Cell

Photo-voltaic type

Silicon photo-voltaic detector cell model EA7 generates a minimum of 300 μ a into a 1000-ohm load at an illumination level of 1250 ft-c of tungsten light at 2800 K. Its response time is less than 20 μ sec. The active area is 0.13 x 0.05 in.; operating temperature is 55 C. The unit is 0.08 in. in diam and 0.5 in. long. Primary application is in computers as a punched-card or tape readout.

Hoffman Electronics Corp., Semiconductor Div., Dept. ED, 930 Pitner Ave., Evanston, Ill.

CIRCLE 171 ON READER-SERVICE CARD

DC Voltmeter

Also used as standard dc power supply



This dc voltmeter is also used as a secondary standard dc power supply. As a voltmeter the unit measures from 1 to 501 v full scale, at an absolute accuracy of 0.02%. It is also used as a null meter to provide accurate measurement of an unknown input. Null meter ranges are from 50 mv to 50 v. When used as a dc power supply, the instrument supplies 1 to 501 v at up to 20 ma. Called model 301, the unit has a stability of \pm 50 ppm for short periods, and \pm 100 ppm for long terms. It is available as a portable bench model or a 19 in. rack mount type.

Kin Tel, Div. of Cohu Electronics, Inc., Dept. ED, 5725 Kearny Villa Rd., San Diego 12, Calif.

CIRCLE 172 ON READER-SERVICE CARD

Power Controls

Have output to 2500 w

These power controls have outputs from 200 to 2500 w and sensitivity of 100 μ a for full output. They utilize magnetic gating amplifiers which drive silicon-controlled rectifiers. These units are for 60 or 400 cps systems and operate at temperatures from -55 to +100 C. They provide regulation of power to ac or dc loads, full wave single-ended output, push-pull control of ac servo motors, or reversible dc output regulation of split field series motors. Their applications are in missiles, ground support handling equipment, radar tracking systems, and industrial control systems.

Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N.Y.

CIRCLE 173 ON READER-SERVICE CARD

EA7
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on, Ill.



New
space-saving,
lightweight

differential DC amplifier

*amplifies low-level
telemetry signals
with high efficiency*

Smallest size available—only 2½" long x 1¾" square. Weighs only 8 ounces. ±10 millivolts "in"...±5 volts "out."
Excellent linearity. From null to 5 VDC output, the linearity is 0.5%. From null to 2.5 VDC, it's 0.25%.

High stability—1% of gain and null value in 5 minutes from a cold start. Unit is stable over the full environmental range, and over power input variations.

Sources floating—input, output and power sources are completely isolated from one another.

Meets MIL-E-5272A for humidity, vibration and shock. Designed with magnetic amplifier reliability.

Write for complete data.



**NETWORKS
ELECTRONIC
CORPORATION**

14806 Oxnard Street, Van Nuys, Calif.
Telephone: S**Tate** 2-3114

CIRCLE 174 ON READER-SERVICE CARD

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**NETWORKS
ELECTRONIC**
*—originators of the
glass-enclosed thermal relay
— announce
a NEW*

**LOW-CURRENT
THERMAL RELAY**

**FOR
SOLID
STATE
APPLICATIONS**

normally open type NO. M555 (Actual Size)
Maximum Dimensions: .165" dia. x .550" long

normally closed type NO. M449 (Actual Size)
Maximum Dimensions: .250" dia. x .860" long

Send for complete data.

**NETWORKS ELECTRONIC
CORPORATION**
14806 OXNARD STREET • VAN NUYS, CALIFORNIA • STATE 2-3114

CIRCLE 175 ON READER-SERVICE CARD

*—miniature size...hermetically
sealed, and 99.99% proven reliability*

Protect your costly transistors with this tiny new N.O. thermal relay, only .0125 cubic inch in volume. It fires positively at .180 amp. For higher firing currents see graph for time delays obtainable. The fuse supports .120 amp. max. continuous current without burning. Operation is based on the "fuse burnout" principle which gives wide latitude to systems designers. The N.C. type fires positively at .350 amp. and supports .230 amp. max. continuous current without burning.

Hermetically sealed in glass by NETWORKS' exclusive method of bonding metal headers to glass housings which are resistant to heat and shock. The glass provides interior visibility—a great advantage over metal or potted types.

Qualification tested in the completely equipped NETWORKS' environmental laboratories. Normally-open type is tested to withstand:

Temperature: -100°F to +400°F

Vibration: 20 to 2000 cps at 15 G's

Shock: 50 G's for 2 to 4 MS

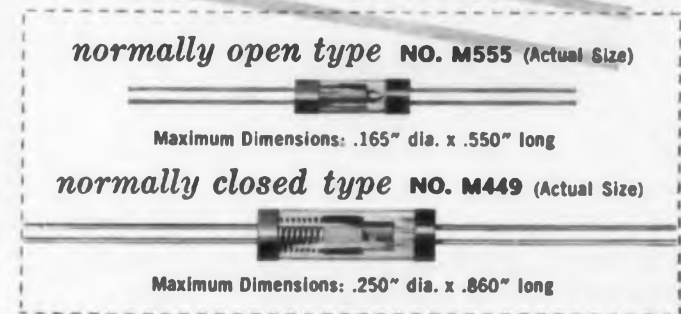
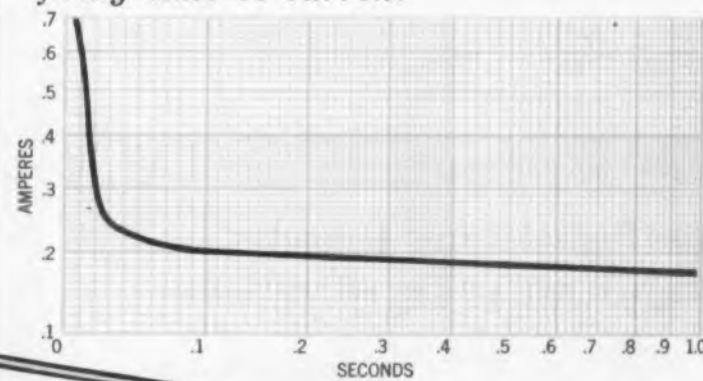
Higher ratings for Normally-closed type.

NETWORKS relays meet all pertinent Mil. Specs.

99.99% reliability. NETWORKS maintains continuous checks on daily production. If failure occurs in a lot, the entire lot is scrapped. There has been no failure in 1,000,000 delivered units.

Designed for use as a low-current sensing device, or for overload protection in guided-missile circuitry and complex electronic equipment. Used extensively to program parameters into pre-flight or flight computers.

firing time vs current



Send for complete data.

**NETWORKS ELECTRONIC
CORPORATION**

14806 OXNARD STREET • VAN NUYS, CALIFORNIA • STATE 2-3114

NEW PRODUCTS



Feed-Through Terminal Slotted-lug type

Type FT-1025 slotted-lug feed-through terminal can be simply pressed into a hole without nuts, washers, or lockwashers. It is especially suited for assemblies requiring potting or other sealed-in equipment requiring external connections.

Sealectro Corp., Dept. ED, 139 Hoyt St., Maroneck, N.Y.

CIRCLE 176 ON READER-SERVICE CARD

Digital Readout

Characters are 2 x 3 in.

In-line, in-plane digital readout has 2 x 3 in. characters. Called model SGS-103, it requires 2-1/2 in. of back panel. Multiple units may be arranged in-line, occupying 3 x 4 in. of panel space per digit. Operating voltage is 350 v, dc or ac. Eleven inputs are provided; decimal point is available. Applications include digital voltmeters and aircraft instruments.

I.D.E.A., Inc., Electronic Equipment Div., Dept. ED, 7900 Pendleton Pike, Indianapolis 26, Ind.

CIRCLE 177 ON READER-SERVICE CARD

Digital Strain Indicator

Response time is 0.4 sec per 1000 counts



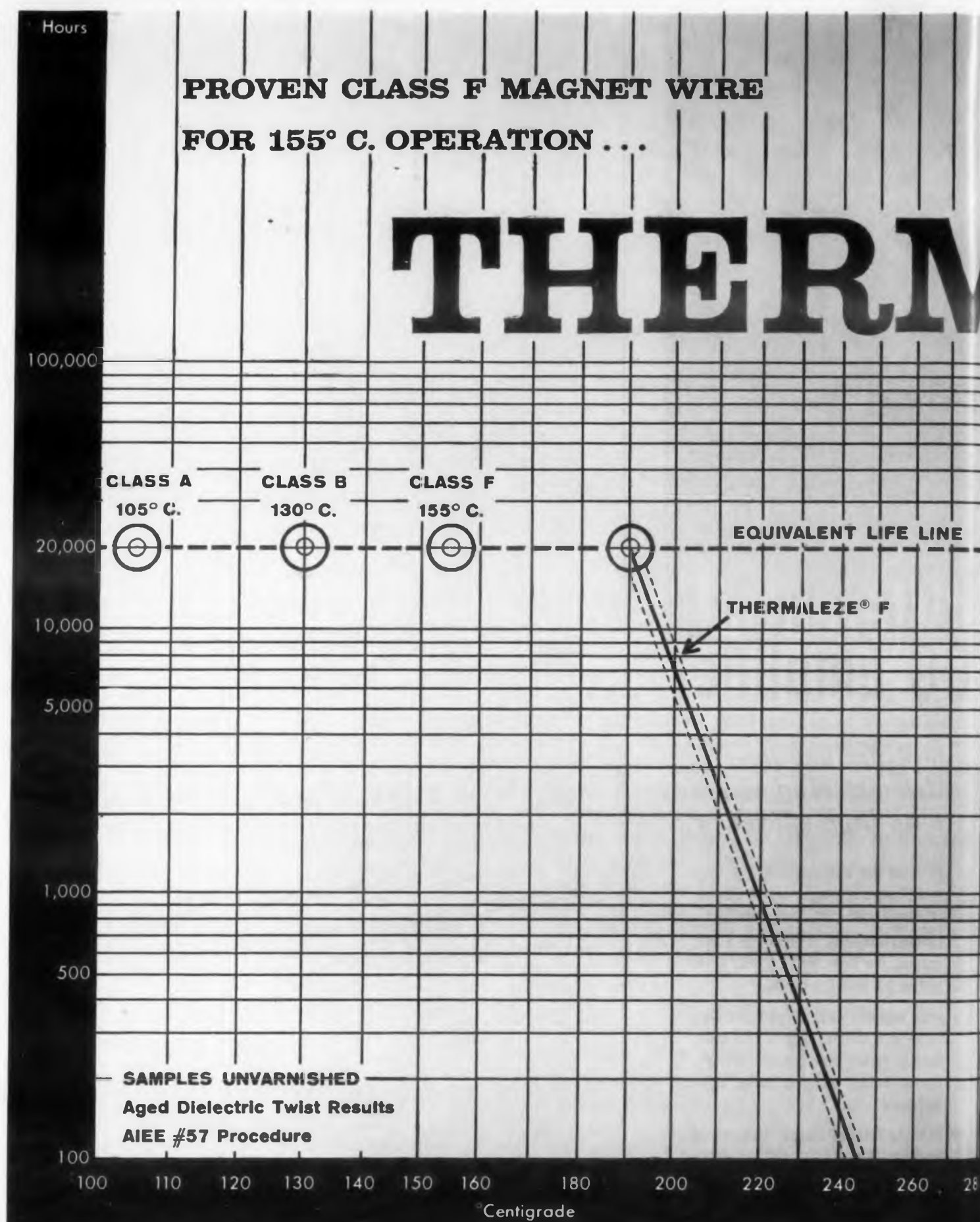
This digital strain indicator provides direct readout in any specified units and offers a response time of 0.4 sec per 1000 counts. It can also be equipped to operate printers, tape punch units, and typewriters. The instrument applies dc power to the bridge which may have 50 to 500 ohms resistance with no change in calibration or accuracy. Dual potentiometers permit the measurement of open circuit output voltage of the bridge.

Datran Electronics, Dept. ED, 1836 Rosecrans Ave., Manhattan Beach, Calif.

CIRCLE 178 ON READER-SERVICE CARD

PROVEN CLASS F MAGNET WIRE FOR 155° C. OPERATION ...

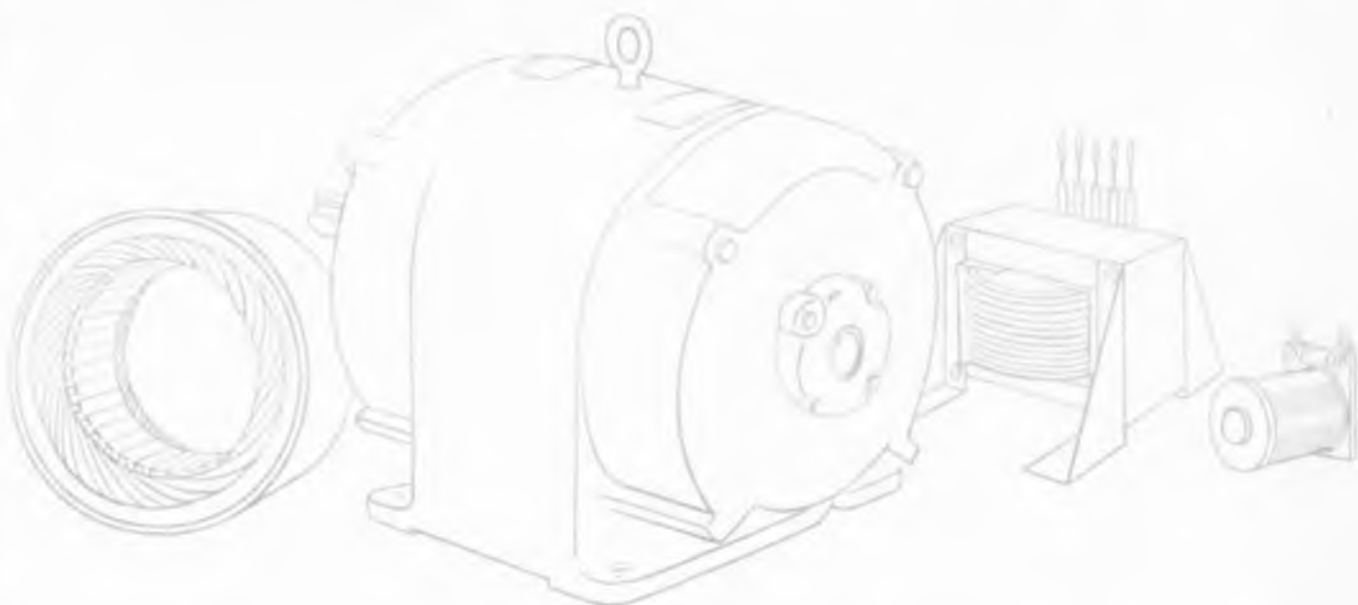
THERM



Any time your problem is magnet wire, consult Phelps Dodge for the quickest, surest answer.

Thermaleze® F 155° C.

Gives your equipment longer thermal life!



Performance proved in many practical applications!

Class F and Class B stator windings, high temperature layer or random wound coils, potted, encapsulated or impregnated.

Excellent all-around balance of thermal, physical, chemical and electrical properties—assuring stronger, better balanced, more reliable insulation systems.

Thermaleze® F—a polyester cyanurate film-insulated magnet wire is available in all sizes . . . round, square and rectangular wire.



Headset

Has frequency response of 50 to 5000 cps

This boom-mike headset features a receiver with a rising response curve at voice range for maximum intelligibility and a uniform frequency response of 50 to 5000 cps. The unit pictured here has a noise canceling dynamic microphone which meets TSO C-58. Carbon, reluctance, and crystal microphones are also available. Weighing 3.5 oz, the unit has many communications applications. It meets FAA requirements.

Telex, Inc., Dept. ED, St. Paul, Minn.

CIRCLE 180 ON READER-SERVICE CARD

Silicon Transistors

Dissipate 500 mw

The series A silicon transistors, types 2N332 through 2N336, can dissipate 500 mw at 25 C with no heat sink. They have a minimum collector-to-emitter breakdown voltage of 45 v and a minimum emitter to base breakdown voltage of 4 v. The alpha cut-off frequency rating ranges from 10 mc for type 2N332A to 15 mc for 2N336A. The transistors are npn type and are designed for amplifier applications in af and rf ranges and for general purpose switching. They are hermetically sealed in welded cases.

General Electric Co., Semiconductor Products Dept., Dept., ED, Charles Bldg., Liverpool, N.Y.

CIRCLE 181 ON READER-SERVICE CARD



Panel Enclosures

NEMA type 12

This line of NEMA type 12 panel enclosures have two Z-bar supports welded to the enclosure wall, permitting secure bolting of wired panels from the front without stud shearing or stripping. They are of all-steel construction with leakproof seams and have a neoprene door gasket. Single-door wall-mounted enclosures, as well as two-door floor-mounted types, are available in sizes from 12 x 24 x 6 in. to 72 x 72 x 12 in. to meet standard NEMA specs.

Michigan Controls Co., Dept. ED, 8790 Grinnell Ave., Detroit 13, Mich.

CIRCLE 182 ON READER-SERVICE CARD

FIRST FOR
LASTING QUALITY
—FROM MINE
TO MARKET!



PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 179 ON READER-SERVICE CARD

1959 ELECTRONIC DESIGN • October 14, 1959



2N416
2N417
2N425
2N426
2N427
2N428



specify with assurance
when you specify

INDUSTRO

alloy junction germanium

PNP TRANSISTORS

Absolute reliability has been imperative in the Polaris. The extreme reliability designed into the Polaris Missile Program requires transistors which far exceed the operating and environmental conditions of MIL-T-19500A.

Industro is proud of its contribution to the success of this vital military project.

Whether your transistor requirements are military or commercial you can depend on Industro. We invite your inquiries.

INDUSTRO

TRANSISTOR CORPORATION
35-10 36th Avenue • Long Island City 6, N. Y.
IN CANADA: CANADIAN GENERAL ELECTRIC COMPANY LIMITED

CIRCLE 183 ON READER-SERVICE CARD

NEW PRODUCTS



Cradle Relays

Weigh 1 oz

These cradle relays weigh 1 oz max and have a contact rating of 2 amp resistive, 1 amp inductive; low-level or 5 amp contacts are also available. Contact arrangements include dpdt, 4pdt, 6pstno and 6pstnc. A 6pdt arrangement is supplied in the open-type relay. Dc coil resistances range from 1.3 to 15,000 ohms. Dielectric strength is 1000 v rms; insulation resistance is 1000 meg. Operate-to-make time is 7.5 msec; release-to-break time is 3.5 msec.

Allied Control Co., Inc., Dept. ED, 2 East End Ave., New York 21, N.Y.

CIRCLE 184 ON READER-SERVICE CARD

Gaussmeter

Has range of 0 to 30,000 gauss



Model 100 gaussmeter gives readings in three scales: 0 to 300, 0 to 3000, and 0 to 30,000 gauss. Designed to measure direction and magnitude of flux density, this instrument can also be used to plot flux paths or to measure flux leakage. High-purity indium arsenide, having a temperature coefficient of 0.1%, is used as the sensing element. This element, which measures 0.019 x 0.125 in., permits insertion of the flat probe tip into narrow air gaps. The instrument will read dc flux in the presence of a strong ac field. No amplifier is used. A 4.5 v battery is built into the unit. Dimensions are 10-1/8 x 4-3/8 x 7-1/2 in. and weight is 5 lb.

F. W. Bell, Inc., Dept. ED, 975 S. High St., Columbus 6, Ohio.

CIRCLE 185 ON READER-SERVICE CARD

55

temperature & millivolt ranges



with 1 Speedomax[®] H Recorder

Yes, a single Speedomax H Recorder enables you to measure practically any temperature or millivoltage encountered in research activities. Simply pick the stocked range card and scale you need from 50 thermocouple or 5 millivolt ranges . . . substitute them in your Speedomax H Recorder . . . insert matching chart paper . . . and you're ready to record.

The specifications listed below are for the Speedomax H Strip Chart Recorder with a widely used range of 0 to 10 millivolts. For information on other ranges, contact your nearest L&N Office, or write to address below.

List No.—3-32-000-044-6-120-5 Speedomax H Model S Recorder, available for delivery in less than four weeks.

Record—Single-point continuous line.

Measuring Circuit—D-c potentiometer.

Electrical Range—0 to 10 millivolts.

Accuracy Rating—± 0.3% of span.

Dead Band—0.2% of span.

Chart Number—600006: 50 uniform divisions in 6 1/2". Chart tear-off included.

Chart Speed—120 inches per hour.

Span Step Response Time Rating—1 second nominal.

External Circuit Resistance Rating—Up to 2500 ohms for normal performance.

Current Standardization—Automatic, every 48 minutes.

Power Supply—Operates on 120v, 60~.

Optional Feature—Carrying handle and feet available. Add (-9) to List No.

Price—\$585.00 f.o.b. Philadelphia or North Wales, Pa. (subject to change without notice). Add \$12.00 to price for (-9) suffix if desired. Use List No. 3-32-000-044-6-120-5 when ordering from L&N, 4908 Stenton Ave., Phila. 44, Pa.

LEEDS NORTHROP
Instruments Automatic Controls • Furnaces

CIRCLE 186 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

CANNON PLUGS

Schweber

FOR
IMMEDIATE
LARGE
QUANTITY
DELIVERY
AT
FACTORY
PRICES

2500

Yes! You can now order up to 2500 each of such popular Cannon Connector types as Miniature D, KO, DPD, DPA, DPX, etc. Immediate shipment at factory prices.

Schweber

ELECTRONICS

50 HERRICKS ROAD, MINEOLA, L.I., N.Y.
PIONEER 6-6520 TWX G-CY-NY-580

CIRCLE 187 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

RELIABLE MULTI- PURPOSE "K" SERIES

K STANDARD



FOR AIRCRAFT, ELECTRONIC, INSTRUMENT, MILITARY, MISSILE, INDUSTRIAL AND COMMERCIAL APPLICATIONS Standard K and RK in straight and angle 90° plugs with wall mounting receptacles. Conduit and clamp entry types. 1 to 110 contacts in 250 different insert arrangements. 10, 15, 30, 40, 60, 80, 115 and 200 amp. silver plated brass on copper contacts. High quality phenolic, melamine, and formica insulators. Cadmium-plated aluminum alloy shells. Flashover voltages: 110 to 5000V, 60 cps ac rms.

KH-RKH



FOR USE UNDER CRITICAL PRESSURE AND LEAKAGE CONDITIONS—Hermetically sealed plugs with steel shells, steel contacts, and Canseal glass insulators for true hermetic sealing. Electro tin plating over cadmium plate over copper flash provides highly receptive surface for soldering and corrosion resistance.

RK



FOR FLUSH OR SEMI-FLUSH MOUNTING—Cannon RK Plug assemblies are equipped with an external threaded coupling nut which is the reverse of the standard K Series. Note: RK will mate only with RK's.

TBF-K



FOR CARRYING CIRCUITS THROUGH BULKHEADS Cannon TBF-K Bulkhead Plugs feature a double-faced construction allowing mating at both ends. Pin inserts. Single piece shell.

RLKL-LKL



FOR TV AND OTHER PANEL SWITCHING OPERATIONS—Quick connect and disconnect RLKL Plugs are designed for one-hand fast disconnect use on TV station program switching panels and similar type operations. Feature a quick coupling means. Latch-lock secures plug to mated fitting (RLKL receptacle). Thumb pressure releases it.

FW-K FWR-K



FOR OPEN FLAME PROTECTION AGAINST HIGH TEMPERATURES—Cannon K Firewall Plugs are available in straight and angle 90° shell types. Wall mounting receptacles also available. Phenolic or fireproof inserts of glass-filled materials. Crimp type contacts. Cannon originated the firewall connector and continues to be the leader in this important field.

SK-M7-21C



FOR USE IN TELEPHONE "BEEPER" AND SIMILAR APPLICATIONS—Widely used on telephone recording units known as "beepers." Adaptable for other similar applications.

K ACCESSORIES—Cannon K Series Accessories include Straight and Angle 90° Junction Shells, Dust Caps, Bonding Rings, Gland Nuts, Clamps, and Dummy Receptacles to hold and protect plugs when not in use.

Cannon has available a wide variety of other Plug designs FOR EVERY CONCEIVABLE APPLICATION...including aircraft and electronic Plugs conforming to Specification MIL-C-5015D; Unit-Plug-In Rack/Panel and Modular; Audio and Low-Level Circuit Plugs; Miniature and Sub-Miniatures; Coaxial RF Series Plugs, Printed Circuit Plugs; GM Plugs and Cannon Plug/Harness Systems: "Kwik-Term" Terminals and DC Solenoids.

FOR ADDITIONAL INFORMATION on the typical designs illustrated...other configurations for your specific applications...or the design, engineering and manufacture to your special needs...write to **Cannon Electric Company**—3208 Humboldt Street, Los Angeles 31, California. Please refer to Dept. 438

LARGEST FACILITY IN THE WORLD FOR PLUG RESEARCH-DEVELOPMENT-MANUFACTURE

**CANNON
PLUGS**

Factories in Los Angeles, Santa Ana, Salem, Toronto, London, Paris, Melbourne, and Tokyo. Distributors and Representatives in the Principal Cities of the World.

CIRCLE 188 ON READER-SERVICE CARD

NEW PRODUCTS



Power Supplies

Have 15 w output

Made for use with computing systems or strain gage apparatus, the PI series of power supplies has 15 w output with 0.1% regulation. The range of voltage available is 0 to 300 v dc. Recovery is less than 50 μ sec, ripple is 0.01%, and overshoot is less than 1% of the voltage setting. The unit is programmable over a narrow voltage range. It measures 4-1/16 x 4-7/8 x 6-1/2 in., weighs 3 lb.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 189 ON READER-SERVICE CARD

Digital Voltmeter

Compact design



Measuring 6-1/2 x 8-1/2 x 8-1/4 in. and weighing 11 lb, this digital voltmeter has no mechanical step-switches. Accuracy is within 1% of full scale on all dc ranges and is better than 2% above 20% of full scale on all ac ranges, from 50 cps to 0.6 mc. The ranges are manually set with automatic indication at 1, 10, 100, and 1000 v ac and dc. The dc polarity indication is also automatic. Other features are: mercury cell calibration, seven tubes and seven transistors, and three cold-cathode counting tubes. Internal print-out connections are available.

Communications & Control Div. of Franklin Electronics, Inc., Dept. ED, 5901 Noble Ave., Van Nuys, Calif.

CIRCLE 190 ON READER-SERVICE CARD

More engineers specify Trimpot because:

Trimpot line is complete

Bourns offers you the largest selection of leadscrew actuated potentiometers... 20 basic models—4 terminal types—three mounting methods.

Trimpot is small

Space saving size and rectangular shape permit the installation of 12 to 17 units in one square inch of panel area.

Trimpot is accurate

Multi-turn screwdriver adjustment provides 9000° of rotation... you can make and repeat the finest adjustments.

Trimpot is stable

Adjustment shaft is self-locking... settings are virtually immune to severe acceleration, vibration and shock.

Trimpot is fully tested

All instruments are 100% inspected before shipment to assure you of reliable performance.

Trimpot is proved

It is used in more military and commercial equipment than any other leadscrew actuated potentiometer.

Largest selection

Trimpot[®]

the original leadscrew-actuated potentiometer

Only Bourns Trimpot potentiometers give you these outstanding features

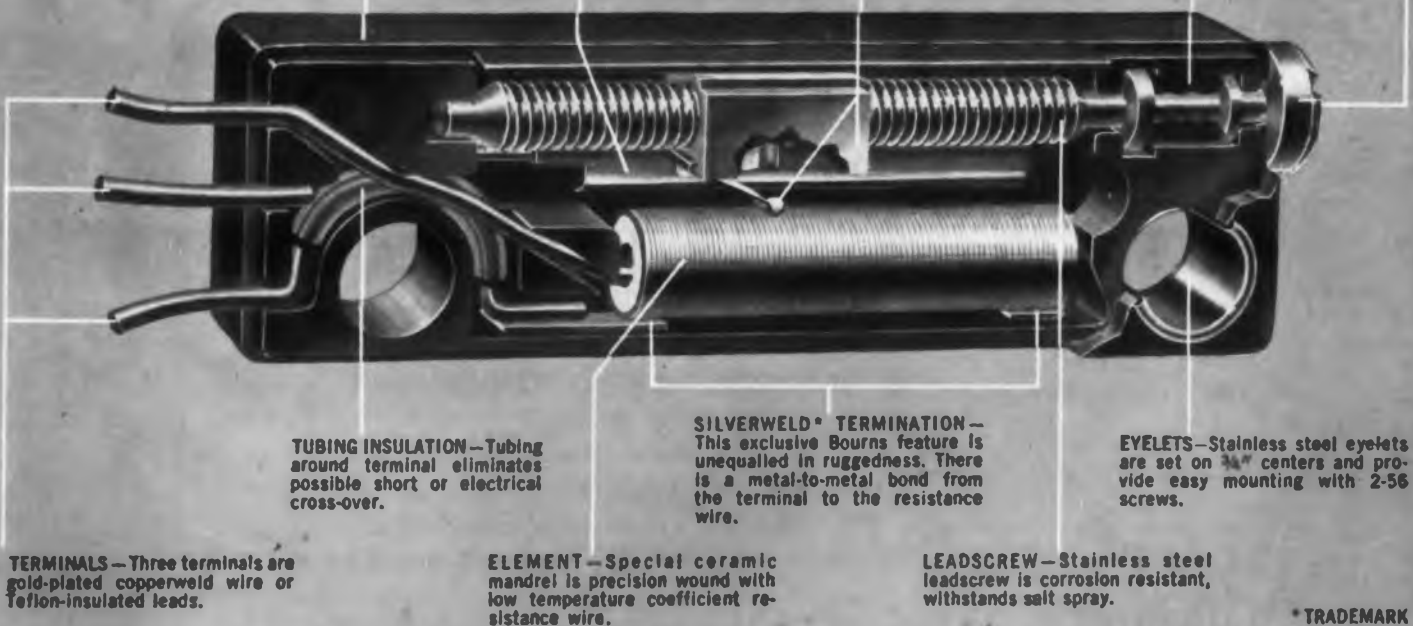
BODY—High-temperature, thermosetting plastic body is sealed, enabling potentiometer to meet Mil-Specs for humidity, sand, dust, fungus, salt spray, etc.

COLLECTOR BAR—Precious metal collector bar provides positive electrical contact, improves potentiometer performance and reliability.

WIPER CARRIAGE—Special high-temperature plastic carriage with precious metal contact spring permits exact settings and stability under severe environmental conditions.

SHAFT HEAD—Stainless steel with machined slot for screwdriver adjustment. Meets military salt spray requirements.

O-RING—Silicon rubber O-ring seals potentiometer against humidity, withstands high temperature.



TUBING INSULATION—Tubing around terminal eliminates possible short or electrical cross-over.

SILVERWELD[®] TERMINATION—This exclusive Bourns feature is unequalled in ruggedness. There is a metal-to-metal bond from the terminal to the resistance wire.

EYELETS—Stainless steel eyelets are set on 3/4" centers and provide easy mounting with 2-56 screws.

TERMINALS—Three terminals are gold-plated copperweld wire or Teflon-insulated leads.

ELEMENT—Special ceramic mandrel is precision wound with low temperature coefficient resistance wire.

LEADSCREW—Stainless steel leadscrew is corrosion resistant, withstands salt spray.

* TRADEMARK

This cutaway of Model 220 is typical of the design of all Bourns Trimpot potentiometers though some features may vary from model to model.

Longest record of reliability



General Purpose Wirewound Trimpot—Model 200. Operates at 105°C / L,S,P terminals / 1/4 watt / 10 ohms to 100K. Available as rheostat, Model 201.



High-Resistance Wirewound Hi-R[®] Trimpot—Model 207. Operates at 175°C / L terminal / 2 watts / 100 ohms to 100K. Available as rheostat, Model 208 Hi-R Trim R[®].



Dual-Element Wirewound Twinpot[®]—Model 209. Operates at 105°C / L terminal / 1/4 watt / 10 ohms to 20K. Two potentiometer outputs with one adjustment shaft.



General-Purpose Carbon Trimpot—Model 215. Operates at 125°C / L,S,P terminals / 1/4 watt / 20K to 1 Meg. Available as Mil-Spec humidity-proof unit, Model 235 (1K to 10 Meg).



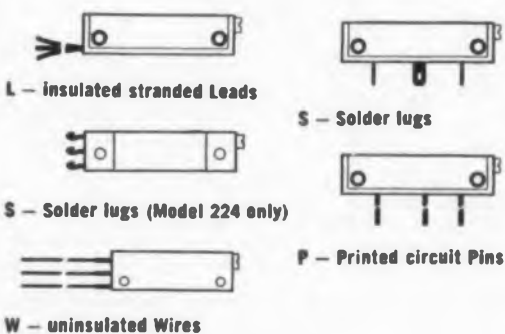
Subminiature Wirewound Trimpot—Model 220. Operates at 175°C / L & W terminals / 1 watt / 100 ohms to 20K. Meets Mil-Specs for humidity.



Panel-Mount Trimpot

All models are now available with the added convenience of panel mounting. Unique design permits quick factory attachment of rugged panel-mount assembly to standard "on-the-shelf" Trimpot potentiometers. The Panel Mount Trimpot takes as little

Key to terminals



Standard resistances (ohms)

10	50	200	1K	5K	20K	100K	500K
20	100	500	2K	10K	50K	200K	1Meg

other Resistances Available



High-Temperature, Humidity-Proof Wirewound Trimpot—Model 224. Operates at 175°C / L,S,P terminals / 1 watt / 100 ohms to 100K. Meets Mil-Specs for humidity.



Humidity-Proof Wirewound Trimpot—Model 236. Operates at 135°C / L,S,P terminals / 0.8 watt / 10 ohms to 100K. Meets Mil-Specs for humidity.



High-Temperature Wirewound Trimpot—Model 260. Operates at 175°C / L,S,P terminals / 1 watt / 10 ohms to 100K.



High-Quality Commercial Wirewound Trimit[®]—Models 271, 273, 275. Operates at 85°C / L,S,P terminals / 1/4 watt / 100 ohms to 10K.



High-Quality Commercial Carbon Trimit[®]—Models 272, 274, 276. Operates at 85°C / L,S,P terminals / 0.2 watt / 20K to 1 Meg.



Low Cost Commercial Wirewound E-Z Trim[®]—Model 277. Subminiature—1" x 17/64" x 5/16". Tapered all-purpose lug terminals / 1/2 watt / 100 ohms to 10K. For computers, test equipment, industrial control systems, etc.

as 1/12 sq. inch of panel space, meets Mil-Specs for vibration, shock, salt spray, etc. Recessed head prevents accidental changes of setting. Silicon rubber O-ring and Teflon washer provide moisture barrier.

Write for detailed specifications and list of stocking distributors.

BOURNS Inc.

P.O. Box 2112P, Riverside, California
Plants: Riverside, California
and Ames, Iowa

In Canada: Douglas Randall (Canada), Ltd., licensee

Sphere-Gap Assembly

For high-voltage measurements



Voltages up to 120,000 v may be measured at accuracies of $\pm 3\%$ with this calibrated sphere-gap assembly. Measurements are made of dc potentials and crests of ac voltages at commercial power frequencies. A current limiting resistor assembly is incorporated to minimize sphere pitting and to suppress oscillation. Spacing of the two 6.25 cm spheres is controlled by a micrometer adjustment calibrated in thousandths of an inch.

Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 192 ON READER-SERVICE CARD

Tape Search System

Transistorized

The Univac tape searchwriter searches a magnetic tape file for a desired item and automatically types the information. Transistorized, this device may also be used as an error-checking interrogator. Power supplies, read-write amplifiers, control circuits, error-checking circuits, and tape control are included. Any standard Univac characters can be entered from the keyboard or paper tape as the identifying data.

Remington Rand Univac, Dept. ED, 315 Park Ave. S., New York 10, N.Y.

CIRCLE 193 ON READER-SERVICE CARD



Pulse Modulator

Output is to 10 kw

Type BL-P-030 pulse modulator powers small magnetrons requiring inputs to 10 kw peak at a duty cycle to 0.002. Pulse widths from 0.1 to 2 μ sec can be supplied. Meters are provided for pulse voltage, average voltage, average magnetron current, and magnetron filament current. Jacks are also provided for monitoring peak pulse current, pulse voltage, and the trigger repetition rate.

Bomac Labs., Inc., Dept. ED, 1 Salem Road, Beverly, Mass.

CIRCLE 194 ON READER-SERVICE CARD

Exclusive manufacturers of TRIMPOT[®], TRIMIT[®]. Pioneers in potentiometer transducers for position, pressure and acceleration.

CIRCLE 191 ON READER-SERVICE CARD

NEW PRODUCTS



Recorder Servo type

This servo recorder has a span step response time of less than 0.5 sec on a 4.5 in. chart. Its power sensitivity is better than 10^{-17} w with 4 meg off-balance input resistance and 2.5 mv dc electrical span. A ten-speed chart drive and a high-capacity ink handling system are incorporated in the unit. The recorder function can be easily changed with plug-in input units. Models with 9.75 in. charts are also available.

Texas Instruments, Inc., Dept. ED, 3609 Buffalo Speedway, Houston 6, Tex.

CIRCLE 195 ON READER-SERVICE CARD

Connectors

For miniature coaxial cable

This compression-type connector will connect RG195U cable and No. 24 coaxial cable. The connector frames will accommodate three, five or eight inserts, snapped in from either front or back. The inserts handle up to 21 pins or sockets. A plug or receptacle insert holds male or female contacts which may be intermixed. Coaxial cable inserts and standard wire inserts may be mounted in the same frame. The pin and socket contacts are crimped to both inner and outer conductors.

Burndy Corp., Dept. ED, Norwalk, Conn.

CIRCLE 196 ON READER-SERVICE CARD

Plastic Capacitors

Have ratings to 30 kv



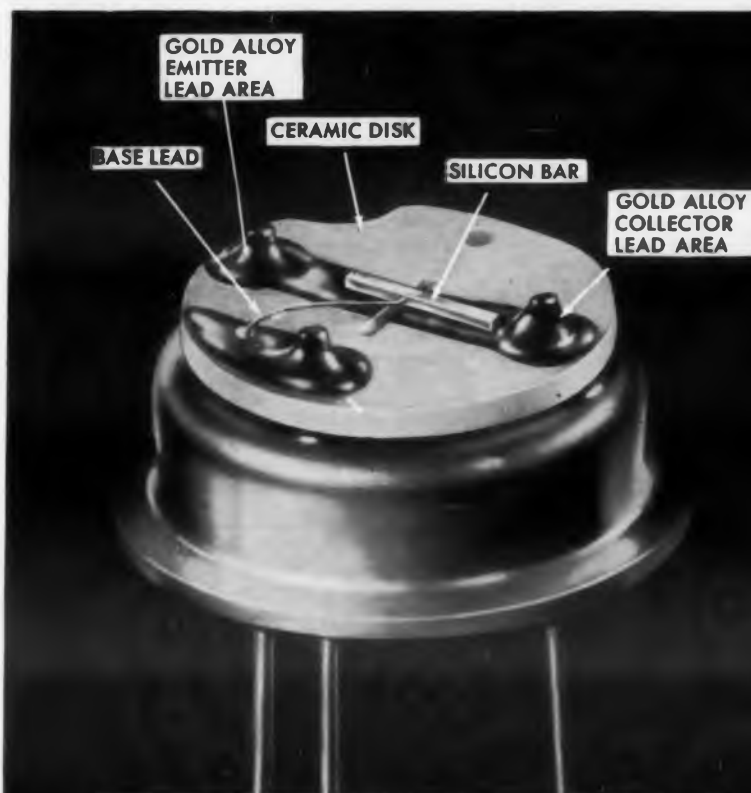
These capacitors, designated the HV series, are made of arc-resistant plastic and are available in rated voltages of 6, 10, 12, 15, 20, 25, and 30 kv. A wide range of capacities and three different terminal types can be supplied. Typical applications are in fly-back circuits.

Aerovox, Hi-Q Div., Dept. ED, Olean, N.Y.

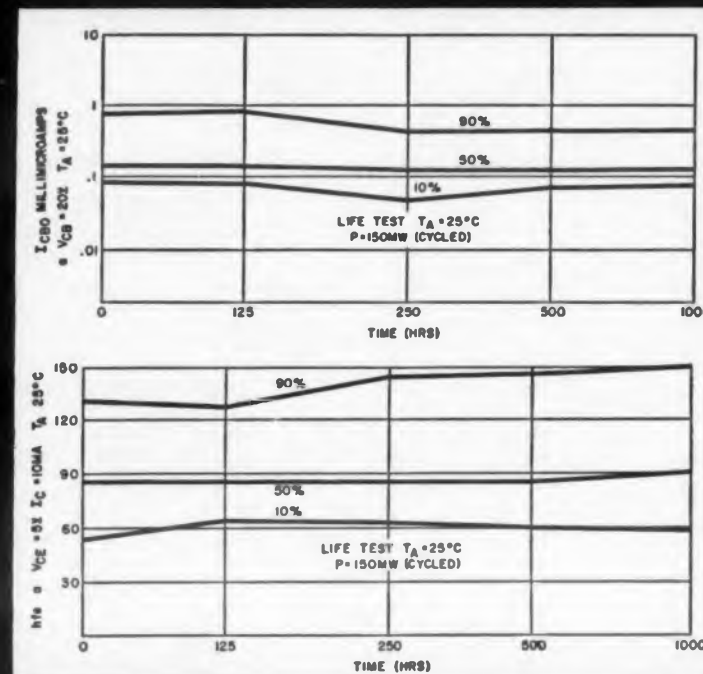
CIRCLE 197 ON READER-SERVICE CARD

General Electric Semiconductor News

New life test data prove superior



Magnified photo of silicon transistor showing Fixed Bed Construction. All parts are firmly fastened, with no suspended parts except wire lead. Transistor reacts as a solid block in resisting shock and vibration.



Charts show extreme stability of performance throughout 1000 hours of life for beta and I_{CBO} . Test conditions were 150 mw at 25°C, 200°C storage and 25 mw at 125°C. Drift rates were substantially the same under all conditions.

New NPN Tetrodes: Higher gain at high temperature and low current

LARGE QUANTITIES OF TYPES 3N36 AND 3N37 TESTED AND PROVED. HIGH RELIABILITY THE RESULT OF TWO YEARS OF MANUFACTURING EXPERIENCE*

Mechanical Reliability	Test	Results	% Survival
3-ft drop-shock (2500 G's. Mil St'd calls for 500G's)		2 out of 595 did not survive	99.66
	Temperature cycling (-55°C to 100°C)	1 out of 375 did not survive	99.78
Life Test Reliability	Cycled power @ 50 mw (device rated at 30 mw)	6 out of 500 exceeded parameter limits at 1000 hours	98.8
	Oven @ 85°C	17 out of 500 exceeded parameter limits at 1000 hours	96.8
Shelf		No parameter failures of 500 units at 1000 hours	100.0

*General Electric's rigid standards call for only a slight shift in parameters to be a "failure." Many of these "failures" are still within EIA limits.

Here are two new germanium transistors that operate on lower voltages, require less current and are more rugged (see box below) than any other transistors that perform a like function. Furthermore, they deliver a high and constant gain at various voltages and at low power dissipation levels. Therefore, they are not only useful at high temperatures, but they also simplify circuit design and eliminate the need for close voltage regulation.

Features: Maximum gain at 1 ma, 5 volts or 5 mw. Flat gain noise factor from 1 ma to 5 ma. **Where to use them:** Mobile communications (made possible the first transistorized portable receiver). Wide band amplifier, oscillator and switching applications for radar and video at frequencies to 200 mc. **Availability:** Now . . . from your General Electric Semiconductor Sales Representative and in stock at your G-E Semiconductor Distributor's.

Absolute Maximum Ratings (25°C)	2N36	2N37	
Collector voltage to base 1 or base 2 (V_{CB})	+ 7	+ 7	V
Emitter to base 1 or base 2 (V_{EB})	+ 2	+ 2	V
Collector current (I_C)	+ 20	+ 20	ma
Emitter current (I_E)	- 20	- 20	ma
Base 2 current (I_{B2})	2	2	ma
Total Power dissipation	30	30	mw

Electrical Characteristics (25°C)	2N36	2N37	
Output capacity (C_{ob})	2	1.5	μ f
Noise figure (NF)	11	11	db
Input impedance (h_{ie})	100- j 27	80- j 10	ohms
Current transfer ratio (h_{fe})	2.2 \angle -81°	1.1 \angle -100°	
Common base cutoff frequency (f_{cb})	50 MIN.	90 MIN.	mc
Common Emitter power gain (G_e)	11.5	9	db
Measurement frequency	60	150	mc

stability of G-E silicon transistors

Uniform characteristics out to 1000 hours exhibited by silicon transistors featuring Fixed Bed Construction

Comprehensive tests performed on General Electric silicon transistors show remarkably stable performance throughout 1000 hours of operation at high temperatures. Each test was run on seven lots of fifty Type 2N337 or 2N338 transistors (part of the series 2N332 through 339). These are the results:

350 units were given a 150 mw operating test at 25°C.

Only two units exceeded parameter limits, a successful performance rate of 99.4 percent.

350 units were given a 200°C storage test.

Only three units exceeded parameter limits, a successful performance rate of 99.1 percent.

Fixed Bed Construction, plus stabilized pro-

cessing makes these results possible. No fluxes, resins or solders are used — only a gold alloy which forms an integral bond between all parts.

Besides the demonstrated electrical characteristics, General Electric's silicon transistors can absorb physical punishment far beyond normal specifications. All parts are solidly fixed together and react as a solid block in resisting shock and vibration. Test units have been fired from a shotgun, struck with a golf club and rattled freely in an auto hubcap for 700 miles—and worked afterward.

Electrically and mechanically, this series of transistors is the most thoroughly tested and proved today—your assurance of high stability and reliability. Call your General Electric Semiconductor Representative for further details.

ABSOLUTE MAXIMUM RATINGS AT 25°C

	2N332-6	2N337-8	
Collector to base voltage	45	45	volts
Emitter to base voltage	1	1	volt
Collector current	25	20	ma
Collector power dissipation	150	125	mw
Operating temperature	-65°C to 175°C		-65° to 150°C

Absolute Maximum Ratings at 25°C

Collector to base voltage	20 volts
Emitter to base voltage	15 volts
Collector to emitter voltage	20 volts
Collector current	300 ma
Base current	50 ma
Emitter current	300 ma
Storage temperature	85°C to -65°C
Operating junction temperature	85°C
Power dissipation	150 mw

Now available—4 new NPN alloy transistors

Four new germanium switching transistors, made by the highly controllable NPN alloying process, are now being warehoused by General Electric and its distributors. The four transistors, Types 2N634, -5, -6 and 2N388, feature extremely consistent parameters. I_{CO} for instance, multiplies up in a normal fashion, so that higher temperature I_{CO} may be predicted from low temperature readings.

The transistors provide 150 mw power dissipation. They are useful in emitter-follower applications in computers, high current flip-flops, and are ideal as complementary devices to PNP computer transistors, such as the 2N396.

For complete information call your General Electric Semiconductor Sales Representative, your G-E Semiconductor Distributor, or write Section S23109, Semiconductor Products Dept., General Electric Company, Electronics Park, Syracuse, New York.

GENERAL ELECTRIC

Semiconductor Products Dept., Syracuse, New York

CIRCLE 198 ON READER-SERVICE CARD

Tape Readers

For punched or printed information



These tape readers are capable of reading 80, 160 or 240 bits of information simultaneously on a 1 in. frame of tape, in single-, dual- or triple-tape models. They have a 26.5 v dc bi-directional tape drive, are self-contained with storage reels to hold 250 ft of tape, and provide random or sequential access to 3000 discrete tests. Designed for programming automatic test equipment, model TP-201A, shown here, is an 80-bit reader using 2 in. tape, with 1 in. for punched information and 1 in. for printed information. It reads 10 transverse rows of 8 holes in standard teletype configuration. Contacts are rated at 0.05 amp.

Anaheim Electronics Co., Inc., Dept. ED, 1016 Raymond Way, Anaheim, Calif.

CIRCLE 199 ON READER-SERVICE CARD

Controlled Infrared Source

Temperature range is 50 to 600 C



Having a temperature range of 50 to 600 C, model PE521-4 controlled infrared source measures the sensitivity of infrared detectors and infrared systems. It can also be used as a reference standard to determine remote target temperature and emissivity or as a standard of radiant energy. The device can accommodate a thermocouple in its heated core. The radiating element is a pure silver core with a cone-shaped cavity. Radiation has a cosine distribution over a 20 deg field within 2%. The unit is supplied with a 0.5 in. diam aperture plate; other sizes are interchangeable. Power requirements are 160 w max, dimensions are 6-1/2 x 7-1/8 in., and weight is 6 lb. The source operates with PE521-5 temperature controller. Source temperature can be reset to within 0.3 deg C. The controller requires 300 w max at 115 v, 60 cps; it can also be furnished to operate at 110 v, 400 cps.

Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.

CIRCLE 200 ON READER-SERVICE CARD

NEW PRODUCTS



Single-Channel Oscilloscope

With plug-in sweep delay

Model K-120 single-channel oscilloscope has a plug-in sweep delay with 18 calibrated ranges from 2 μ sec to 1 sec per cm. The unit includes a wide-band vertical amplifier with 0.017 μ sec rise time, sweep lock-out, beam position indicators, single-knob calibrator, and sweep controls. The unit may be used in pulse applications such as radar, guidance systems, and nuclear work. In addition to the plug-in sweep delay, these plug-in pre-amplifiers are available: type 20A, dc to 20 mc, 0.05 v per cm; and type 20B, an electronic switch pre-amplifier.

Electronic Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE 201 ON READER-SERVICE CARD



Initiator

Weighs less than 0.5 lb

Weighing less than 0.5 lb, this initiator is used for missile or rocket high explosive destruct applications. It may be placed in an igniter configuration to initiate solid and liquid propellant rocket motors. The device is capable of remote arming and disarming by means of an electrical signal either carried by land lines prior to launching or by telemetry when the missile is in flight. This unit will operate at 99.85% reliability under any environmental conditions encountered by space vehicles.

McCormick Selph Associates, Dept. ED, Hollister Airport, Hollister, Calif.

CIRCLE 202 ON READER-SERVICE CARD

SILICONE NEWS from Dow Corning

NEW: "Solid-State" Fluid

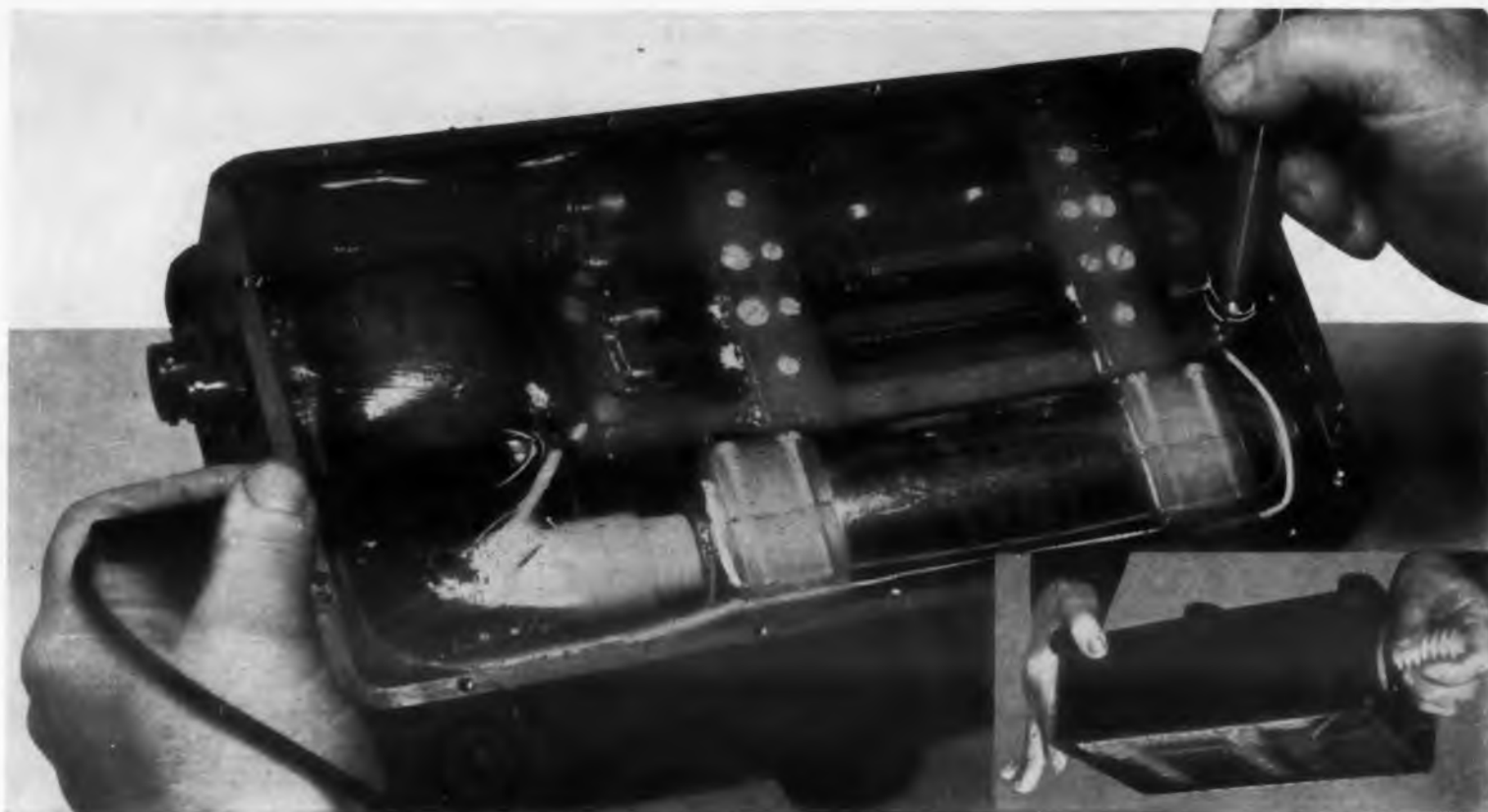


PHOTO COURTESY CBS LABORATORIES

Now: Potted Protection Plus Visual & Instrument Checking

The newest development in potting and encapsulating materials is Dow Corning Dielectric Gel. Supplied as a crystal clear fluid plus catalyst, it pours easily into assemblies and sub-assemblies, fills every void, sets up to a firm, pliable, transparent gel. The gelled mass exerts virtually no stress on components; has excellent adhesion; will not displace if vibrated or inverted. Potted components and connections are visible, probes can be inserted through it for instrument checking. When probes are removed, the gel heals itself, leaving no voids.

Here's how Dielectric Gel aids miniaturization: When designing the high voltage power supply for their new Photoscan airborne reconnaissance system, CBS Laboratories Division of Columbia Broadcasting System Inc., had to meet stringent reliability requirements despite elevated temperatures, high vibration levels, severe size and weight limitations. Their new design and miniaturization techniques were made possible by Dielectric Gel.

Requiring only 0.09 cubic feet complete, with components spaced less than $\frac{1}{4}$ " apart without danger of arcing, the new power supply provides output voltages that can be regulated from 1,000 to 25,000 volts. Current capacity at 25 kv is well over 100 microamperes. This power supply is an integral part of Photoscan, a universal visual intelligence-gathering, processing and transmitting system which can readily be installed in virtually any missile or air-borne vehicle. The units are small, light in weight, simple to install and service.

PROPERTIES OF CURED DIELECTRIC GEL

Color	Water	White
Specific Gravity at 25 C		0.970
Coefficient of Thermal Conductivity:		
(cal per cm °C sec)	150 C	0.00070
	200 C	0.00078
Electric Strength*, volts per mil		800
Dielectric Constant†	23 C	150 C
100 cps - 0.1 Mcs	3.0	2.6
Dissipation Factor†		
100 cps	0.0005	0.002
1.0 kc	0.0005	0.0005
0.1 Mcs	0.0001	0.0001
Volume Resistivity†, ohm-cm	1×10^{15}	1×10^{14}

* 60 cycles, rapid rise, 0.020 inch-spacing of 0.5 inch-diameter spherical electrodes.

† Using 54 mmfd fixed air capacitor, Cardwell type, ER-50-FS as electrodes, ASTM D150-54T and D1169-52T.

Dielectric Gel, plus CBS Laboratories packaging techniques simplify volume production problems . . . assure high voltage power supplies that are compact, reliable and easy to service.

Write for more information on Dow Corning Dielectric Gel, the new potting material that permits visual and instrument checking of potted electronic circuitry and simplifies production problems.

Your nearest Dow Corning office is the number one source for information and technical service on silicones.



CIRCLE 600 ON READER-SERVICE CARD

Dow Corning

...other silicones aid miniaturization



Light Silicone-Glass Parts Resist Heat

Where space is small, silicone-glass laminates make ideal parts. Reasons: they resist heat and humidity; are easy to fabricate into miniature components; resist creep and delamination. Silicone-glass laminates are light weight, strong, have good dimensional stability, withstand operating temperatures to 250 C, have low loss factor; permit adjacent soldering and have high resistance to moisture, ozone, arcing and corona.

In the geophysical well-logging instrument shown, Schlumberger Well Surveying Corporation specified terminal boards of silicone-glass laminate. The silicone laminate proved more reliable under operating conditions and easier to fabricate than other materials.

CIRCLE 601 ON READER-SERVICE CARD

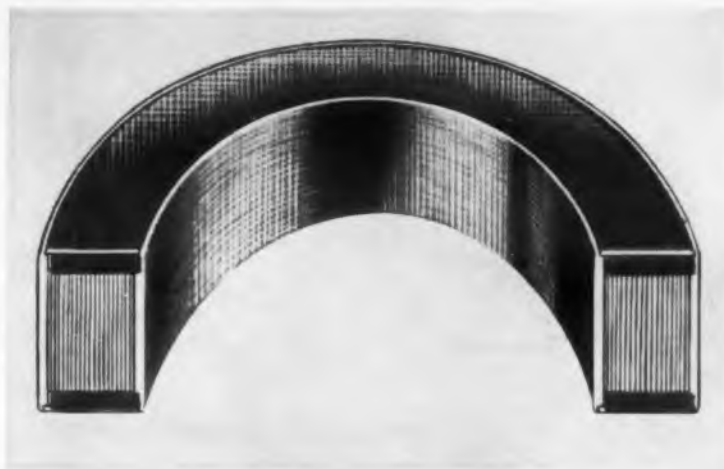
Silastic Assures Reliability Of Miniature Tube

Here's a good example of how miniaturization is aided by Silastic®, the Dow Corning silicone rubber.

A single tube from the line of Beam Switching Tubes developed by the Electronic Tube Division of Burroughs Corporation can replace as many as 90 transistors, diodes and resistors in electronic distributing, switching, and counting circuits. But proper operation and continued reliability depend upon the relationship of crossed magnetic and electrical fields . . . determined by the relative position of the glass envelope and the magnet which surrounds it. This positioning is very critical.

A cushion of Silastic assures proper alignment, bonds the glass envelope and magnet, provides greater shock resistance than any other material tested . . . contributes to the ease with which the tube meets military shock, vibration and other environmental requirements. Easily applied by simple injection techniques, Silastic is also used between magnet and tube shield.

CIRCLE 602 ON READER-SERVICE CARD

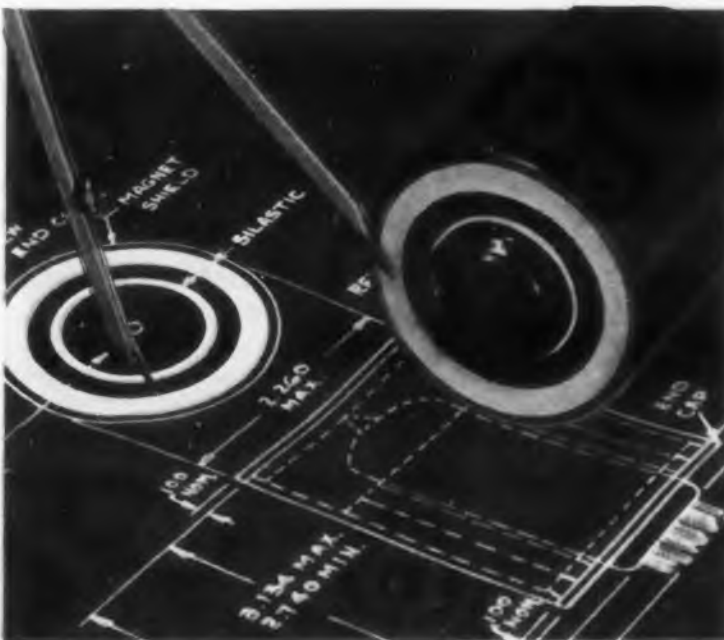


Silicone Compounds Cushion Small Cores

Tape wound toroidal cores, in both miniature and large sizes, are cushioned with silicone compounds between core and outer box by Magnetics Inc. Through the damping effects of the grease-like Dow Corning compounds, their phenolic-boxed cores are protected against vibration, shock effects and strain due to temperature change. They're "performance-guaranteed" up to 177°C.

Dow Corning silicone compounds were selected because they're inert, have high heat resistance and are easily applied. The compounds are nongumming, nonmelting, maintain a stable viscosity from -75 to 200 C. They have excellent dielectric, damping and heat-dissipation qualities, and are superior barriers to moisture. Other firms use silicone compounds for heat-sinks, sealants and similar applications, both mechanical and electrical.

CIRCLE 603 ON READER-SERVICE CARD



Optical Silicon

For use in infrared detection devices

For use in infrared surveillance and detection devices, this optical silicon is made from ingots having impurities of less than 2 parts per 100,000,000. Individual blanks for lenses, optical windows, and hollow domes with diameters to 7 in. are manufactured. More than 95% transmission of a signal of any wavelength between 1 and 6 microns is provided. The melting point is 1420 C and resistance to thermal shock is high.

Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE 203 ON READER-SERVICE CARD

Torquemeter

Has ratings from 10 to 400 lb-in.



This torquemeter provides linear deflection to any full scale torque desired within the range of 50 to 100% of the sensor maximum torque. The interchangeable sensors have maximum torque ratings from 10 to 400 lb-in. The sensor detects dynamic torque transmitted by shafts rotating at speeds up to 2400 rpm without brush contact with the rotating element. The torque is continuously displayed at the indicator with an accuracy within 2% of full-scale reading.

Rotiform Co., Dept. ED, 1509 Colorado Ave., Santa Monica, Calif.

CIRCLE 204 ON READER-SERVICE CARD

Epoxide Bobbins

Encapsulate wire-wound resistors

This series of winding forms and bobbins are used to hermetically seal wire-wound resistors. The shell is heat sealed to the bobbin, enclosing the resistor in an epoxide resin container. The thermosetting resin has good physical and electrical characteristics, high tensile strength, a dielectric constant of 3.7 at 60 cps, and a loss factor of 0.009 at 60 cps. These units have diameters from 1/8 in. and heights from 1/4 in., and withstand 150 C.

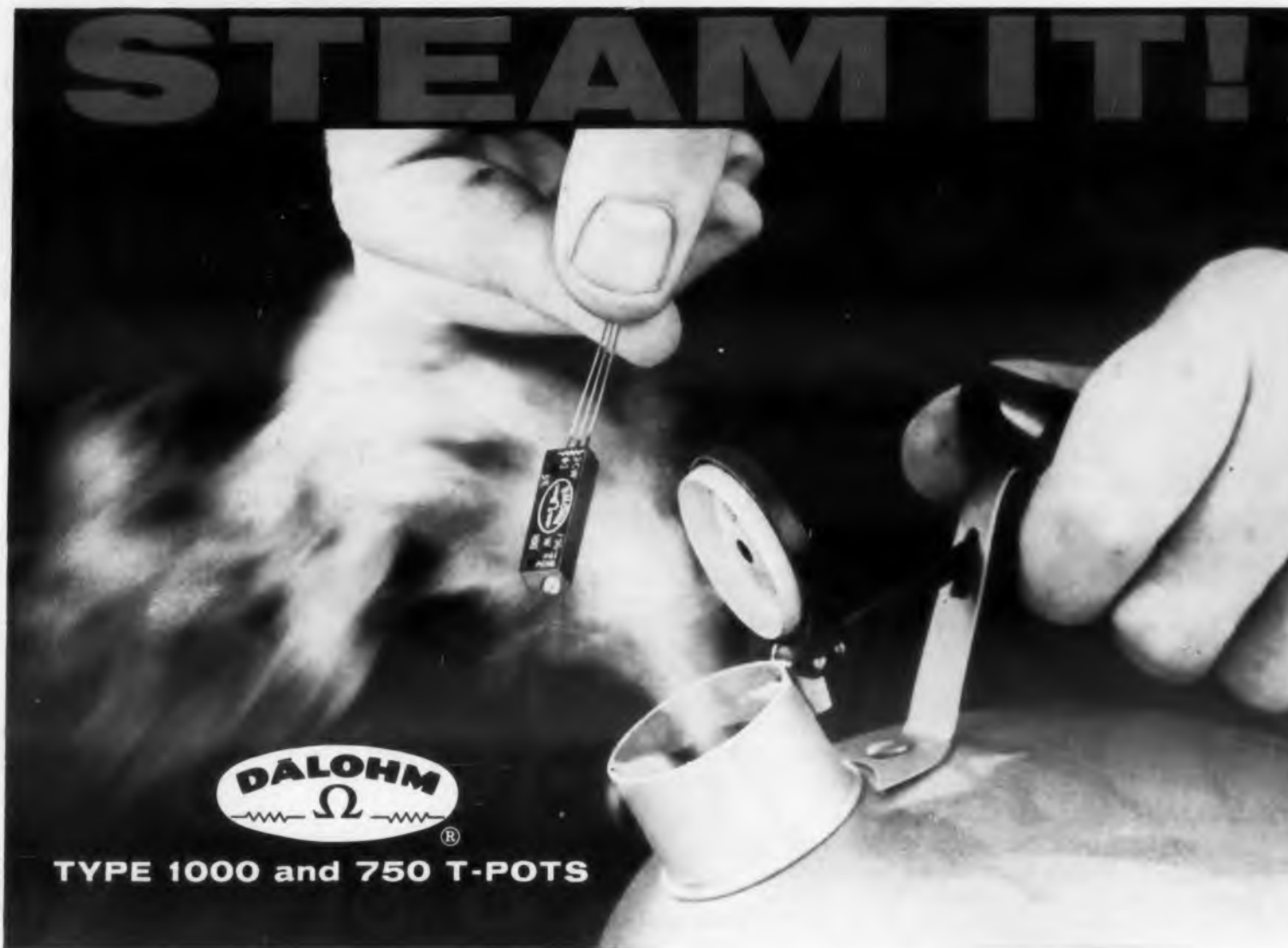
Thor Ceramics, Dept. ED, Bloomfield, N.J.

CIRCLE 205 ON READER-SERVICE CARD

DOW CORNING CORPORATION MIDLAND, MICHIGAN

branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

CIRCLE 600, 601, 602, 603 ON READER-SERVICE CARD



INHERENT STABILITY

Assured in a DALOHM 750 or 1000 Trimmer Potentiometer

The ability to perform reliably under extreme conditions of heat and humidity is only one mark of the inherent stability that is standard in Dalohm trimmer potentiometers.

Stored on the shelf for months... or placed under continuous load... operating in severe environmental, shock, vibration and humidity

conditions... Dalohm precision trimmer potentiometers retain their stability because it has been "firmly infixed" by Dalohm design and methods of manufacture.

For all applications demanding trimmer potentiometers that meet or surpass MIL specifications, you can depend on Dalohm.

WIRE WOUND • SEALED • HIGH POWER • DALOHM TYPE 750 and 1000 TRIMMER POTENTIOMETERS

Miniature and standard sizes with completely sealed cases. Three terminal configurations provide the solutions for demanding design problems.

	750	1000
Rated at ...watts	2	2.5
Resistance range	10 ohms to 30K ohms	10 ohms to 50K ohms
Standard tolerance	± 5%	± 5%
Size	.180" x .300" x 1.000"	.180" x .300" x 1.25"
Screw adjustment	17 ± 2 revolutions	25 ± 2 revolutions
Weight	.2 grams	2.5 grams

Write for Bulletins R-41A and R-44, with handy cross-reference file cards.

- Completely sealed
- Meets humidity requirements of MIL-STD-202A, Method 106A or MIL-E-5272A, Procedure 1
- End resistance is 3%, maximum
- Nominal resolution is from 0.1% to 1.2%
- Temperature coefficient is 50 PPM/° C.
- Meets load life requirements of MIL-R-19A
- Surpasses applicable paragraphs of MIL-R-12934A

SPECIAL PROBLEMS?

You can depend on DALOHM, too, for help in solving any special problem in the realm of development, engineering, design and production. Chances are you can find the answer in our standard line of precision resistors (wire wound, metal film and deposited carbon); trimmer potentiometers; resistor networks; collet-fitting knobs; and hysteresis motors. If not, just outline your specific situation.

from **DALOHM**
Better things in
smaller packages
DALE PRODUCTS, INC.
1328 28th Ave., Columbus, Nebr.

CIRCLE 206 ON READER-SERVICE CARD

NEW PRODUCTS



Time Meters

Register from 0.1 sec to 99,999 hr

For recording elapsed time in industrial or laboratory operations, type 632 time meters register from 0.1 sec to 99,999 hr. Time ranges available are seconds or tenths of seconds, minutes, tenths or hundredths of minutes, and hours, tenths or hundredths of hours. The meters are available with or without reset and have hermetically sealed cases which meet MIL-E-5272A. Motors can be specified for 115 or 220 v ac at 60, 50 or 25 cps; and in limited time ranges, for 115 v ac at 400 cps, or for any voltage from 6 to 32 v dc. The dials can be square, as shown, or round.

Cramer Controls Corp., Dept. ED, Centerbrook, Conn.

CIRCLE 207 ON READER-SERVICE CARD

Fiberglass Honeycomb

For circuit panels

Reinforced fiberglass honeycomb core may be used in the construction of strong and lightweight circuit panels. The core permits the use of very thin printed facings on the panel, simplifying the problem of solder-connecting circuitry through the facing. A 9 x 3-1/2 in. panel remains rigid under four-point suspension at temperatures ranging from -48 to +160 F.

Hexcel Products Inc., Dept. ED, 2332 Fourth St., Berkeley 10, Calif.

CIRCLE 208 ON READER-SERVICE CARD



Counter

Rate is 6,000,000 counts per min

Model 300T solid-state multiple preset counter offers a rate of 6,000,000 counts per min. The standard range is 1 to 9999; 5 to 8 digit units are also available. The unit requires 18 v dc at 0.2 amp. The standard power supply operates from 115 or 230 v at 60 cps. The dimensions are 3-1/2 x 9-1/2 x 13 in. and the weight is less than 10 lb.

Erie-Pacific Div. of Erie Resistor Corp., Dept. ED, 12932 S. Weber Way, Hawthorne, Calif.

CIRCLE 209 ON READER-SERVICE CARD

CIRCLE 210 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Potentiometer

Linear motion type

This 1/2 in. linear motion potentiometer, type C 76, has a temperature range of -65 to $+275$ F and withstands a vibration of 35 g. Its ranges are 1/8 to 12 in. and linearity is 0.5% of full range. Critical elements are isolated and oil-sealed in a high-strength alloy case. The unit meets MIL-E-5272A for sand, dust, and humidity. Designed specifically for internal installation in hydraulic actuators, the unit can be used to measure displacement of missile and aircraft actuators, and as a single or double potentiometer output.

Servonic Instruments, Inc., Dept. ED, 640 Terminal Way, Costa Mesa, Calif.

CIRCLE 211 ON READER-SERVICE CARD

Miniature Flexible Couplings

For servos and computers



Suitable for servos and computers, these flexible couplings have 0.125 in. diam and 0.245 in. length, over-all dimensions. Torque is 0.1 to 250 oz-in., side thrusts are from 1 g at 0.005 in. off-set, and twist angles are less than 0.3 deg. The bellows type couplings can provide a wall thickness as low as 0.007 in. and are used in preference to other couplings where a rigid drive between two shafts is required.

Servometer Corp., Dept. ED, 222 Main Ave., Passaic, N.J.

CIRCLE 212 ON READER-SERVICE CARD

Resistor Standards

Two lines available

These two lines of resistor standards are available: reference resistors in values of 100, 1000, 10,000, 100,000, 1,000,000 and 10,000,000 meg certified within 1% and laboratory standard resistors in values of 10, 100, 1000, 10,000 and 100,000 meg certified within 0.2%. Each unit is aged and has less than -0.2% drift during the first year. Voltage coefficient is about -0.0001% . Temperature coefficient for the low megohm units is about 20 ppm per deg C and for the high megohm units is about -0.2% per deg F.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 213 ON READER-SERVICE CARD

CIRCLE 210 ON READER-SERVICE CARD

Optional Chopper Stabilization



Chopper Stabilization Unit Only,
Installed or in Kit Form . . . \$75

ONLY[®] REGATRON PROGRAMMABLE POWER SUPPLIES HAVE IT!

0.01% or 0.003 V from no load to full load . . . this is the conservative regulation specification for Regatron Programmable Power Supplies equipped with chopper stabilization. And just as important, chopper stabilization assures a higher order of regulation and stability at every output voltage, even at fractions of one volt.

There are other advantages too: Chopper stabilization provides for exceptionally high repeatability of voltage control settings . . . enhances

remote control operation.

And chopper stabilization can be specified at any time. The compact plug-in unit can be installed at the factory as an original accessory, or it can be installed in the field. A complete kit is available for field installations. Instructions and all hardware are included.

Ask your local E/M representative for more information, or write . . .

• REGISTERED U.S. PATENT OFFICE. PATENTS ISSUED AND PENDING.



ELECTRONIC
MEASUREMENTS
COMPANY, INCORPORATED
EATONTOWN • NEW JERSEY

CIRCLE 214 ON READER-SERVICE CARD



Tiny Living Heat Exchangers. Some species of deep sea fish have countercurrent bundles of blood vessels (rete mirabile, shown twice actual size) so efficient that if boiling water and ice water were counterflowing in them, heat transfer would be complete to 1/10,000 of a degree!



Miniature Pressure Transducer for airborne instrumentation, 1" long, 1" O.D., withstands accelerations in 3 planes up to 40g with error less than 1%. Utilizing low-torque characteristics, 2 MPB bearings provide capacity, life and maintain exacting precision of a sensitive linkage.



Man With Miracles. This is Harry Marschausen, one of MPB's Sales Engineers. Through men like him, MPB's extensive engineering experience and design consultation are readily available to all industry. When your application requires a miracle in miniaturization, call in your MPB man.

Miracles in Miniaturization Continue



ACTUAL SIZE OF THE BEARINGS
IN PRESSURE SWITCH SHOWN ABOVE

Man is making fabulous progress in his ceaseless fight against friction and inertia. Today's machines operate at fantastic speeds and accelerations . . . on earth . . . in the sky . . . and beyond. But space for components daily becomes more precious and while bearings used in these machines must have tremendous stamina, many of them must be almost un-

believably compact. MPB makes over 500 types and sizes of such bearings ranging down to 1/10" O.D. Send for illustrated catalog describing them. Special bearings supplied when necessary. Design assistance at your request. Write **Miniature Precision Bearings, Inc.**, 910 Precision Park, Keene, N. H.

CIRCLE 215 ON READER-SERVICE CARD

MINIATURE PRECISION

MPB
BEARINGS, INC.

Helps you perform miracles
in miniaturization

NEW PRODUCTS



Clock
Has increments of
0.02 sec

This 24 hr clock, model 4000, has increments of 0.02 sec. A 12 v dc high-speed, push-button-actuated motor allows for presetting of hours and minutes. Seconds are set by a manual reset knob. Since low torque is required to drive the clock, the timing motor may be miniature type. The numbers are 3/8 in. high and may be black on white or white on black; fluorescent numbers may also be provided. Model 4500, also available, has a 12 hr drum.

Haydon Instrument Co., Dept. ED, Waterbury, Conn.

CIRCLE 216 ON READER-SERVICE CARD

Circuit Board

Measures 9.5 x 12.5 x 1 in.

Model 23 circuit board measures 9.5 x 12.5 x 1 in. and contains 108 contact cells arranged in 9 rows, 12 columns. The 0.25 in. cells consist of gold-plated eyelets and rubber cores. Spacing between cells is 1 in., center to center. The board is made of cellulose-filled phenolic.

Plastic Associates, Dept. ED, 185 Mountain Rd., Laguna Beach, Calif.

CIRCLE 217 ON READER-SERVICE CARD



Servomotor
Size 15

Type T1311-22 size 15 inertial damped servomotor operates in the temperature range of -54 to +200 C. No-load speed is 4500 rpm, stall torque is 1.45 oz-in., and weight is 12 oz. The unit consists of a standard servomotor and a drag cup integral with a rear shaft extension.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 218 ON READER-SERVICE CARD

Sequence Controller

Switches from 2 to 12 circuits

This controller switches from 2 to 12 circuits in a predetermined sequence, repeating the sequence as long as actuating pulses are fed into it. Designated model SC 500, it takes one step in the switching sequence for each energizing pulse, but it can be supplied to take two or more steps. Switch contacts are pilot duty, 3 amp at 115 v ac.

Warco Industries, Inc., Dept. ED, 6625 Delmar Blvd., St. Louis 3, Mo.

CIRCLE 219 ON READER-SERVICE CARD

Oscillogram Scanner

Has two-foot viewing area



Oscillogram scanner model S-2 is a self-contained, electrically driven record transport system with a backlighted viewing area two feet wide. The drive system consists of two independent rollers, each containing a variable speed assembly. The record speed can be varied from 0 to 100 ft per min. A transparent cursor is mounted on a horizontal bar for direct editing purposes. This instrument requires 110 v, 60 cps, 250 w of input power; record widths may be 0 to 12 or 0 to 16 in.

Gerber Scientific Instrument Co., Dept. ED, 89 Spruce St., Hartford 1, Conn.

CIRCLE 220 ON READER-SERVICE CARD

Tantalum Capacitors

Liquid electrolyte type

These liquid electrolyte tantalum capacitors, types CL-15, CL-39, CL-40, and CL-43 have ratings of 150 μ f at 30 v and 50 μ f at 90 v. Their operating temperature range is -55 to $+125$ C. The units are hermetically sealed, and will meet test requirements for salt spray, shock, vibration, moisture resistance, and reduced pressure. They conform to applicable parts of MIL-C-3965B. Cases are 7/8 in. in diam.

The Magnavox Co., Dept. ED, Fort Wayne, Ind.

CIRCLE 221 ON READER-SERVICE CARD

the extraordinary molded carbon potentiometer CLAROSTAT SERIES 53

Used and proved superior in tens of thousands of installations, the Clarostat Series 53 molded carbon potentiometer is now available in quantity schedules to meet any production requirement.

The extraordinary performance and reliability of the Series 53 result from a Clarostat-conceived design that eliminates all metal-to-

metal movable contacts, reducing noise, wear, and backlash.

For any application requiring the inherent superiorities of the molded carbon potentiometer, check the extraordinary features of the Clarostat Series 53 before settling for the ordinary...

- * Pre-molded and pre-selected resistance element.
- * One-piece carbon contact with simultaneous contact on resistance element and collector terminal.
- * Zero backlash. Maximum stability
- * Gold-plated terminals for easiest soldering.
- * Grease seal around shaft.
- * Terminals molded in element and control base.
- * Full 2-watt rating at 70°C.
- * Available in completely encapsulated units for maximum environmental protection.



SPECIFICATIONS

POWER RATING: 2-watts at 70°C

RESISTANCE RANGE: Linear—50 to 10 meg. Tapered—250 to 5 meg. (Right or left-hand)

INSULATION BREAKDOWN: Between terminals and ground for 1 minute, 1000 v.d.c.

SWITCHES: SPST, SPDT, DPST

TORQUE: 1 to 6 oz. in. Up to 20 oz. in. with jam nut bushing

EFFECTIVE ROTATION: $312^\circ \pm 3^\circ$

CONSTRUCTION: Meeting requirements of MIL-R-94 where applicable.



CLAROSTAT MFG. CO., INC.

DOVER, NEW HAMPSHIRE

In Canada:

CANADIAN MARCONI CO., LTD., TORONTO 17, ONT.

direct
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IMMEDIATE
DELIVERY!

Phone your local Clarostat Industrial Distributor for popular, standard Series 53 or military style RV-4 units...for fast delivery from local stock.

CIRCLE 222 ON READER-SERVICE CARD

THOMAS A.

EDISON

Time Delay Relay assures sharp, clear aerial photos... automatically



The F8U-1P Crusader recently set new coast to coast speed record. CAI camera control system with Edison Time Delay Relay was used to automatically provide sharp, clear aerial photographs of the entire flight.

HERE'S WHAT A CUSTOMER SAYS ABOUT EDISON TIME DELAY RELAY...

"The CAX-12 servo power unit is a very vital part of the intricate 'brain' of the automatic camera control system, and naturally, we must have absolute reliability in all components. Therefore, as you know, we have relied on Edison Thermal Time Delay Relays since the original design of this CAX-12 and similar units. Since space for this type of equipment is at a premium, the compact size was a most important factor in original selection, but our units must also withstand severe environmental testing, involving vibration, moisture, shock, pressure fluctuation and extremes of temperature. Needless to say, the Edison Relay met all of these exacting requirements in our laboratories, and we've been specifying Edison ever since!"

(The above letter was received from Chicago Aerial Industries)



Edison's Thermal Time Delay Relay being inserted in the CAX-12 servo power unit.

Chicago Aerial Industries has developed a camera control system that allows one jet pilot to do the job of ten expert aerial photographers... automatically.

Heart of this new unit is the CAX-12 servo power unit. It accurately synchronizes film speed with speed of the jet — changes lens openings in response to electronic signals — regulates shutter speed and controls driving motor on cameras.

Because this power unit is vital to the camera control system component reliability is a must. That's why CAI relies on

Edison Thermal Time Relays exclusively for CAX-12.

Edison's line of miniature time delay relays are available for a wide range of electronic applications. They are light, small, rugged and offer these advantages:

- Designed to withstand vibration frequencies to 500 CPS
- Exceptionally high rate of contact closure
- Permanent calibration and hermetic seal
- Extremely rigid mechanical structure using high-strength, high-expansion alloys.

Thomas A. Edison Industries INSTRUMENT DIVISION

55 LAKESIDE AVENUE, WEST ORANGE, N. J.



CIRCLE 226 ON READER-SERVICE CARD

NEW PRODUCTS

Test Chamber

Has two doors

Series FB-30 high and low temperature test chamber has two full opening doors opposite each other. Equipment can be on test and observed through the 24 x 24 in. viewing window provided in each door. Possible applications include volume production testing techniques. Capacity is 30 cu ft.

Conrad, Inc., Dept. ED, 141 Jefferson St., Holland, Mich.

CIRCLE 223 ON READER-SERVICE CARD

Silicon Rectifier

Delivers 300 ma dc

Type S-5130 continuous duty silicon rectifier delivers 300 ma dc at 10,400 piv with a resistive inductive load. Maximum peak current is 3000 ma and maximum dc current is 300 ma. The unit operates at temperatures to 100 C. Impregnated housing insures against shock. The unit replaces type 866 mercury vapor rectifier tubes.

Sarkes Tarzian, Inc., Rectifier Div., Dept. ED, 415 N. College Ave., Bloomington, Ind.

CIRCLE 224 ON READER-SERVICE CARD

Power Supply

Portable, transistorized

Model P-100-1 portable power supply is completely transistorized and provides a continuously variable output over two ranges, 0 to 50 v dc at 0 to 2 amp, and 0 to 100 v dc at 0 to 1 amp. Voltage regulation is 0.1% for both line and load variations. Output is floating and incorporates remote load change sensing. Ripple is 1 mv rms max, recovery is 50 µsec max, overshoot is less than 1% of the voltage setting. The unit measures 7-1/4 x 11-1/4 x 12 in.

Mid-Eastern Electronics, Inc. Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 225 ON READER-SERVICE CARD

Selenium Rectifiers

Are rated at 45 and 26 v

Model 45 selenium rectifier is rated at 45 v, with NEMA current densities of 0.32 amp per in². It is available in cell sizes up to 2 in. sq. Rated at 26 v, with NEMA current densities of 0.64 amp per in², model 2X is available in all cell sizes.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Clifton, N.J.

CIRCLE 227 ON READER-SERVICE CARD

Transfer Switch

Doubles heating output stations

This transfer switch converts a single or two-position output induction heating generator into a dual output system. Changeover time for tooling is eliminated because the fixtures and coils can be left set up and ready for use. The switch is for use with work stations equipped with output transformers.

Induction Heating Corp., Dept. ED, 181 Wythe Ave., Brooklyn 11, N.Y.

CIRCLE 228 ON READER-SERVICE CARD

Telemetry Package

Compact design

This compact fm-fm telemetry package is designed for airborne use in small missile systems. The unit includes a 20 v, 60 ma power supply, ten subcarrier oscillators, a mixer-amplifier, and a 2 w transmitter, the only non-transistorized circuit. The unit is a 10 channel, go/no-go type.

The Martin Co., Orlando Div., Dept. ED, Orlando, Fla.

CIRCLE 229 ON READER-SERVICE CARD

Precision Potentiometer

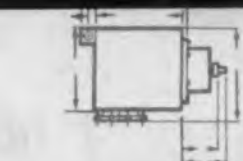
Resolution is 0.1% at 50 K

This 7/8 in. precision potentiometer has less than 0.1% resolution at 50 K and has $\pm 3\%$ linearity. It is available in resistance ranges from 100 to 500,000 ohms. Rated at 3 w, it operates from -55 to $+165$ C. The noise level remains low over rated life of 1000 hr at 2.5 w.

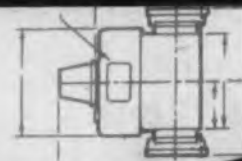
Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville, Mass.

CIRCLE 230 ON READER-SERVICE CARD

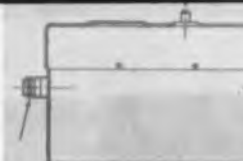
CIRCLE 231 ON READER-SERVICE CARD



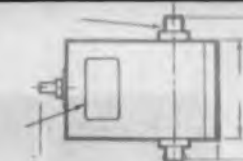
Type: Waveguide termination tolerance cavity
Frequency Range: 5925-6425 mc
Loaded Q: 1000-1400
Frequency Resolution: Can be set to $\pm 0.05\%$
Accuracy at 70°F: $\pm 0.05\%$ at 70°F
Stability: $\pm 0.1\%$ over temperature range of 70°F $\pm 70^\circ$ F
RF Connectors: RETMA or UG 344, U
Construction: Invar cavity and tuning elements
Mode: TE₁₁₁



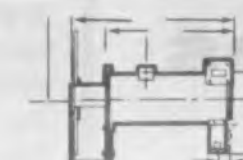
Frequency Range: 8.5-9.6 kmc
Bandwidth at 3 db points: 9 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 3 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1 (screwdriver control)
Mode: TE₁₁₁



Frequency Range: 1200-1400 mc
Bandwidth at 3 db points: 8-10 mc
Bandwidth at 35 db points: 30 mc max
Insertion Loss: 2 db max
Input VSWR (with matched load): 1.5:1 max
Number of Resonant Sections: 3
Number of Tuning Controls: 1
Mode: TEM A, 4
Calibration: Can be furnished with counter dial



Frequency Range: 2700-2950 mc
Bandwidth at 3 db points: 5 mc min
Bandwidth at 35 db points: 40 mc max
Insertion Loss: 3 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1 (screwdriver adjustment or counter dial)
Mode: TEM A, 4



Type: Absorption type frequency meter with crystal detector
Frequency Range: 5.3-9.7 kmc
Loaded Q: 5000 min
Absorption Dip: Approximately 1 db
Calibration: Direct reading spiral dial, 1 mc
Frequency Resolution: min of 1.32 mc
Accuracy at 70°F: $\pm 0.1\%$



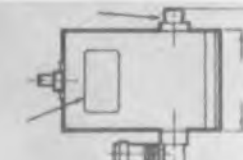
Frequency Range: 10,000-10,800 mc
Bandwidth at 3 db points: 9 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 3 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₁₁₁



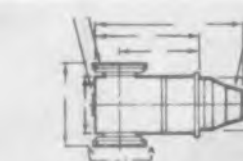
Frequency Range: 5.5-11.5 mc
Bandwidth at 3 db points: 60 mc max
Bandwidth at 35 db points: 1.5 max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TEM A, 4



Type: Panel mounted frequency meter and crystal detector
Frequency Range: 7.3-25 kmc
Loaded Q: 1000 min
Calibration: Micrometer versus frequency
Frequency Resolution: 78 kc, variable dial, low and high end
Accuracy at 70°F: $\pm 0.1\%$



Frequency Range: 2700-2950 mc
Bandwidth at 3 db points: 5 mc min
Bandwidth at 35 db points: 40 mc max
Insertion Loss: 3 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1 (screwdriver adjustment)
Mode: TEM A, 4



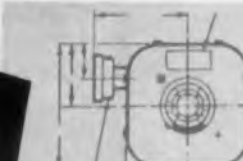
Type: Transmission type cavity
Frequency Range: 7100-8500 mc
Loaded Q: 1500 ± 500
Transmission Loss: 0.01-0.02
Calibration: Counter dial versus frequency
Accuracy at 70°F: ± 1 mc
Stability: ± 2 mc over temperature range of 70°F $\pm 70^\circ$ F
RF Connectors: UG 5: U



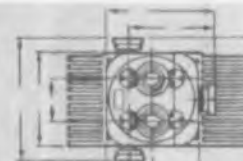
Frequency Range: 7.0-17.5 kmc
Bandwidth at 3 db points: 9 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 2 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TE₁₁₁



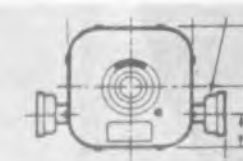
Frequency Range: 5.5-11.5 mc
Bandwidth at 3 db points: 19 mc min
Bandwidth at 35 db points: 1.5 max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TEM A, 4



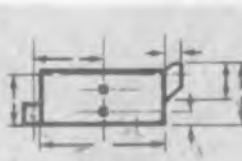
Frequency Range: 11.4-17.5 kmc
Bandwidth at 3 db points: 9 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 2 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TE₁₁₁



Frequency Range: 7.5-8.5 kmc
Bandwidth at 3 db points: 10 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 1 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 3
Number of Tuning Controls: 1 per channel
Mode: TEM A, 4



Frequency Range: 10.8-11.6 kmc
Bandwidth at 3 db points: 9 mc min
Bandwidth at 35 db points: 35 mc max
Insertion Loss: 3 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TE₁₁₁



Frequency Range: 2700-2950 mc
Bandwidth at 3 db points: 10 mc ± 2 mc
Bandwidth at 35 db points: 120 mc max
Insertion Loss: 2.5 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 2
Number of Tuning Controls: 1
Mode: TEM A, 2
RF Connectors: 33-135 microdot



Frequency Range: 5350-5805 mc
Bandwidth at 3 db points: 19 mc min
Bandwidth at 35 db points: 1.5 max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 4
Number of Tuning Controls: 1
Mode: TEM A, 4



Frequency Range: 2.5-3.7 kmc
Bandwidth at 3 db points: 3.00 mc min
Bandwidth at 35 db points: 30 mc max
Insertion Loss: 3.5 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 3
Number of Tuning Controls: 1 (screwdriver adjustment)



Frequency Range: 2.5-3.7 kmc
Bandwidth at 3 db points: 3.00 mc min
Bandwidth at 35 db points: 30 mc max
Insertion Loss: 3.5 db max
Input VSWR (with matched load): 1.5 max
Number of Resonant Sections: 3
Number of Tuning Controls: 1 (screwdriver adjustment)

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Ward William & Company, Advertising

* over 400 microwave frequency meter or filter designs

With hundreds to choose from, you can select the microwave frequency meter or tunable band pass filter to meet your exact requirement. If the unit you need is not already in stock, it can be produced readily by modifying one of the Frequency Standards meters or filters now available. This means both minimum lead time and development costs.

Send your technical requirement for a prompt analysis or meet with our staff to discuss your specific problem.

Literature on Standard Products Available on Request

FREQUENCY STANDARDS

Division of Harvard Industries, Inc. Box 504, Asbury Park, New Jersey
Phone: PRospect 4-0500 TWX A PK 588

major advance in miniaturization:
SUPRAMICA® 555
commutator plates



360 rectangular contact
 2-pole commutator plate of
 SUPRAMICA 555 ceramoplastic

on a 3 inch precision-molded plate
 ... up to **540 rectangular contacts!**

Since 1948 . . . when Mycalex Electronics Corporation pioneered the first *precision-molded* MYCALEX® 410 glass-bonded mica, 180-contact commutator plate . . . MYCALEX switches have introduced a degree of accuracy and dependability never before approached in mechanical switching.

And now, Mycalex offers a *new* ceramoplastic commutator plate design destined to set *even higher* standards for long-life, low-noise-level multiplexing.

Typical of these new plates is the CP 427. Its specifications call for *precision-molded* SUPRAMICA 555 ceramoplastic which delivers total dimensional stability as well as superb thermal endurance (700°F.). The individual contacts of this plate have an exclusive *rectangular* form and embody tolerances within the .0005" range. They are permanently fixed in place.

An exclusive brush-holder design permits *lower pressures* on the wipers . . . gives *lower contact resistance* with a noise level of *less than 10 microvolts*. Brush bounce is eliminated and life greatly extended. MYCALEX switches using this type of design have been tested satisfactorily for over 1000 hours at 600 RPM without maintenance.

Information on complete MYCALEX switches or matched brush assemblies and plates is available.

General Offices and Plant: 121-H Clifton Blvd., Clifton, N. J.
 Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.

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SYNTHAMICA
 SINCE 1948
 MYCALEX
 SUPRAMICA
MYCALEX
 ELECTRONICS CORPORATION

NEW PRODUCTS

Testing Transformer

Has 10 kva capacity

For dielectric and corona level testing, this testing transformer has a capacity of 10 kva. The unit is corona free to at least 75 kv rms; the high voltage oil-filled bushing is corona free to 150 kv rms. The size is 30 x 26 x 83 in. and weighs 900 lb. Applications are dielectric testing in accordance with ASTM standards, corona testing in connection with general missile program, and testing ceramic bushings, cable components, apparatus or insulation.

Peschel Electronics, Inc., Dept. ED, Towners Patterson, N. Y.

CIRCLE 233 ON READER-SERVICE CARD



Pressure Transducer

Available in 11 ranges

Model 725 miniature pressure transducer available in 11 standard pressure ranges from 0 to 200 through 0 to 5000 for measuring pneumatic and hydraulic media. Resistance elements are available from 1000 to 10,000 ohms. Power rating is 1 w. The static error band, based on terminal base calibration and including hysteresis, friction resolution, and deviation from theoretical perfect calibration, is $\pm 0.8\%$. The dynamic error band for all effects, including vibration, is $\pm 1.8\%$ for sweep or dwell vibration in the range of 20 to 2000 cps up to 35 g. The instrument measures 1-3/4 in. in diam and 7/8 in. high.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 234 ON READER-SERVICE CARD

Silicon Rectifiers

For use in power supplies

Types 1N536, 1N537, 1N538, 1N539, 1N540, 1N547, and 1N1095 hermetically sealed, diffused junction type silicon rectifiers are specifically designed for use in power supplies of industrial and military equipment capable of operating at dc forward currents to 750 ma and temperature of -65 to $+165$ C. The piv ratings are 50 to 500 v and maximum reverse current is 5 μ a at maximum rated peak inverse voltage. Ambient temperature is 25 C. The maximum forward-voltage drop at a dc forward current of 500 ma is 1.1 v.

Radio Corp. of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 235 ON READER-SERVICE CARD



Cycle Timer Motor-driven

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oints.

Type AC-42 motor-driven cycle timer repeats a set sequence of switching operations when the motor circuit is energized. This timer is available with intervals of 15 sec to 24 hr. Operation is 120 or 240 v at 50 or 60 cps. The switch is rated at 25 amp or 1/3 hp at 250 v ac. A spdt switch is used and all terminal and blade configurations are heavy gage spring brass without welded or staked joints.

Towne
General Time Corp., Haydon Div., Dept. ED,
New Britain, Conn.

CIRCLE 236 ON READER-SERVICE CARD

Hand Winder Variable speed

duce
ranges

This heavy duty hand winder is available in a choice of 6 variable speed/torque ranges: up to 54, 103, 108, 135, 207, or 258 rpm. Model 610-AM winds wire sizes up to No. 8 AWG at 12 in. diam; maximum coil OD is 12 in. The machine is furnished with 1/4 hp, 5000 rpm, 115 v 60 cps motor.

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Geo. Stevens Manufacturing Co., Inc., Dept. ED, Pulaski Rd. at Peterson, Chicago 46, Ill.

CIRCLE 237 ON READER-SERVICE CARD



Resistance Thermometer Operates from -100 to +500 F

12, River

Model S-22 resistance thermometer operates from -100 to +500 F. It has a resistance of 470 ohms at 32 F, which varies about 1 ohm per deg F. The platinum sensing element is potted for maximum environmental capabilities, dielectric and mechanical strength. The lead wires provide at max 5 lb min pull strength. The thermometer measures 0.156 in. in diam and 0.281 in. in length. Calibration accuracies of $\pm 0.25\%$, $\pm 0.5\%$, and 1% are available.

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Minco Products, Inc., Dept. ED, 740 Washington Ave. N., Minneapolis 1, Minn.

CIRCLE 238 ON READER-SERVICE CARD

Save on labor costs

Centralab's heat-stable plastic shaft controls



SNAP into place

You can save on installation costs—up to \$10.00 per thousand units—because CENTRALAB Model 2 variable resistors SNAP into position.*

This exclusive "Snap-Tite" design is but one of the many features that make the Model 2 so practical. The thermo-setting plastic shaft is UL approved. You have a choice of six shaft lengths—and the shafts have service adjust screwdriver slots front and rear. The shaft and contact rotor are molded in one piece for rigid, vibration resistant construction.

SPECIFICATIONS

Resistance element: Composition
Resistance range: 250 ohms to 10 megohms
Taper: Available in seven standard tapers
Effective Rotation: 300°
Shaft Lengths: 3/8", 1/2", 5/8", 3/4", 7/8", 1"
Terminals: Standard, plug-in or wire-wrap
*Mounting: Interchangeable with panel piercing for bushing and twist tab mount

Further information and detailed engineering data available in CENTRALAB Engineering Bulletin EP-815. Write for your free copy.



Centralab

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VARIABLE RESISTORS • ELECTRONIC SWITCHES • PACKAGED ELECTRONIC CIRCUITS • CERAMIC CAPACITORS • ENGINEERED CERAMICS

CIRCLE 239 ON READER-SERVICE CARD



For connections you
must count on...

be sure, be safe with

TWIN LOCK TERMINAL BLOCKS

Twin Lock terminal blocks offer the ultimate in terminal reliability, speed of assembly, and versatility of application. Molded of a lightweight phenolic base with reinforced barriers between cavities, the Twin Lock block will accommodate up to 40 connections quickly and surely. Twin Lock's exclusive, insert-and-tighten two-way locking action cuts harness assembly time to a fraction of that required by any other block. Twin Lock contact points, either tin plated, gold plated or plated to customer specification, assure lowest resistance connection. Wire end connectors, compatibly plated, can be supplied for manual or automatic assembly. Available in either vertical or side entry types, the Twin Lock block is applicable wherever a fast, positive, reliable electrical connection is required. For complete information on these remarkable new blocks, write for the T-1000 and T-1010 Terminal Block Brochure.



1024 West Hillcrest Blvd.
Inglewood, California

Coliseum Tower, 10 Columbus Circle,
New York 19, New York

CIRCLE 240 ON READER-SERVICE CARD

SIMPLE

The terminal connector, crimped onto the wire end, slips easily into the block cavity. No screws or washers to remove, nothing to drop, just insert it.

SPEEDY

When connectors have been inserted, they're locked electrically and mechanically. Then, when the circuits have been checked, a few quick turns of the lock screw and they're double-locked.

SURE

When the connector has been inserted and tightened, the Twin Lock terminal block connection is positive—electrically and mechanically. Over 100 lbs. force is required to break this connection.

NEW PRODUCTS



RF Signal Sources

For radar and microwave use

Model 700 high power rf signal sources for radar and microwave use are available for cw pulse or dual modes of operation. Klystrons, pulse magnetrons, cw magnetrons, or traveling wave tubes are used as generator elements in this series. Each unit has rf power monitors, filament regulators, band switching, generator tube protective circuits, vacuum or semiconductor power supplies, and complete control function indicators. Frequency ranges available are from uhf through the K-band frequencies.

Burmac Electronics Co., Inc., Dept. ED, Rockville Center, N.Y.

CIRCLE 241 ON READER-SERVICE CARD

Millivoltmeter

Is chopper stabilized



This chopper-stabilized millivoltmeter measures dc voltage from 0.0005 to 300 v. Operating on power frequency of either 60 or 400 cps, model 301 has 10 voltage ranges; the meter has an arc length of 5-1/8 in. Model 301C has a zero-center and is used as a voltage-sensitive null indicator. For applications where control as well as indication is required, the instrument is available with a meter-relay instead of the conventional meter. Models 301-CMR and 301-C-CMR are equipped with double-locking contacts mounted on adjustable pointers.

Metronix, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE 242 ON READER-SERVICE CARD



Frequency Generators

For aircraft and missile use

Made for aircraft and missile use, type T frequency generators have a range of 240 to 3200 cps and an accuracy of 0.001%. The output signal may be either square or sine wave. The unit operates at temperatures from -55 to +100 C, withstands vibration of 20 g from 5 to 2000 cps, and withstands 150 g shock at 11 msec. Minimum operating life is 5000 hr. Required input is less than 20 ma. Hermetically sealed, the unit conforms to MIL-E-5272A. It measures 1 x 1 x 3 in. and weighs 5.5 oz.

Gyrex Corp., Dept. ED, 3003 Pennsylvania Ave., Santa Monica, Calif.

CIRCLE 243 ON READER-SERVICE CARD

Transistor

Collector current rating is 5 amp

Type 2N297A transistor has a collector voltage rating of 60 v and a collector current rating of 5 amp. It dissipates 35 w at 25 C and 10 w at 75 C. Made for use in missiles and supersonic aircraft, the transistor conforms to MIL-T-19500/36A (Sig C). It also has applications in high-current switching, audio amplification, voltage regulators, power supply circuits, and power oscillator circuits.

Bendix Aviation Corp., Red Bank Div., Dept. ED, Long Branch, N.J.

CIRCLE 244 ON READER-SERVICE CARD



Preamplifier

For telemetering applications

Designed to operate from a 50-ohm source, type TP-4 telemetering preamplifier covers 215 to 260 mc. Minimum gain is 22 db and maximum noise is 4 db. A power supply is contained in the unit. Weatherproof housing and a sun shield are provided.

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

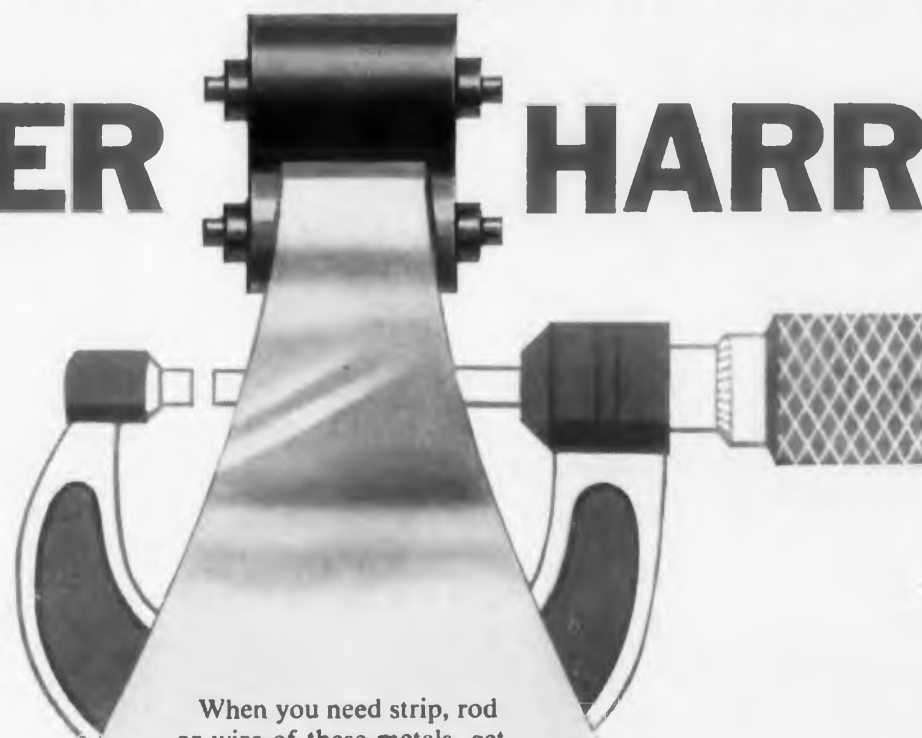
CIRCLE 245 ON READER-SERVICE CARD

ROLLED or DRAWN ALLOYS

NICKEL MONEL INCONEL

for the widest range of sizes specify

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When you need strip, rod or wire of these metals, get exactly what you want...from DRIVER-HARRIS, the leading specialist in high-nickel alloys. For nowhere will you find the technical excellence, productive skills and quality controls to match D-H for strip (widths to 8", thickness down to .0005"), rods in various shapes up to 1/2", wire down to .0005" dia.

Specify "rolled and drawn by Driver-Harris" when you order Monel† nickel-copper alloys, Inconel† nickel-chromium alloys, Incoloy† nickel-iron-chromium alloys, Nickel and Electronic Nickels. They are produced with the same care and quality you expect—and get—with all 132 Driver-Harris alloys.

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MAKERS OF THE MOST COMPLETE LINE OF ALLOYS FOR THE ELECTRICAL, ELECTRONIC, AND HEAT-TREATING INDUSTRIES

CIRCLE 246 ON READER-SERVICE CARD



NEW PRODUCTS

Scaler

Has 1 μ sec resolving time



Model 49-19 decimal scaler has a 1 μ sec resolving time and a total count capacity of 10^8 . Included in the unit is a linear amplifier, precision discriminator and fixed mercury pulse generator, as well as an electrometer type high voltage supply which is continuously variable between 500 and 5000 v. Preset count to 10^8 is provided along with an electrically reset elapsed timer.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 5737 S. Halstead St., Chicago 21, Ill.

CIRCLE 248 ON READER-SERVICE CARD

Beam Power Tubes

High perveance



These high-perveance beam power tubes have high power gain and are used in vhf power amplifiers, and as af power amplifiers and modulators. The 7270 has a 6.3 v, 3.1 amp heater; the 7271 has a 13.5 v, 1.25 amp heater. Each has a maximum plate-dissipation rating of 80 w under ICAS conditions, and can be operated under these conditions with a cw input of 315 w up to 60 mc or with 235 w cw input at 175 mc. As linear rf power amplifiers in single-sideband suppressed-carrier service, they can each provide a useful power output of 135 w.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 249 ON READER-SERVICE CARD

FOR RADAR RECEIVERS VARIAN KLYSTRONS



HIGH FREQUENCY STABILITY, RUGGED CONSTRUCTION, LONG LIFE

The new VA-210B Klystron is a super-rugged oscillator, engineered to give long, reliable service under severe operating conditions. Frequency is extremely stable, even under conditions of the most severe shock, vibration and temperature variation. Features include a unique brazed-on external tuning cavity, a very rugged, quick-heating cathode, a slow-rate non-microphonic tuner and an all metal and ceramic construction.

Varian makes a wide variety of Klystrons and Wave Tubes for use in Radar, Communications, Tests and Instrumentation, and for Severe Environmental Service Applications. Over 100 are described and pictured in our new catalog. Write for your copy.



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VA-210B	1.8 to 10.8 Mc	20 w
VA-2010	8.5 to 9.5 Mc	10 w
VA-2030	8.5 to 9.5 Mc	20 w
VA-21	16.0 to 17.0 Mc	40 w
VA-221H	5.25 to 5.56 Mc	40 w



KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

Pressure Switches

Pressure range is 1 to 500 psig

These hermetically sealed pressure switches, designated model 419, have a pressure range of 1 to 500 psig; overpressure without shift is 3000 psig. Designed for switching circuits in response to pressure changes in hydraulic fluids, fuels, and other gases or liquids, the switches are isolated from the pressure media. The output contacts are spst and the operating temperature range is -65 to $+165$ F. These switches are available in three design configurations, measure about $5/16 \times 1/2$ in., and weigh $1/4$ oz. They conform to MIL-E-005272B, procedure 1, for vibration level, shock, acceleration, and humidity.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 250 ON READER-SERVICE CARD

Receivers

Frequency range from 30 to 260 mc



These miniature receivers cover frequencies from 30 to 260 mc in two bands: 30 to 60 mc and 60 to 260 mc. Model 1905 reception is am and cw; model 1906 reception is fm, am, and cw. The tuners have a low noise figure; the first rf stage uses a planar triode to assure that the noise figure of 6 db is not exceeded at any frequency. The receivers have panels 19 in. wide x $3-1/2$ in. high x 15 in. deep.

Nems-Clarke Co., Dept ED, 919 Jesup-Blair Drive, Silver Spring, Md.

CIRCLE 251 ON READER-SERVICE CARD

Delay Lines

Plug-in type

These delay lines cover delay times from 0.05 to 80 μ sec and have impedances of 50 to 2000 ohms. Standard tolerance on delay is $\pm 2\%$ and the temperature stability of delay is 50 ppm per deg C. Test voltage rating is 600 v dc and working voltage rating is 300 v dc. The temperature range is -65 to $+125$ C. The lines are encapsulated in epoxy casting resin and are protected from moisture, shock, and vibration. Designated series P6, P11, P16, and P24, these delay lines have a rise time of $1/6$, $1/11$, $1/16$, and $1/24$ of delay time.

Artronic Instrument Co., Dept. ED, 11232 Triangle Lane, Silver Spring, Md.

CIRCLE 252 ON READER-SERVICE CARD



SPECIFY SPERRY

SILICON SEMICONDUCTOR DEVICES
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For those applications where reliability and high performance come first, specify Sperry silicon semiconductors—now available in volume production for your application. Performance-proved in many exacting systems—both military and commercial—these outstanding silicon devices are ideal for stringent requirements in missile, airborne, computer and industrial applications.

Developed for maximum reliability, Sperry semiconductors are produced with ex-

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CIRCLE 253 ON READER-SERVICE CARD

FIRST

it was
industrial
applications...

THEN

exacting
military
systems...

...and **NOW**

it's the
**TV
MANUFACTURER**
who sees the solution
to his problems...



The frame grid is the closest approach to the ideal "Physicist's grid"—electrical characteristics but no physical dimensions. It results in: • higher transconductance per milliamperere • tighter G_m and plate current tolerance • low transit time • low capacitances • lower microphonics • rugged construction



AMPEREX FRAME GRID

The grid-to-cathode spacing tolerance is determined by the carefully controlled diameter of grid support rods (centerless ground) and by frame crossbraces between these rods. Extremely fine grid wire eliminates the "island effect" usually encountered in conventional tubes with equally close grid-to-cathode spacing. Rigid support of fine wires reduces mechanical resonance and microphonics in the grid.

CONVENTIONAL GRID

Grid-to-cathode spacing tolerance depends on accuracy of grid dimension, obtained by stretching on a mandrel, and on tolerances of holes in top and bottom mica rod supports. Diameter of grid wire must be large enough to be self-supporting.



ask **Amperex**

about applications assistance on frame grid tubes for TV and FM tuners, and on reliable premium quality (PQ) tubes for industrial and military applications

CIRCLE 254 ON READER-SERVICE CARD

...in

Amperex

**FRAME
GRID
TUBES**

FOR TV TUNERS

6ES8
4ES8
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FOR MILITARY REQUIREMENTS
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For additional data write to
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Amperex Electronic Corporation
230 Duffy Ave.,
Hicksville, Long Island, N. Y.

In Canada:
Rogers Electronic Tubes & Components,
116 Vanderhoof Avenue, Toronto 17, Ontario

NEW PRODUCTS

Wheatstone Bridge

Measures resistances to 11,111 meg



Model 4232-B wheatstone bridge provides complete guarding, eliminating errors caused by adverse humidity conditions and resulting leakage currents. The bridge has a measurement range from 0 to 11,111 meg; accuracy is $\pm 0.01\%$ up to 1 meg and $\pm 0.02\%$ up to 100 meg. Resistors may be tested at full battery potentials up to 100 v. Guard terminals are provided so that the bridge guard system may be completed with a guarded dc bridge power supply and a guarded detector. Housed in a gray metal case, the bridge may be mounted in a 19-in. relay rack; brackets permit table-top mounting.

Leeds & Northrup Co., Dept. ED, 4934 Stenton Ave., Philadelphia 44, Pa.

CIRCLE 255 ON READER-SERVICE CARD



UHF Beam Power Tube

Has 180 kw peak-
pulse output

Type 7214 is a small, forced-air-cooled beam power tube designed for use in grid-pulsed and plate- and screen-pulsed rf amplifiers. It is used with full ratings at frequencies from 960 to 1215 mc. Maximum plate dissipation is 1500 w. When used under CCS conditions as a plate-and-screen-pulsed rf amplifier tube in a cathode-drive circuit at 1215 mc with a 10 μ sec pulse duration and a duty factor of 0.01, the 7214 is capable of delivering a useful peak-pulse power output of about 65 kw with a driver power output of about 11 kw at peak of pulse. Under similar conditions at 400 mc, it can deliver about 100 kw.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 256 ON READER-SERVICE CARD

MEASURE FREQUENCY TO 0.002%



With the PRD Precision
Heterodyne Frequency Meter.

Experts agree that in the range from 100 to 10,000 mc/s the Type 504 is one of the most accurate, easiest-to-use frequency meters in existence today. Yes, here is a completely self-contained unit which covers the bands from simple High Frequency all the way up through X-band without any auxiliary equipment.

A flip of the wrist and you can read frequency to 0.1 mc/s without any long-hand interpolation because the 504 contains a unique automatic interpolation device. And there is a host of other timesaving features which all add up to make the PRD Type 504 a must if you are trying to measure frequency.

Here are some unvarnished specifications which might whet your appetite:

Accuracy:	0.002% at 5 mc/s crystal check-points and 0.03% or better over entire range
Resetability:	0.02% or better
Input sensitivity:	at 500 mc/s and above is -30 dbm at 100 mc/s is -5 dbm
Beat indicators:	Built-in CRT and external headphone jack
Video amplifier bandwidth:	0.8 mc/s

Complete specifications are contained on page D-14 of the new PRD catalog, E-8. For a copy of this 160-page volume, containing hundreds of pieces of other really good microwave gear, send your request on your company letterhead please.

If you want just a specifications page on the PRD Type 504 Precision Heterodyne Frequency Meter, simply fill out the inquiry card in this magazine.

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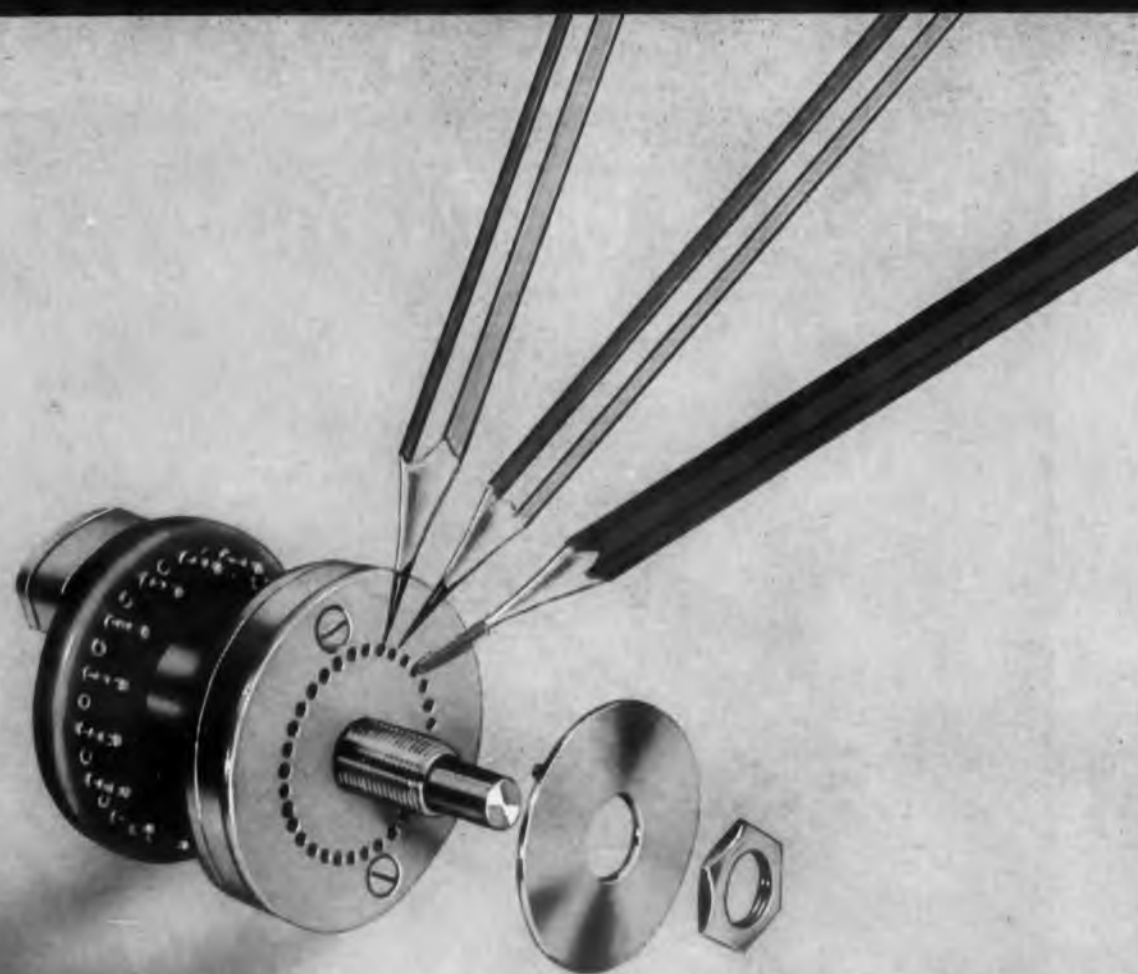
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CIRCLE 258 ON READER-SERVICE CARD



DAVEN

All DAVEN components are now available in your area through these local franchised distributors:

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Stop it

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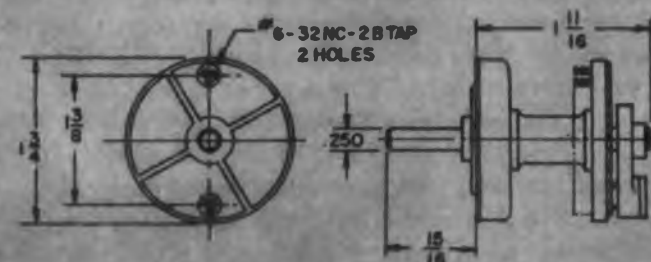
Daven's New Rotary Switch with Adjustable Stop

For flexibility in all types of circuit experimentation, laboratory work, breadboard setups, and in circuitry where the exact number of switch positions might be changed at a later date, the new DAVEN Rotary Switch with an Adjustable Stop is ideal. This unit, as a single pole switch, can have a maximum of either 24 shorting positions with 15° spacing or 32 shorting positions with 11½° spacing. One, two, three, and four pole units are available in this design.

In common with all other DAVEN Rotary Switches, the Adjustable Stop Switch features sturdy, dependable construction; silver alloy contacts and slip rings; tamper-proof,

KNEE ACTION* silver alloy rotor blades; high grade, accurately machined dielectric; and gold flashed turret-type terminals for ease of soldering.

*Patented



Write for complete information.

THE **DAVEN** CO.

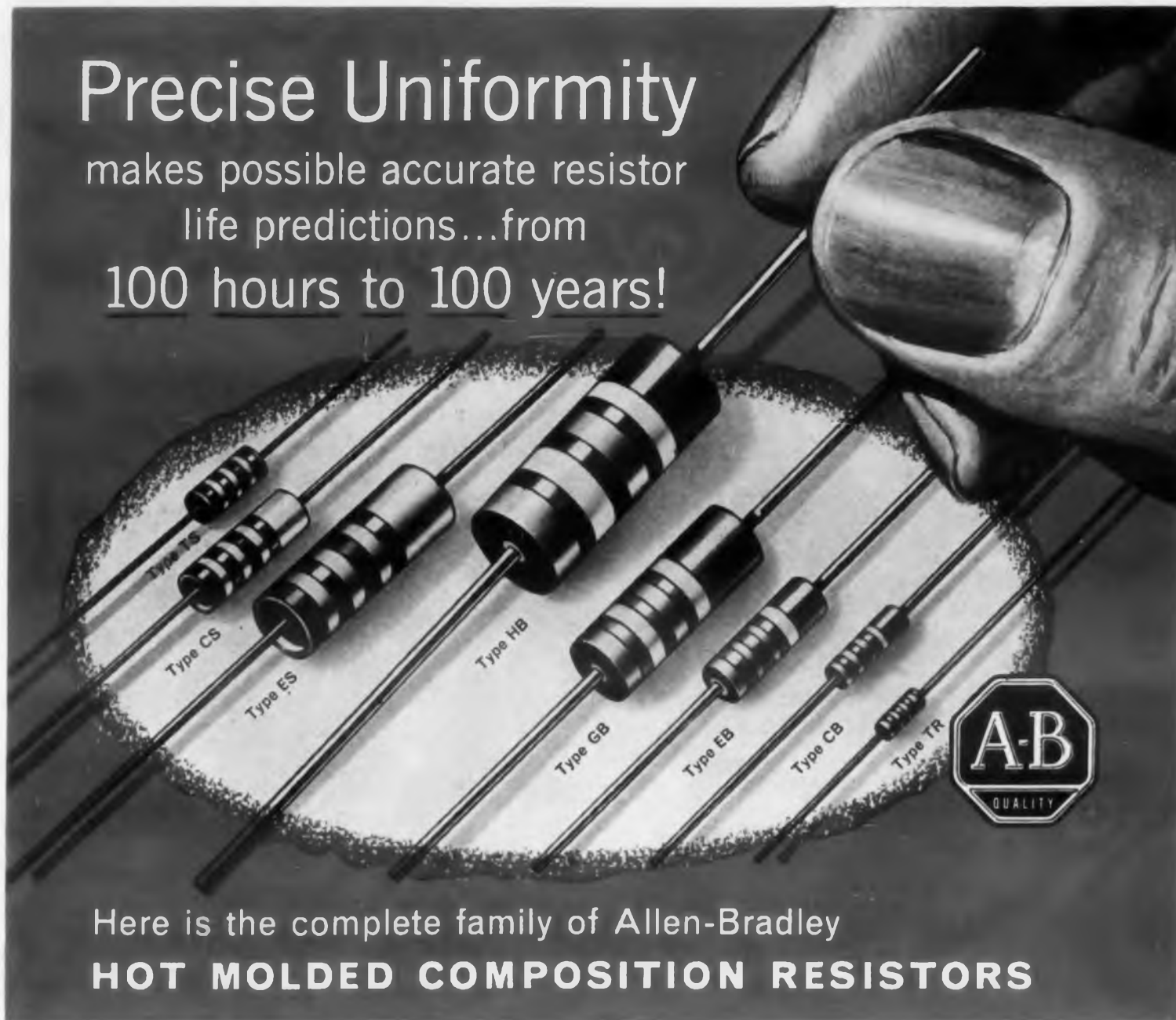


LIVINGSTON, NEW JERSEY



TODAY, MORE THAN EVER, THE DAVEN SWITCH FOR DEPENDABILITY!

Precise Uniformity
makes possible accurate resistor
life predictions...from
100 hours to 100 years!



Here is the complete family of Allen-Bradley
HOT MOLDED COMPOSITION RESISTORS

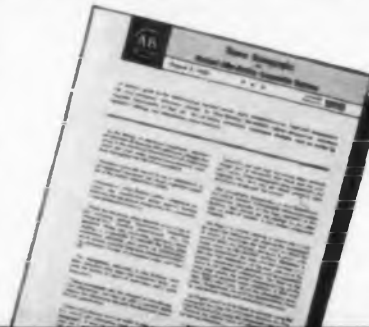
The exclusive hot molding process—developed and perfected by Allen-Bradley—produces resistors so uniform in their characteristics that, when combined with the analysis of test data accumulated over the years, it becomes possible to *accurately* predict the "life" of an Allen-Bradley resistor—from 100 hours to 100 years.

After years of carefully compiling test information obtained by Allen-Bradley Environmental Laboratories, as well as from many independent laboratories, power nomographs have been developed which show the relationship between power input, temperature rise, ambient temperature, life, and permanent resistance change for the standard Allen-Bradley composition resistors.

Inasmuch as catastrophic failure is unknown to occur with Allen-Bradley resistors, the design engineer can safely develop circuitry where predictable changes of characteristics are known and uniform. Furthermore, with Allen-Bradley resistors, changes due to humidity

are temporary and cause no permanent damage to the resistors. Voltage characteristics and temperature characteristics are uniform and are known factors. No other composition resistors possess such uniformity of mechanical configuration, electrical characteristics, and life performance as do these A-B quality resistors.

The power nomographs published in the Allen-Bradley Technical Bulletin 5000E will eliminate all uncertainty of circuitry design in relationship to resistors—provided Allen-Bradley "quality" resistors are used. You will find this information very useful. Bulletin 5000E will be sent to you upon your request.



ALLEN-BRADLEY Quality ELECTRONIC COMPONENTS

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.
CIRCLE 755 ON READER-SERVICE CARD

NEW PRODUCTS

Battery Power Packs

Have shock resistance to 2000 g



These battery power packs, having shock resistance to 2000 g, consist of permanently rechargeable nickel-cadmium battery cells, potted in a plastic case for production in various sizes, shapes, colors, and in a wide range of electrical capacities. Designed for use in satellites, missiles, rockets, and telemetry applications, these battery power packs are hermetically sealed. They are available with 80, 180, 250, 500, 800, and 1750 ma-hr cells, each of which has a nominal rating of 1.2 v.

Gulton Industries, Inc., Alkaline Battery Div., Dept. ED, 212 Durham Ave., Metuchen, N.J.

CIRCLE 259 ON READER-SERVICE CARD

Flush Circuits

Have 0.0002 in. dimensional tolerances



These flush circuits consist of electrical conductors in unlimited configurations. Minimum commercial line width and spacing is about 0.002 in. and dimensional tolerances of 0.0002 in. can be achieved. Angular tolerance is 5 sec of arc over 360 deg. The circuits are flush to less than 1 micron with a finish of 5 μ in. min. Flatness of 0.001 per in. is guaranteed. Surface resins can be epoxy, melamine, phenolic, polystyrene, and teflon. The circuits can be used as commutators, coding discs, emitter discs or switching plates.

Scientific Components, Inc., Dept. ED, 30 S. Salsipuedes St., Santa Barbara, Calif.

CIRCLE 260 ON READER-SERVICE CARD



Tee Circulator

Handles 300 kw
peak power

This tee circulator is a three-port unit which can be supplied at various bands from 3 to 16 kmc. At C-Band, it can handle 300 kw peak power. Insertion loss is 0.5 db max, isolation is 15 db min. Two of these units joined in an H configuration provide four-port circulator action for medium power duplexing. These circulators are used in radar beacon applications and duplexing for radar systems where moderate power handling and narrow bands are required.

Litton Industries, Dept. ED, 336 N. Foothill Rd., Beverly Hills, Calif.

CIRCLE 262 ON READER-SERVICE CARD

Counters

Two types available

The series AD-1 counters eliminate transfer masks or shades and have no interrupted gearing. Type 1400 reads through 359.9 deg to zero and repeat with continued rotation. Type 1401 reads through 6399 mils to zero. Both types are bi-directional and add with clockwise rotation of the input shaft. Their operating temperature is from -60 to +165 F and they meet MIL-E-16400-B and the applicable parts of MIL-STD-167.

Chicago Dynamic Industries, Inc., Precision Products Div., Dept. ED, Diversey Blvd., Chicago 14, Ill.

CIRCLE 263 ON READER-SERVICE CARD



Toroid Transformers

Have outputs to 500 va

These encapsulated toroid transistor power transformers and magnetic amplifiers range from milliwatt size to 500 va outputs with efficiencies to 95%. Meeting all requirements of MIL-T-27A, grades 1, 2, and 5, these toroids withstand mechanical shock and vibration requirements to MIL-E-5272A. Possible uses are in airborne and missile applications.

Mercury Transformer Corp., Dept. ED, 12964 Panama St., Los Angeles 66, Calif.

CIRCLE 264 ON READER-SERVICE CARD

THE RELAY THAT FLIES

with

THE NEW NIKE



NIKE HERCULES, one of America's newest sentries of the sky, is faster and has a much greater range than the original version — Nike Ajax. Capable of carrying a nuclear warhead, NIKE HERCULES can blast an entire fleet of attacking aircraft.

Among the components selected to serve this prime defense weapon is the RX 1402-9, a special model of the WHELOCK Series 121 tubular relay built to the customer's specification. The small size, handy shape and mounting arrangements, and wide ranges of coil resistance and sensitivity make the tubular a most attractive choice for many applications. Chances are you will find your requirements fulfilled by one of the many models available from the standard 500 milliwatt Series 120, the sensitive (85 milliwatt) Series 121 or the shorter Series 123. Technical literature on Wheelock's Tubular Relays available on request.

* 1 3/4" LONG, 1 1/2" O.D.

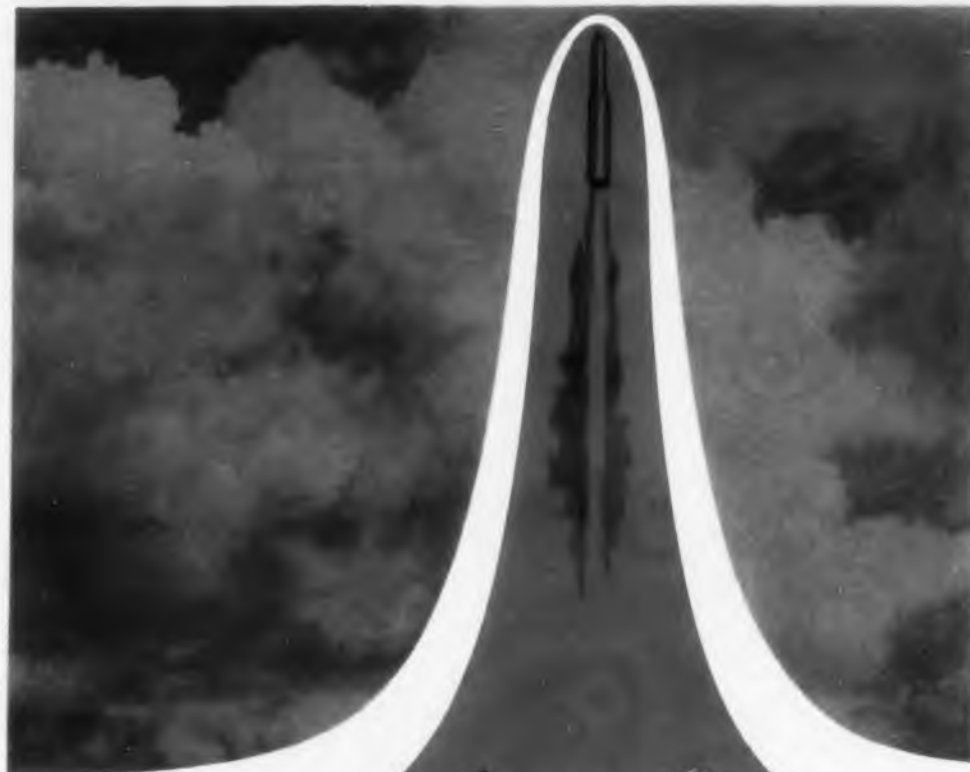
Wheelock SIGNALS
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LONG BRANCH, N. J.

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SOLID PERFORMER CEC'S NEW 4-380A POT PRESSURE PICKUP

Now with a redesigned flexure support system, the 4-380A sets a new standard of performance for low-pressure potentiometer pressure transducers. The 4-380A is unequalled for resistance to shock and vibration. Most pressure ranges are capable of continuous exposure to 25 g vibrations up to 2 KC for periods up to several hours with negligible change in calibration.

Pressure ranges are available from ± 1 psi to 100 psi. Absolute, gage, and differential models are offered. Operating over the temperature range from -65°F to $+200^{\circ}\text{F}$, most pressure ranges exhibit temperature effect of less than one percent. The unique construction of the 4-380A keeps the measured fluid external to the mechanical and electrical system. In absolute models, the internal mechanisms are enclosed within the evacuated chamber. For detailed specifications, call your nearest CEC sales and service office, or write for Bulletin CEC 1604-X18.



Transducer Division

CEC

CONSOLIDATED ELECTRODYNAMICS / 360 sierra madre villa, pasadena, california
CIRCLE 265 ON READER-SERVICE CARD

NEW PRODUCTS

Indicator Lights

Miniature

The DLR series miniature indicator lights have replaceable flange type lamps. The lamps may be neon or incandescent type. The unit features single-nut mounting on a $3/8$ in. hole. Two-terminal construction permits complete isolation from the metal body. Standard lens colors are available.

Transistor Electronics Corp., Dept. ED, 3357 Republic Ave., Minneapolis, Minn.

CIRCLE 266 ON READER-SERVICE CARD

Noise Generator

Variable frequency spectrum



Model NG1000A noise generator provides a source of random noise with a gaussian amplitude distribution and a variable frequency spectrum. The rms output voltage is variable depending upon the shaping filter used: 6 v rms for the widest bandwidth filter to 1 v rms for the narrowest filter. The unit is made for a standard 19 in. rack.

GPS Instrument Co., Inc., Dept. ED, 180 Needham St., Newton, Mass.

CIRCLE 267 ON READER-SERVICE CARD

Amplifier

With power splitters

Model SA-23 amplifier provides a band pass of 54 to 88 mc and 174 to 216 mc with 38 db gain on each band. It has a multi-channel output of 53 dbmv, 10,000-hr, type 6922 input tubes, and silicon rectifiers. Separate tilt and gain controls are provided for each band with a 13 db gain control range. Models ES-2 and ES-4 power splitters have a bandwidth of 50 to 225 mc with an impedance of 75 ohms. The amplifier weighs 6-1/2 lb and measures 12 x 4-1/2 x 5 in., model ES-2 power splitter measures 2-1/8 x 2-1/4 x 1-1/4 in., and model ES-4 measures 2-1/8 x 2-1/2 x 2-1/4 in.

Entron, Inc., Dept. ED, P.O. Box 287, Bladensburg, Md.

CIRCLE 268 ON READER-SERVICE CARD

How Indiana Steel's engineers help you solve microwave magnetic problems

CASE IN POINT:

A leading microwave component manufacturer. *Problem:* Produce a special load isolator magnet to fit smaller space contour in a new radar unit. Also, deliver the new magnet to the customer in 12 days

Solution: Indiana engineers turned to their previous design files, selected an existing magnet and modified it to meet the new size specifications. Gauss tests showed that the new design met the customer's specified magnetic field range. The magnet was delivered within the time specified.

THREE BASIC DESIGNS FOR LOAD ISOLATOR APPLICATIONS



U MAGNET



C MAGNET



FLAT C MAGNET

Permanent magnet specialists at Indiana Steel utilize three basic magnet designs for load isolators: two variations of the C magnet, and the U magnet. All three of these designs can be varied to meet specific customer requirements.

WIDE EXPERIENCE IN MICROWAVE APPLICATIONS

Magnet specialists at Indiana have designed and produced permanent magnets for a wide range of microwave applications including pm-focus traveling wave tubes, load isolators, radar magnetrons, backward wave oscillators. Our engineers will give prompt attention to your microwave problems or any other permanent magnet applications. Call your Indiana man or write us direct. Ask for Catalog No. 20M10. "Alnico V Load Isolator Magnets."

THE INDIANA STEEL PRODUCTS COMPANY VALPARAISO, INDIANA

SALES OFFICES IN: Boston, Chicago, Cleveland, Los Angeles, New York, Philadelphia, Rochester

INDIANA PERMANENT MAGNETS

World's largest manufacturer of permanent magnets.

IN CANADA: The Indiana Steel Products Company of Canada Limited, Kitchener, Ontario

CIRCLE 269 ON READER-SERVICE CARD

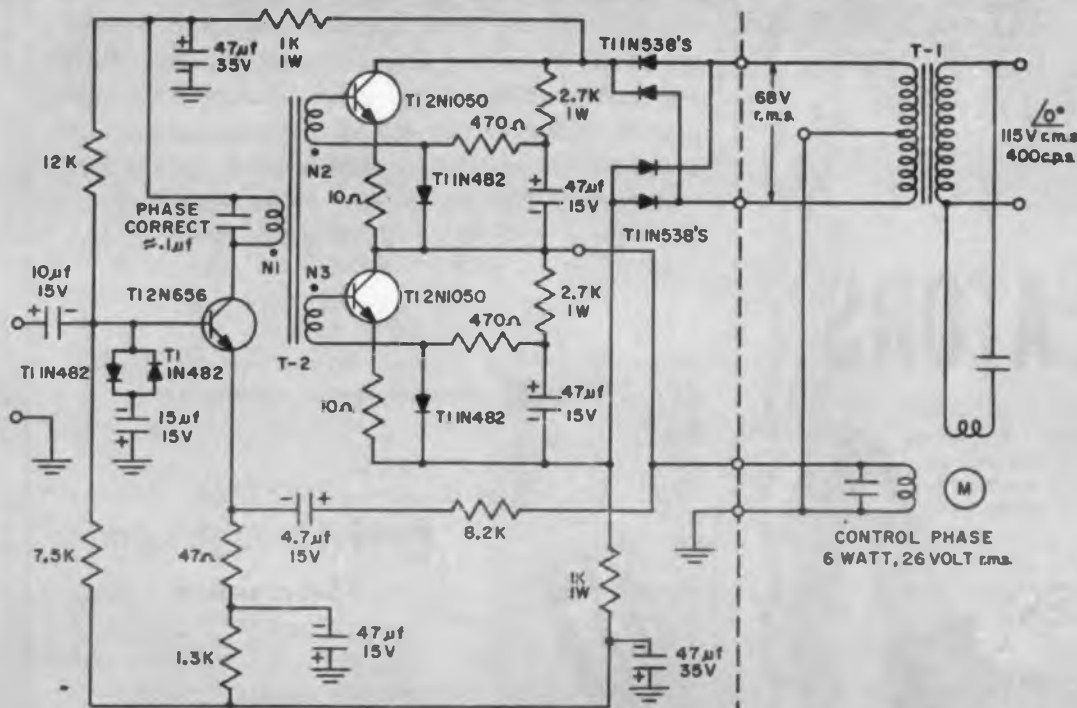
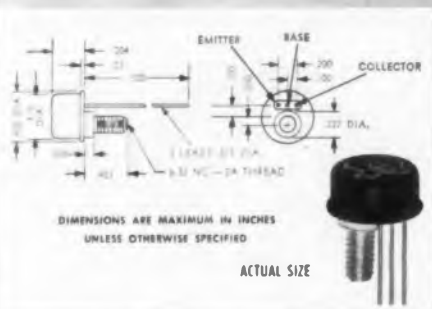
ELECTRONIC DESIGN • October 14, 1959

How to get 55% over-all efficiency in transistorized 6-watt servo amplifier

HIGH-EFFICIENCY SERVO CIRCUIT REQUIRES . . .

- no output transformer
- no center-tap motor winding

Higher over-all efficiency than in a conventional Class-B push-pull amplifier is achieved in this servo by use of unfiltered rectified a-c for current supply voltage—with resulting reduction in size, weight and power supply requirements. This higher efficiency means greater transistor reliability, smaller heat sink and/or higher allowable ambient temperatures. Output will remain sinusoidal when amplifier is overdriven.



TRANSFORMERS

T-1 400 cps, 12-watt power transformer step-down 115 volt to 68 volt c.t.
 T-2 400 cps, 65-mw driver transformer. Turns ratio N1: N2: N3 = 2: 1: 1
 Primary Current = 10 ma d-c. Primary Inductance = 1.5 hy.

...with TI 2N1050 N-P-N silicon transistors!

Exclusive TI 2N1047 intermediate-power series now gives you maximum design flexibility plus high efficiency . . . all in a miniature package!

Consider the design flexibility made possible by the exclusive features of this series . . . 40 watts dissipation at 25°C case temperature . . . unique stud mounting for maximum thermal efficiency . . . 80- and 120-volt

BV_{CEX} . . . 15-ohm R_{CS} . . . -65°C to +200°C operating and storage range . . . choice of beta spreads.

Apply TI's guaranteed specs to your design situations today. This use-proved series is available off-the-shelf — at factory prices — in 1-999 quantities from your nearby authorized TI distributor, and in production quantities from your TI sales office.

PARAMETER	TEST CONDITIONS	2N1047	2N1048	2N1049	2N1050	unit
		min. max.	min. max.	min. max.	min. max.	
BV_{CEX} Breakdown Voltage	$I_C = 250 \mu a$ $V_{BE} = -1.5v$	80	120	80	120	v
BV_{EBO} Breakdown Voltage	$I_E = 250 \mu a$ $I_C = 0$	10	10	10	10	v
I_{CBO} Collector Cutoff Current	$V_{CB} = 30v$ $I_E = 0$	15	15	15	15	μa
h_{FE} Current Transfer Ratio †	$V_{CE} = 10v$ $I_C = 200ma$	12 36	12 36	30 90	30 90	—
h_{IE} Input Impedance †	$V_{CE} = 10v$ $I_B = 8ma$	500	500	500	500	ohm
R_{CS} Saturation Resistance †	$I_C = 200 ma$ $I_B = 40ma$	15	15	15	15	ohm
V_{BE} Base Voltage †	$V_{CE} = 15v$ $I_C = 500ma$	10	10	10	10	v

†Semiautomatic testing is facilitated by using pulse techniques to measure these parameters. A 300-microsecond pulse (approximately 2% duty cycle) is utilized. Thus, the unit can be tested under maximum current conditions without a significant increase in junction temperature, even though no heat sink is used. The parameter values obtained in this manner are particularly pertinent for switching circuit design and, in general, indicate the true capabilities of the device.

germanium and silicon transistors
 silicon diodes and rectifiers
 tan-Ti-cap solid tantalum capacitors
 precision carbon film resistors
 sensistor silicon resistors

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CIRCLE 270 ON READER-SERVICE CARD



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TI semiconductors are USE-PROVED by thousands of customers and GUARANTEED for one full year! Now available at Factory Prices in 1-999 quantities:

Silicon transistors, germanium transistors, silicon diodes and rectifiers and carbon film resistors.
 sensistor silicon resistors: 1-499
 tan-TI-cap tantalum capacitors: 1-99

FREE
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 1959 INDUSTRIAL ELECTRONICS CATALOG #69

Order now for your copy of this 388-page reference to the newest electronic devices, including Texas Instruments complete line of semiconductors and components.

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 Chicago 4, Illinois

CIRCLE 271 ON READER-SERVICE CARD

125

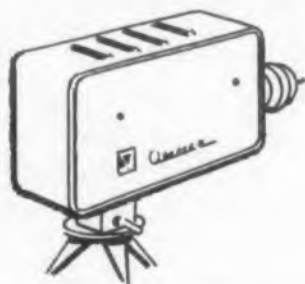
MEMO TO:

Closed Circuit TV Designers
Investigate

VICTOREEN CORONA TYPE VOLTAGE REGULATORS



for pickup
and display tube
Power Supplies



Compact . . . light in weight . . . rugged . . . last literally indefinitely. Victoreen corona type voltage regulator tubes are all of these—and more. They simplify circuits and provide accurate voltage regulation that gives precision of display . . . prevents blossoming . . . improves focus. Investigate Victoreen corona type voltage regulators now. Our Applications Engineering Department will give you fullest details.

A-376A

Make Victoreen your high-voltage regulation headquarters. Request copy of technical information package "Victoreen Corona Type Voltage Regulators."



Victoreen

5806 Hough Avenue • Cleveland 3, Ohio

Export Department, 135 Liberty Street, New York, 6, N.Y.

CIRCLE 272 ON READER-SERVICE CARD

NEW PRODUCTS

Leak Detector

For sealed components

Type C2D5 leak detector is designed for testing hermetically sealed components for leakage up to 10^{-12} cc per sec. The programmed, fully automatic, push-button operation of this unit permits low-cost inspection of such components as transistors, diodes, crystal holders, and relays.

American Electronics, Inc., American Nuclear Div., Dept. ED, 9459 W. Jefferson Blvd., Culver City, Calif.

CIRCLE 273 ON READER-SERVICE CARD



Read-Through Lamp Subminiature

No. 4 subminiature read-through lamp is designed for computer use as a light source in photoelectric readout applications. This 2.5 v, 400 ma lamp is less than 1/4 in. in diameter and 13/16 in. long. Its bulb concentrates a 1/4 in. spot pattern 3/8 in. in front of the lamp for maximum read-through efficiency. Its life is almost 10,000 hr and is available with either a brass midget snap-in base (pictured), or as a wire lamp suitable for direct soldering.

Tung-Sol Electric Inc., Dept. ED, 1 Summer Ave., Newark 4, N.J.

CIRCLE 274 ON READER-SERVICE CARD

Waveguide Flange Seals

Two designs available

The design of these waveguide flange seals provides separate rf and pressure seal regions. Types WG(G711-1)S-5 and WG(G711-1)A-5 are one-piece molded synthetic rubber and have a temperature range of -65 to $+250$ F. Types WG(S5811-2-F)S-5 and WG(S811-2-F)S-5 have an inner ring of molded plastic, which forms a bond with the conducting coating, and an outer pressure ring of silicon rubber. Each of the two designs can be furnished with silver or aluminum coating.

Industrial Electronic Rubber Co., Dept. ED, 31945 Aurora Rd., Solon, Ohio.

CIRCLE 275 ON READER-SERVICE CARD

computing components from Librascope

*New precision
differentials with double-
bearing pinions*



Model	36	37
Pinions	2	2
Bearings per pinion	2	2
Shaft Type	hollow	solid
Shaft Size	1/8" 10	1/8" 00
Inertia	0.075 oz-in ²	0.075 oz-in ²
Max. breakaway torque	0.25 oz-in	0.25 oz-in
Max. backlash (minutes of arc)	7'	7'
Max. static load	6 in-oz	6 in-oz
Max. gear input speed	1200 rpm	1200 rpm
Working Circle	1.090	1.090
Length	0.980	0.980
Weight	1oz.	1.5 oz

LIBRASCOPE'S new Model 36/37 differential with two miniature precision bearings per pinion provides greater accuracy and less backlash than previously available models. Can be ordered with either a hollow or solid shaft. The hollow shaft version (Model 36) employs a unique method of internal shaft clamping which prevents marring of the shaft and reduces overall length. A new and superior method of attaching side gears is also provided. SEND FOR DATA SHEET 36-37

*Angular to lineal
conversion with
sine-cosine mechanism*



Model	43	44
Accuracy	0.2%	0.15%
Max. breakaway torque	0.1 oz-in	0.1 oz-in
Max. recommended speed	100 rpm	100 rpm
Max. recommended load on pin	4 oz.	4 oz.
Throw	1/2"	1"
Diameter	2"	2 1/2"
Weight	2.0 oz.	2.5 oz

The LIBRASCOPE Sine-Cosine Mechanism accurately converts angular rotating motion into lineal sine-cosine movement. Instantaneously solves problems of changing variables involving vector components, range and bearing computation, flight computation, and many other trigonometric functions. SEND FOR DATA SHEET 43-44

LIBRASCOPE, INC.
Commercial Division

L19-10

LIBRASCOPE

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PRECISION
COMPANY**

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
LIBRASCOPE, INC. Commercial Division,
100 East Tujunga Avenue • Burbank, California

CIRCLE 276 ON READER-SERVICE CARD

METAL FILM RESISTORS



NEW! This precision low noise metal film resistor meets and exceeds requirements with temperature coefficient of plus or minus 50 ppm/°C independent of resistance value. Standard tolerance plus or minus 1 per cent. Type WHM-1.125" long x .406" diam. — is equivalent to MIL Style RN 75, maximum voltage rating 500V. Type WFH-.781" long x .250" diam. — equivalent to MIL Style RN 70, maximum voltage rating 350V.

Enclosed in specially designed hermetically sealed plastic casing (patent pending) to protect precision resistor element.



RESISTANCE PRODUCTS COMPANY

914 S. 13 St. Harrisburg, Pa.

Specialists in manufacturing quality resistors: Precision Wire Wound — High Voltage — High Megohm — High Frequency. Our test equipment and standards for checking and calibrating are matched only by leading laboratories. Write for more information.

HIGH MEGOHM RESISTORS

Type H. For electrometer circuits, radiation equipment and as high resistance standards. Resistance available to 100 million megohms. Voltage rating to 15,000 volts. Low temperature and voltage coefficient. Seven sizes, from 3/4" to 3" long, of which 2 meet requirements of MIL-R-14293A. Standard resistance tolerance 10%. Tolerance of 5% and 3% available. Also matched pairs with 2% tolerance.



CIRCLE 277 ON READER-SERVICE CARD

CABINET COOLER.—Model RC-6 maintains temperature control of rack mounted electronic equipment. It requires 12-1/4 in. of rack height, and has permanently lubricated bearings, automatic temperature control, and sealed refrigeration system.

Airflow Co., Dept. ED, 400 S. Stonestreet Ave., Rockville, Md.

CIRCLE 278 ON READER-SERVICE CARD

SERVO MOTOR.—Model 18 SM 691, 115 v, 60 cps, can be wound for any standard carrier voltage supply. It requires an input of 9 w per phase with 0.64 pf. No-load speed is 3200 rpm, torque at stall is 4 oz.-in., and acceleration at stall is 70,000 radians per sec². This size 18 motor operates at temperatures to 200 C and weighs 15 oz.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton, Calif.

CIRCLE 279 ON READER-SERVICE CARD

NUCLEAR BATTERIES.—Model K-11 Krypton 85 batteries have current ratings of 200 to 1000 μ a, an open circuit potential of several thousand volts, and a linear charging rate to 1000 v.

Universal Winding Co., Dept. ED, P.O. Box 1605, Providence 1, R.I.

CIRCLE 280 ON READER-SERVICE CARD

INSULATION SLEEVING.—This Zippertubing is available in red, white, green, yellow, and blue for ready identification of cables, pipes, or conduits.

Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles, Calif.

CIRCLE 281 ON READER-SERVICE CARD

SERVO KIT.—Contains standard parts from which a variety of 1-7/8 in. diam electro-mechanical instrumentation can be assembled. Kit model 20-200 contains over 274 pieces.

Servo Development Corp., Dept. ED, 567 Main St., Westbury, N.Y.

CIRCLE 282 ON READER-SERVICE CARD

MOMENTARY CONTACT SWITCH.—Rated at 0.5 amp at 115 v ac, it will withstand a dielectric test of 1000 v. A normally open push type, No. 425-1 has nipple mounting; terminals are solder type.

Alcor Manufacturing Co., Dept. ED, 4444 W. Roosevelt Rd., Chicago 24, Ill.

CIRCLE 283 ON READER-SERVICE CARD

CERAMIC TRANSDUCER ELEMENT.—Has high stability at temperatures up to 300 C. US 500 has a high linear coupling coefficient and is used either as a sensor, or as a high power driver.

U.S. Sonics Corp., Dept. ED, 625 McGrath Highway, Somerville, Mass.

CIRCLE 284 ON READER-SERVICE CARD

lifelong association with quality

Lavoie test instruments are known and relied upon right around the world. Superlative design, consistent reliability and the industry's prime order of accuracy are the ingredients which continue to stamp all quality instruments bearing the Lavoie name.

Here are four representative units, each of which invites your trial and the beginning... or continuation... of a lifelong, rewarding association with the Lavoie standard of quality.



LA-302 ROBOTESTER

Provides the immediate profits of the automated approach to volume testing as well as for unique individualized test programs. High-speed sampling, go/no-go indication, with digital readout of fault isolation.



LA-20W SPECTRUM ANALYZER

Features 1 to 44 Kmc range in one instrument, selection of square law, linear or log detection, 10-KC resolution at 3 db points, regulated filament and plate supplies. Unit illustrated is only one of a full line of spectrum analyzers.



LA-70A FREQUENCY METER

Frequency measurements from 20 mc to 3000 mc with .0001% accuracy. Oven-controlled crystal oscillators, direct dial reading and light in weight for ease in portability. Ideally qualified to accommodate stringent FCC communications requirements.



LA-90 FREQUENCY STANDARD

New design approach to crystal oven thermal regulation permits frequency stability of 1 part per 10⁶ per day at low cost, in small package. Oven temperature stability of 0.01%. Output frequency (basic LA-90 unit): 1 mc, 5 mc, 100 kc, 10 kc, 1 kc.

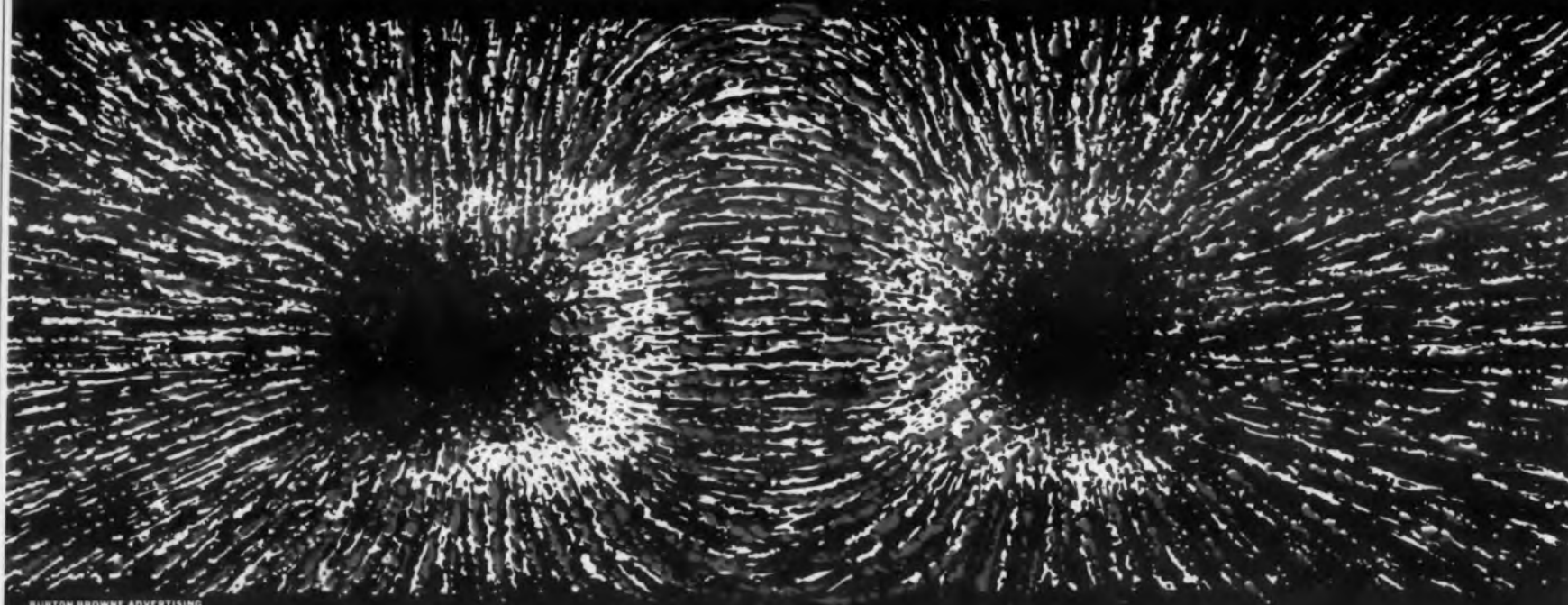
Technical literature describing these units in detail is available on request. Detailed technical data may also be supplied on a selection of Pulse Generators, WWV Receivers and Crystal Ovens and a diversified line of quality test equipment for laboratory and plant.

Lavoie Laboratories, Inc.

MORGANVILLE, NEW JERSEY

CIRCLE 285 ON READER-SERVICE CARD

FARADAY the FIELD and FREQUENCY RESONANCE



Creative Imagination took Michael Faraday from the experimental discovery of the induction of electricity to the theory of "the field" — foundation of all the new physics including relativity.

Creative imagination at National Co. has taken the known unvarying resonance of the Cesium atom and translated it into a frequency producing instrument with a stability of frequency of 1 part in 10^{11} — this is man's most accurate measurement of time.

The applications and adaptations are many-fold and still largely unexplored.

National Co. is a community of minds and talents that enjoys the challenge and the prestige of success in such advanced fields as multipath transmission, noise reduction, correlation techniques for signal processing, Tropospheric scatter systems, Ionospheric scatter sys-

tems, molecular beam techniques, long range microwave transmission, and missile check-out equipment using microwave and digital techniques.

National Co. has grown with the Tradition of New England electronics. Your needs and problems receive exceptional attention at National Co. because, here, *creativity is required, recognized and rewarded.*

Write or phone

tuned to tomorrow **National!**

National Company, Inc., Malden, Mass.

MANUFACTURERS OF MATERIEL AND EQUIPMENT FOR U.S. DEFENSE

NEW PRODUCTS

Power Supply

Output is 750 v dc

Model BL-N-004 power supply has an output of 170 μ a at 750 v dc with a 28 v dc source. The output voltage variation is $\pm 3\%$ when the input varies between 22 and 34 v. The output current is limited by a self-contained 4.7 meg resistor. Both the input and the output terminals are isolated from the case. The unit measures 5 x 2 x 1-1/8 in.

Bomac Labs, Inc., Dept. ED, 1 Salem Rd., Beverly, Mass.

CIRCLE 286 ON READER-SERVICE CARD

Magnetic Control Reactors

Have outputs from 7 to 300 w

This line of 60 cps magnetic control reactors are supplied to operate on any ac line from 26 to 115 v. Their output rating is from 7 to 300 w. The use of high-gain toroidal coils provides complete control with 2 to 5 ampere-turns. Applications include motor and generator speed controls, battery chargers, regulators, and regulated power supplies. All units are packaged in standard MIL-T-27 cases and are fully potted and hermetically sealed.

Magnetico, Inc., T.A. Div., Dept. ED, 6 Richter Court, E. Northport, N.Y.

CIRCLE 287 ON READER-SERVICE CARD

Telemetry Calibrator

Transistorized

Model TG-72 telemetry calibrator is fully transistorized, utilizes miniature components, and has easily removable printed circuit boards. Eighteen IRIG channels can be simultaneously monitored, or checked individually, automatically or manually, on a sequencing basis. All channels can be scanned at $\pm 7.5\%$ of center frequency; the upper five channels can be scanned at $\pm 15\%$ of center frequency. Either 3- or 11-point calibration per channel is available. All frequencies are crystal controlled to an accuracy of 0.01%; remote control is optional.

CIRCLE 288 ON READER-SERVICE CARD

*Economies in equipment size, weight, and
power consumption begin with...*

RCA PPM TRAVELING-WAVE TUBES

for X-Band operation



RCA Dev. Type 1140 PPM Traveling-Wave Tube—cut away to show self contained periodic permanent magnets

RCA TRAVELING-WAVE TUBES FOR X-BAND OPERATION

RCA Type No.	Frequency (MC)	Typical Performance		Duty Factor	Focusing Method	Approx. Size	
		Power Output	Low-level Gain (db)			Weight (lb.)	Length (in.)
A-1140	8000-12000	10 mw	40	CW	PPM	5½	14
A-1133	8000-12000	1 w	35	CW	PPM	6	15
A-1181	7500-11200	50 peak watts	35	0.05	PPM	6	14

RCA Microwave-Tube Engineers invite inquiries for customized versions

RCA's continuing program to provide designers with a comprehensive and reliable line of traveling-wave tubes is exemplified by three new PPM focused X-band TWT's.

Focusing by means of Periodic Permanent Magnets makes possible more compact and lighter equipment designs. Waveguide couplings significantly reduce power loss, improve performance and efficiency in

this complimentary family of developmental X-band traveling-wave tubes for ECM, drone target systems, and radar applications. And all three tubes are designed for high-altitude airborne operation.

For traveling-wave tubes in any application in the L, S, C, and X bands, call the RCA Field Office nearest you. Your RCA Field Rep-

resentative will be happy to give you detailed information on RCA commercial and developmental types—or customized versions—for your specific system needs.

GOVERNMENT SALES

HARRISON, N. J.
415 S. 5th Street, HUmboldt 5-3900
DAYTON 2, OHIO
224 N. Wilkinson St., BALdwin 6-2366
WASHINGTON 6, D. C.
1625 "K" St., N.W., DIstrict 7-1260

INDUSTRIAL PRODUCTS SALES

DETROIT 2, MICHIGAN
714 New Center Building, TRinity 5-5600
NEWARK 2, N. J.
744 Broad St., HUmboldt 5-3900
CHICAGO 54, ILLINOIS
Suite 1154, Merchandise Mart Plaza,
WHitehall 4-2900
LOS ANGELES 22, CALIF.
6355 E. Washington Blvd., RAYmond 3-8361

Power requirements are 115 v, 60 cps, 80 w. The unit measures 7 x 19 x 16-3/8 in. and weighs 40 lb. Model TG-71, a 5 point calibrator, is also available.

Thompson Ramo Wooldridge Inc., Dept. ED, P.O. Box 90534 Airport Station, Los Angeles 45, Calif.
CIRCLE 289 ON READER-SERVICE CARD

Switches

Pull-push type

For applications requiring greater simplicity of motion than possible with rotary and toggle switches, these pull-push switches are available in two types. Type SK-1 has 8 to 17 oz actuating force with 3 amp 125 v ac rating. Type S-MK has under 6 oz actuating force and a 1 amp 125 v ac rating. Shaft travel is $5/32 \pm 1/64$ in., shaft diameters are 0.25 and 0.187 in., and shaft lengths are in increments of 1/16 in.

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

CIRCLE 290 ON READER-SERVICE CARD

Environmental Test Fixture

Resonant-free

Type T environmental test fixture is resonant-free below 2000 cps and may be used to mount test specimens during vibration, shock, and acceleration tests. Designed to convey only the desired environment, the unit tests specimens in three mutually perpendicular axes, simultaneously. The transmissibility factor is under 1.1 at frequencies to 2000 cps. The unit is available in a small size with a dimensional capacity of 6 x 6 x 4-1/2 in. and a weight capacity to 6 lb, for use with a 1500 g-lb exciter. A larger unit, with a dimensional capacity of 12 x 12 x 9-1/2 in. and a weight capacity of 25 lb, for use with a 5000 g-lb exciter, is also available.

Avco Mfg. Corp., Research and Advanced Development Div., Dept. ED, 201 Lowell St., Wilmington, Mass.

CIRCLE 291 ON READER-SERVICE CARD



RADIO CORPORATION OF AMERICA

Electron Tube Division

Harrison, N. J.

DOW**METAL PRODUCTS**

400-TON PRESS draws end pieces of magnesium transmitter housing for missile ground support electronic system. Heated dies make possible one step draws.

The electronic transmitter housing shown in various stages of production on this page is a good example of the type of work carried on at Dow's fabrication plant. It is a large and complex assembly which is produced in quantity, involves many different operations, and must conform to extremely high quality standards.

Large or small jobs. The fabrication plant is a large, well equipped production facility set up to handle large or small jobs, and plenty of both. Its activities encompass every phase of fabrication — deep drawing, bending, spinning, stamping, piercing, machining, arc and spot welding, assembling, chemical treating and painting. The facilities are government certified.

Engineering and quality control. Dow engineers working closely with the customer are frequently able to suggest design modifications which cut costs and/or meet application requirements better. A quality control team using modern methods and equipment assures that high standards of craftsmanship are rigidly maintained.

Many "firsts". The fabrication plant has pioneered many developments in the production of magnesium parts and products. They were first to hot draw the lightest structural metal, and first to spot weld and automatically weld it. They have also been a leader in the production use of chemical treatments and finishes for magnesium.

Whatever your requirements, if they involve fabricated Magnesium Aluminum parts or assemblies, it will pay you to make Dow your supplier.

ARE YOU UTILIZING DOW'S EXTENSIVE FABRICATION FACILITIES?

Dow, primary producer of magnesium and its alloys, offers capacity and outstanding capabilities of its Metal Products Fabrication plant.



"WRAPPER", or shell of housing is roll formed of magnesium sheet.



AUTOMATIC ARC WELDER, using tungsten-inert gas process, joins end to wrapper.



ASSEMBLY involves attachment of doors, hardware, other components using riveting, bolting, welding.

THE DOW METAL PRODUCTS COMPANY, Midland, Michigan

DIVISION OF THE DOW CHEMICAL COMPANY

CIRCLE 292 ON READER-SERVICE CARD

NEW PRODUCTS

Racks

Frames are 22 in. wide

The F series of modular transmitter racks have front and rear rounded tops, 22 in. wide frames made of 14-gage steel, and two adjustable panel mounting angles. Doors, end panels, flush doors, shelves, and turrets can be furnished.

Premier Metal Products Co., Dept. ED, 357 Manida St., New York 59, N.Y.

CIRCLE 293 ON READER-SERVICE CARD

Pulse Counter

Low torque



Model 2010 low torque pulse counter has six drums, but is also available in two, three, four, and five drum types. Activated by a stepping motor, the drums have speeds up to 40 counts per sec. The stepping motor has no ratchets, contacts or springs to wear out, assuring a long life. The gear's positive meshing feature eliminates skipping or missing a count. Easy direct reading is accomplished with 5/16 in. numbers.

Haydon Instrument Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 294 ON READER-SERVICE CARD

Silver-zinc Battery

Activates in 0.5 sec

Weighing 2.7 lb and measuring 3 x 3 x 4.5 in., model P14A silver zinc, 19-cell battery activates in 0.5 sec. The signal required for activation is 28 v at 2 amp. The battery provides 1 ampere-hour of 28 v current; maximum current is 5 amp. It withstands vibration to 10 g, acceleration to 20 g, and shock to 5 g, in all three major axes. The temperature range is 50 to 150 F; other models are available with temperature ranges of -65 to +165 F. Estimated pre-activation shelf life is 5 yr. The battery has automatic activation and contains only one moving part.

Cook Batteries, Dept. ED, 3850 Olive St., Denver 7, Colo.

CIRCLE 295 ON READER-SERVICE CARD

Silicon Rectifiers

Diffused-junction type

Types 1N440-B, 1N441-B, 1N442-B, 1N443-B, 1N444-B, and 1N445-B hermetically sealed, diffused-junction type silicon rectifiers are designed to meet very low reverse current requirements in magnetic amplifiers, dc blocking circuits, and power supplies. These units have a maximum forward-current rating of 750 ma at an ambient temperature of 25 C, and piv ratings of 100 to 600 v.

Radio Corp. of America, Semiconductor and Materials Div., Dept. ED, Somerville, N.J.

CIRCLE 296 ON READER-SERVICE CARD



Oscilloscope

Has single plug-in unit

Model K-160 oscilloscope has a single plug-in system for all signal generating and processing circuitry. The main frame indicator of this model consists of a 5 in. single-gun cathode ray tube, its associated beam controls, identical X and Y main amplifiers, and a power supply capable of handling plug-in load requirements.

Electronic Tube Corp., Dept. ED, 1200 E. Mermaid Lane, Philadelphia 18, Pa.

CIRCLE 297 ON READER-SERVICE CARD

Anode Connector

Right angle type

Having the positive-locking connection clip and dust-proof cap set at right angles to the lead wire, this high voltage anode connector is especially designed for use in cramped picture tube areas. The spring clip provides a positive, vibration-proof lock when engaged in the picture tube receptacle. The cap is made from ozone and corona-resistant neoprene and withstands 30,000 v. Standard lead wires are 18-gauge with 16 of 30 stranding and 20-gauge with 10 of 30 stranding. The wire insulation is 0.045-in. white rulan and the outer jacket is 0.02-in. red vinyl.

Mandex Mfg. Co., Inc., Dept. ED, 2614 W. 8th St., Chicago 32, Ill.

CIRCLE 298 ON READER-SERVICE CARD

Ingenious, ultra-convenient...

NEW 196A OSCILLOSCOPE CAMERA

combines every feature you've wanted



FULL-SIZE, DISTORTION-FREE PICTURES. Full picture area may be scaled.

SHARP, CLEAR PICTURES, JUST LIKE CRT ITSELF. New f/1.9 lens has a flat field.

ADJUST CAMERA ON SCOPE. Not necessary to remove camera to set f-stop and shutter.

SIMPLE, ONE-HAND MOUNTING. Easy clamp mounts camera on scope with "quick-lock" tab.

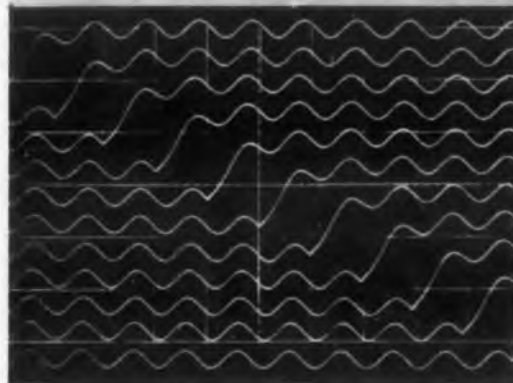
MULTIPLE EXPOSURES ARE EASY. With one hand, move lens through 11 detented positions.

EASY TAB PULLING. Polaroid® Land Camera back is securely fastened.

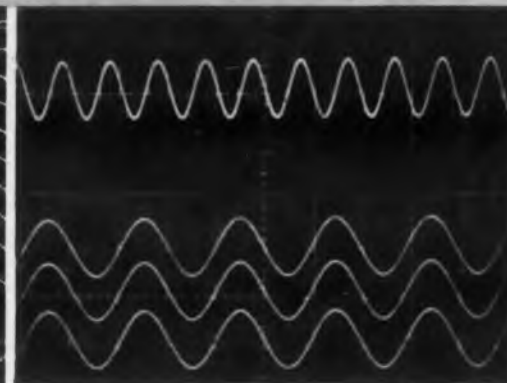
INSURED AGAINST LIGHT LEAKS; uses professional camera bellows.

WEAR GLASSES? Keep 'em on while viewing image with both eyes.

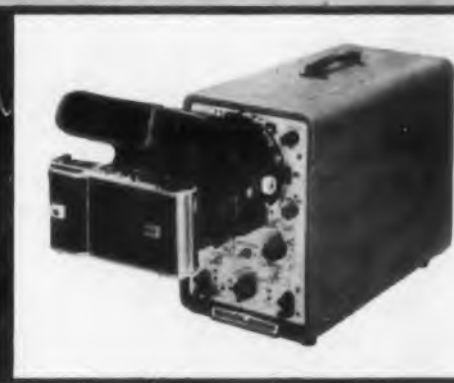
10 CM GRATICULE FILLS FULL FILM AREA!




Up to 11 equally spaced exposures available



Two 4 x 10 cm field exposures. No overlapping



New -hp- 196A Camera on -hp- 120A Oscilloscope

The new  196A Oscilloscope Camera is the most convenient means yet devised for recording oscilloscope traces. Operation is extremely simple and swift; loss of film from

light leakage is eliminated; mounting and unmounting takes just seconds; the entire unit is light weight, rugged, compact, yet a precision instrument in every respect.

Check the specifications below, and ask your  representative for demonstration on your oscilloscope.

Object/Image Ratio:	1 to 0.9. (Adjustable to 1:1 ratio)	Film:	Polaroid® Land types 42, 44, 46, 46-L.
Lens:	Wollensak 3" (75 mm) f/1.9 Oscillo-Raptar	Size:	13½" long, 9¼" high, 10" wide Weight 9 lbs.
Shutter:	Alphax #3. Time, Bulb, 1/100, 1/50, 1/25, 1/10, 1/5, 1/2, 1 second	Accessories Available:	Carrying case, Tektronix adapter
Print Size:	2-7/8" x 3-13/16"	Price:	\$425.00

Data subject to change without notice. Prices f.o.b. factory.


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How Fansteel 77 Metal PLUS Fansteel Engineering



added up to a
\$10,000 Saving!

Fansteel does more than just talk "customer savings." Take the case of these Fansteel 77 Metal contour parts, 3/4" thick x 9 1/2" high x 15" developed length with a radius of 9".



NEED A METAL 50% HEAVIER THAN LEAD?
Fansteel 77 is a metal produced especially for applications requiring maximum density in limited space. It is twice as heavy as steel, 50% heavier than lead, yet—much stronger than cast iron. Non-magnetic 77 Metal is easily machined and easily joined to other metals. Furthermore, it is **non-toxic** and **non-radioactive** requiring no special precautions in handling. Available in finished or semi-finished parts to your specifications or in bars, rods, rings, disks, special shapes.

Fansteel engineers developed new fabrication techniques which cut the cost 30% over former methods of producing the part. To the customer this added up to a \$10,000 saving on this one order alone.

It's just one more example of how the constant search by Fansteel engineers for cost-cutting ways of fabricating Fansteel metals, pays off in big savings for the customer.

Investigate the possibilities of similar savings on your parts... whether it's made from 77 metal, tantalum, molybdenum, columbium or tungsten. Call in the Fansteel man.



CIRCLE 300 ON READER-SERVICE CARD

NEW PRODUCTS

Indicator

Has 12-3/4 in. scale

Model 721 indicator has 300 deg indication and total scale length of 12-3/4 in. When used with accessories, it can be used to indicate such values as flow, liquid level, temperature, pressure, input motion, oxygen level, and resistance. Either a differential transformer receiver or a slidewire receiver can be incorporated for operation with suitable transmitters. Construction is 14-gage sheet steel.

The Hays Corp., Dept. ED, Michigan City, Ind.

CIRCLE 301 ON READER-SERVICE CARD



Power Supplies

Have outputs to 30 kv

These power supplies have continuously variable outputs from 0 to 30 kv in 0.5% increments. Model KV30-5 is rated at 5 ma; model KV30-2.5 is rated at 2.5 ma. The supplies may be operated with either negative or positive polarity. Input power is removed when load exceeds 110% of rated current. A series current limiter protects the supply against damage by short circuits. Both units weigh 55 lb; operation from 220 v 50/60 cps, single phase, may be obtained.

Kilovolt Corp., Dept. ED, 2 Manor House Square, Yonkers, N.Y.

CIRCLE 302 ON READER-SERVICE CARD

Overvoltage Tester

Provides 150 kv dc

This 150 kv dc overvoltage tester is rated at 5 ma, but provides 20 ma for burning. The use of air insulation accounts for smaller size and weight. Selenium rectifiers and corona shields are included. The open design of the unit facilitates maintenance. The required input is 115 v ac.

Peschel Electronics, Inc., Dept. ED, Towners, Patterson, N. Y.

CIRCLE 303 ON READER-SERVICE CARD

TUBE PROBLEM:

The Armed Forces needed a new version of the 6J4 reliable tube type which would provide a tube life of almost 1000 hours. Existing tubes of this type had an average life of only 250 hours. In addition, this new tube had to be produced under ultra-high quality control standards.

SONOTONE SOLVES IT:

By making improvements in the cathode alloy and setting up extremely tight controls in precision, manufacture and checking, Sonotone engineers produced a 6J4WA with a *minimum* life of 1000 hours... most running *much longer*.

RESULTS:

The Sonotone 6J4WA is one of three reliable tubes now being manufactured under U.S. Army Signal Corps RIQAP (Reduced Inspection Quality Assurance Program), monitored by the U.S. Army Signal Supply Agency. And the same rigid quality standards apply to Sonotone's entertainment type tubes as well.

Let Sonotone help solve *your* tube problems, too.

Sonotone

Electronic Applications Division, Dept. TGG-109

ELMSFORD, NEW YORK

Leading makers of fine ceramic cartridges, speakers, microphones, tape heads, electron tubes.

In Canada, contact Atlas Radio Corp., Ltd., Toronto

CIRCLE 304 ON READER-SERVICE CARD

CIRCLE 305 ON READER-SERVICE CARD

Biggest thirst in the universe

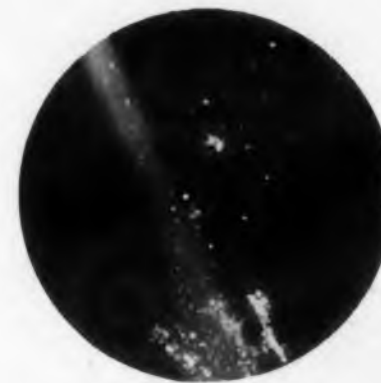


Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems. We are seeking qualified engineers and scientists to aid us in these and other projects.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with **DOUGLAS** Donald W. Douglas, Jr., President of

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- Dynamic Analysis of Flutter and Vibration
- Aeroelasticity
- Design of Complex Structure
- Trajectory Analysis
- Space Mechanics
- Welding
- Metallurgy

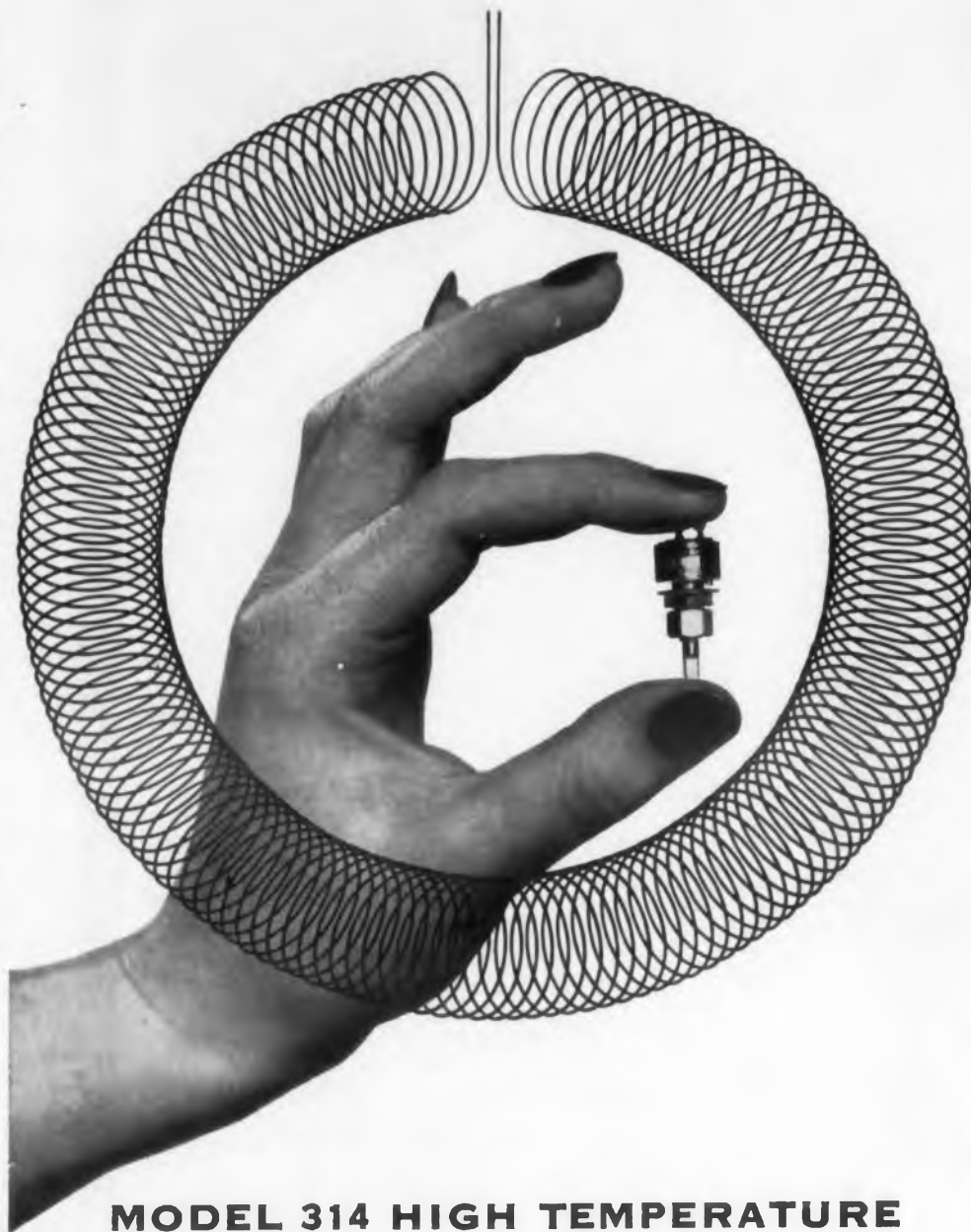
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- Mathematical Analysis

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write to:

Mr. C. C. LaVene
Box 601-E
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

CIRCLE 305 ON READER-SERVICE CARD



MODEL 314 HIGH TEMPERATURE SUBMINIATURE POTENTIOMETER

The Daystrom model 314 operates in temperatures from -55°C to $+250^{\circ}\text{C}$ withstanding shock to 20 G's in 3 axes and vibration from 20 G's to 2000 CPS. Meets MIL-E-5272 and other specifications for airborne applications.

SIZE: Dia. 0.5 inches... Length $\frac{3}{8}$ inches

WEIGHT: 9.8 Grams

POWER RATING: $2\frac{1}{2}$ watts at 40°C

LINEARITY: (best practical) 0.5%

Total resistance: 50Ω to 25K (variations available on request)

Resistance tolerance: $\pm 5\%$

For further information contact the representative in your area or the factory direct. Ask for Data File ED-279-1.

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CIRCLE 306 ON READER-SERVICE CARD

openings exist for highly qualified engineers



NEW PRODUCTS

LAVALIER MICROPHONE.— Model D-12 is 3-25/32 in. long. Frequency response is 70 to 12,000 cps; impedance is 50 ohms. Output level is -57 db.

American Microphone Manufacturing Co., Dept. ED, 412 S. Wyman St., Rockford, Ill.

CIRCLE 307 ON READER-SERVICE CARD

STEPPING SWITCH.—Stepping rate is over 15 per sec. This unit switches 1 amp inductive at 24 v. Operating range is -60 to $+160$ F. It can be supplied with rotary interrupter springs and off-normal springs.

Electrodyne Corp., Dept. ED, 503 S. McClay St., Santa Ana, Calif.

CIRCLE 308 ON READER-SERVICE CARD

CERAMIC DISC CAPACITORS.— Have capacitances of 0.03, 0.04, and 0.05 μf , 600 wvdc. Part of the DD series, they measure $\frac{7}{8}$ in. in diam and are $\frac{15}{64}$ in. thick.

Centralab, Div. of Globe-Union Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 309 ON READER-SERVICE CARD

PERMANENT MAGNET ALLOY.—Alnico VII A has an energy value of 2.8 million oriented. It has a high coercive force and resists demagnetization when subjected to high environmental heat. Applications include magnetic core meters and instruments.

Indiana Steel Products Co., Dept. ED, Valparaiso, Ind.

CIRCLE 310 ON READER-SERVICE CARD

TAPE DUPLICATOR.—Produces 150 copies in 8 hr. Model 10 makes three high-speed copies simultaneously and operates at 30 ips. Frequency response is from 50 to 10,000 cps.

Magnetic Recording Industries, Dept. ED, 126 Fifth Ave., New York 11, N.Y.

CIRCLE 311 ON READER-SERVICE CARD

MERCURY TIMER RELAY.—Operates on half the current of former models. This relay is available with normally open or normally closed contacts and time delays on opening or closing or both, in dc or ac types.

Durakool, Inc., Dept. ED, Elkhart, Ind.

CIRCLE 312 ON READER-SERVICE CARD

PLIERS.—Will skin 22- or 24-gage wire. Insulation is cracked in the slot provided in the nose. For telephone or electronic use, they are 6 in. long.

Mathias Klein & Sons, Dept. ED, 7200 McCormick Rd., Chicago 45, Ill.

CIRCLE 757 ON READER-SERVICE CARD

This package can end your worries about silicon processing . . .



Inside this box you'll find doped silicon single crystal slices from Allegheny.

Who needs them? You do . . .

If you wish to increase production without tying up capital in facilities for slicing, lapping, etching and such.

If you'd like to avoid being dependent on just one source of supply.

You solve either (or both) of these problems with Allegheny's new service because you get single crystal slices that are ready for use.

These slices from vertically pulled or float zoned crystals are doped to range with 99.999% group III and/or V elements. Standard thicknesses from .005" to .020" and diameters from $\frac{1}{4}$ to $1\frac{1}{2}$ inches.

As for lapping, this we do to your specification. If you wish, we prepare one or both sides for diffusion. Otherwise slices are etched, cleaned and dried before being delivered to you.

Details? We'll provide answers to your questions, promptly.

NOTE: You'll find that Allegheny devotes its efforts exclusively to producing ultra-pure silicon in every form. You might also be interested in more facts about bulk, billets, rods, doping alloys, seeds or special forms.

If so, write, wire or phone:

Allegheny Electronic Chemicals Co.
207 Hooker-Fulton Bldg., Bradford, Pa.
252 North Lemon St., Anaheim, Calif.

ALLEGHENY
ELECTRONIC CHEMICALS CO.

Producers of semiconducting materials for the electronics industry.

CIRCLE 313 ON READER-SERVICE CARD

Coaxial Cables

Four Types Available

These four types of coaxial cable meet or exceed MIL-C-17B. Type SSD single-shield, solid-dielectric is a minimum loss type with solid or stranded copper wire conductor, solid polyethylene dielectric, braided annealed copper shielding, and standard vinyl jacketing. It is also available in high or low temperature cable, with armor jackets of aluminum or steel and double shielding construction. Type SSDS single-shield, semi-solid dielectric cable has a higher velocity of propagation and lower capacitance than SSD cable due to the semi-solid polyethylene dielectric. Type JEL double-shielded, double-jacketed triaxial cable is for use where low radiation loss is required. It has solid copper or copper weld center conductor, solid polyethylene dielectric, braided annealed bare copper shielding, and Xelon jacketing. Type SSDL single-shield, solid-dielectric cable has an outside diameter of over 1 in. and is used at high power levels.

Times Wire and Cable Co., Inc., Dept. ED, Wallingford, Conn.

CIRCLE 314 ON READER-SERVICE CARD

Servo Amplifiers

Operate in -55 to $+100$ C range

These 400 cps transistorized servo amplifiers deliver rated power continuously in an ambient temperature of -55 to $+100$ C. They are designed to drive any standard size 11, 15, or 18 servo motor with a 40 v center tapped control winding. Type T2000 has a voltage gain of 1000 and a power output capability of 3.5 w at 40 v rms. It measures 1 x 1 x 1 in. Type T5000 measures 1-7/8 x 1-5/8 x 3, has a gain of 1500 and an output capability of 6.2 w. Type T6000 has a voltage gain of 1000 and an output capability of 9.3 w. It measures 2-3/8 x 1-3/4 x 3-3/4 in. All units operate from a 28 v dc source and have a 10,000 ohm input impedance.

Magneto, Inc., T.A. Div., Dept. ED, 6 Richter Court, E. Northport, N.Y.

CIRCLE 315 ON READER-SERVICE CARD

CIRCLE 316 ON READER-SERVICE CARD



213,149,873
cycles

Test proves reliability of P&B's LS telephone type relay

These 16 LS relays, wired into a self-cycling chain, each operated 213,149,873 times before the test was discontinued. This test was made for a nationally prominent manufacturer and the certified results are available upon request.

Here is proof of the inherent reliability of P&B telephone type relays... and of the kind of performance you can expect when you specify them. LS relays are available with up to 20 springs (10 per stack) and are adaptable for printed circuit mounting.

Whenever multiple switching of loads up to 4 amperes is required, the LS can usually meet space, weight and—importantly—price considerations. Get full information today by calling or writing Zeke R. Smith, vice president, Engineering, or contact your nearest P&B representative.

LS ENGINEERING DATA

GENERAL:

Breakdown Voltage: 1,000 volts rms 60 cy. min. between all elements.
Ambient Temperature: -55° to $+85^{\circ}$ C.
Weight: 3 to 4 oz.
Dimensions: 1 1/2" W. x 2 3/8" L. x 1 1/2" H. (4 Form C)
Enclosures: Sealed or dust cover (W can) Sealed or dust cover, up to 6 Form C, single contacts (D can)
Mountings: Four #6-32 tapped holes 3/4" x 3/8" o.c. Other mountings available.

CONTACTS:

Arrangements: 20 springs (10 per stack) max.
Material: 1/16" dia. twin palladium. Other materials available for specific applications.
Lead: 4 amps @ 115 volts 60 cy. resistive.

COIL:

Resistance: 55,000 ohms max.
Power: 65 mw DC per movable standard (50 mw possible); 3.5 watts max. at 25° C.
Voltage: Up to 200 volts DC.

TERMINALS:

Contacts: Three #18 AWG wires.
Coil: Three #20 AWG wires.
 Available with octal plug, taper tabs or printed circuit pins.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



TS RELAY

Short coil relay is available in AC and DC versions. Long life construction. Can be supplied (DC) with up to 20 springs (10 per stack).



GS RELAY

Excellent sensitivity: 50 mw per movable arm minimum (DC). For applications requiring many switching elements in small space.



BS RELAY

Long coil provides high sensitivity (25 mw per movable arm) and room for slugs for pull-in delays (150 milliseconds max.) or drop-out delays (600 milliseconds max.).

FREE

LS DETERMINATION DATA
 Send today for booklet containing certified results of recent test described above. Data includes test circuit, interim and final measurements.



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DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA

IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

NEW PRODUCTS

NPN Germanium Transistors

Five types available

Types 2N444, 2N445, 2N446, 2N447, and 2N306 germanium npn alloy junction transistors are made to conform to JETEC, TO-9 outline. Types 2N444, 2N445, 2N446, and 2N447 are for small-signal amplifier and high-speed switching applications. The ac current gain and alpha cut-off frequency increase progressively with the type numbers. Type 2N306, for general purpose applications, has a collector to base voltage of 20 v dc at 25 C. The other transistors have a collector to base voltage of 15 v dc.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 317 ON READER-SERVICE CARD

Acoustic Vibration System

Produces 147 db white noise



For testing aircraft and missile components, this acoustic vibration system produces 147 db of white noise. The 30 cu ft reverberation chamber contains 16 lf and 16 hf loudspeakers and two microphones. Eight 260 w power amplifiers supply electronic signals.

Ling-Altec Electronics, Inc., Dept. ED, Anaheim, Calif.

CIRCLE 318 ON READER-SERVICE CARD

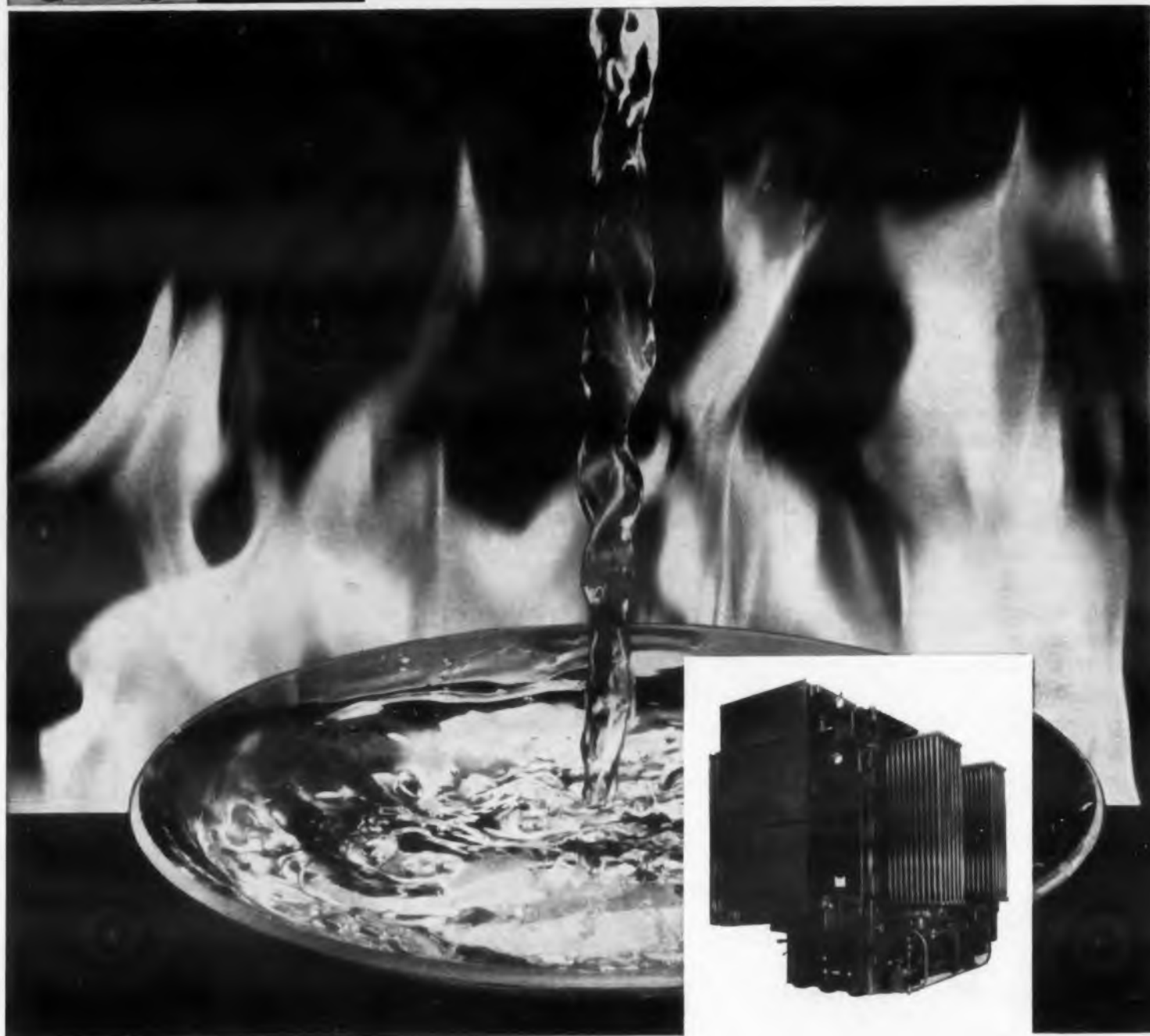
Generator Relay

Minimum operating current is 0.14 amp

Type SA high-speed generator relay, for all protective circuit functions, has a minimum operating current of 0.14 amp through one restraint circuit and the operating circuit in series. No auxiliary transformers or other external compo-



THE RAW MATERIALS OF PROGRESS



FC-75 DAMPS DANGER, CUTS COSTS

Non-flammable, non-explosive 3M inert liquids now allow high voltage transformers to be vapor-cooled with complete safety. And that means they can be located right next to the load.

The result: big savings in installation and maintenance costs. Power loss is reduced! And fluorochemically cooled V/g transformers can be installed in residential areas, crowded downtown areas . . . even indoors . . . without firewalls, drainage pits, sprinkler systems or other fire prevention equipment.

That's why Westinghouse Electric Corporation has chosen

3M Brand Fluorochemical Inert Liquid FC-75 for its V/g transformers.

Their report — greater safety, reduced installation costs. More quiet operation (with fluorochemicals, transformers are self-cooled at 100% load), no maintenance required for the coolant or the core and coils!

Fluorochemicals are outstanding for practical use as evaporative coolants and insulators. They're also non-explosive, non-corrosive, non-toxic, non-flammable and they're odorless. Investigate the remarkable properties of 3M fluorochemical inert liquids in terms of your own product design and performance problems.

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MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW





3M FLUORO-CHEMICAL FC-76 has a pour point of -150°F. , giving it a useful liquid range of -150°F. to 212°F. at atmospheric pressure. In addition, it offers these other useful properties: High dielectric strength in both liquid and vapor state (37 KV @ 0.1" gap for liquid) . . . self-healing in high voltage electrical equipment after repeated arcing . . . excellent wetting power on all types of surfaces . . . compatible with materials commonly used in the construction of high temperature equipment . . . thermally stable to temperatures in excess of 50°F. and, even under extreme use conditions does not form sludge or corrosive products. Heat capacities in both liquid and vapor state are approximately equal.

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Oils, Waxes and Greases • Dispersion
Coatings • Functional Fluorochemicals
• Surfactants and Inert Liquids

CIRCLE 320 ON READER-SERVICE CARD

nents are required; the relay is simply connected to conventional current transformers. At 5 amp, 60 cps, the relay requires 0.25 va from each current transformer.

Westinghouse Electric Corp., Dept. ED, P.O. Box 2099, Pittsburgh 30, Pa.

CIRCLE 319 ON READER-SERVICE CARD

Angular Position Transducer

Output is 6 v ac



Providing an ac output as a function of shaft rotation, model 2203 angular position transducer delivers 6 v full scale or 5.5 ± 0.1 mv per v per deg of arc. The range is ± 45 deg and shaft rotation is continuous. The unit withstands acceleration to 50 g, shock to 100 g, and vibration to 35 g with less than $\pm 0.1\%$ error. Sensitivity is better than 0.005 deg of arc. The required input is 24 v 400 cps. Having a life expectancy of over 10,000,000 cycles, the unit meets the environmental requirements of MIL-E-5272A procedure I and the altitude requirements for MIL-E-5272A procedure II.

Bourns, Inc., Dept. ED, P.O. Box 2112, Riverside, Calif.

CIRCLE 321 ON READER-SERVICE CARD

Electrometer

Measures below 3×10^{-15} amp



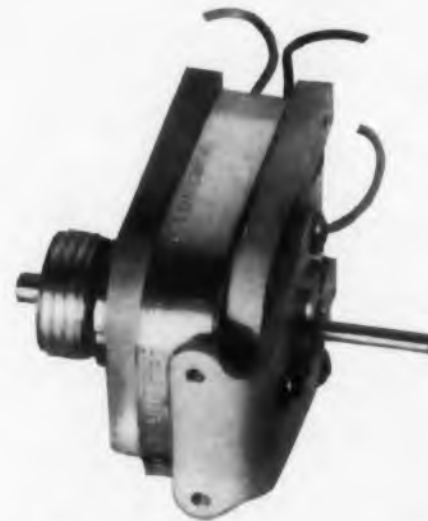
Model 201C electrometer amplifier can measure ac or dc currents below 3×10^{-15} amp. It has a low grid current pentode input, single-ended filamentary amplifier stages, and Zener stabilization.

E-H Research Laboratories, Inc., Dept. ED, 1922 Park Blvd., Oakland 6, Calif.

CIRCLE 322 ON READER-SERVICE CARD

Walks, Frots and Runs On Pulses

... IN 18° JERKS, UP TO 300 JERKS A SECOND



The Cyclonome®

(a stepping motor):

- a device with wires going in and a shaft sticking out.
- looks like a primitive electric motor.
- ratchets magnetically. Has only one moving part, supported by ball bearings.
- runs by alternating magnetic field (variously produced by juice in the wires) in even, powerful jerks, 20 per revolution.
- if hooked up right, according to the dope in our new Bulletin, the number of 18° steps will forever be the same as the number of pulses sent down the wires.
- go by the rules, and you can produce analogs on precision pots or capacitors, find places on magnetic tape or numbers on coding discs, get high speed multi-throw switching, index movie film, or just count bits on drum counters at speeds not otherwise possible.

There are also other things you could do with this motor, we hope, and here is what you have to work with. The Cyclonome has 20 stable positions or 20 steps per revolution . . . a max. torque of 80 gm-cm . . . an inertia of 0.7 gm-cm² . . . a max. pulse rate of 300 pps with pure inertia load of 1 gm-cm² or pure friction of 40 gm-cm. Circuit power requirements range from $\frac{1}{3}$ to 40 watts depending on

speed and load. Physically, the motor measures about 1 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ " x 1 $\frac{1}{4}$ " high (except for the shaft) and weighs about 11 ounces.

If your curiosity has now been aroused, we'd be delighted to send you the new Bulletin and tell you whatever else we might know about applying the Cyclonome to your application.

At Canadian I. R. E. Booth 341
NEC-Chicago Booths 188-189

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An Affiliate of the Fisher-Pierce Co. (Since 1939)
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In the game of tick-tack-toe, the right *second move* is very important. It can pre-determine the winner.

The same principle applies in purchasing precision nuts. *First*: decide the type and size of nut required. *Second*: specify the recognized source for quality, delivery and price . . . Fischer Special Mfg. Co.

As the leading producer of "turned" nuts, Fischer supplies standard, special and miniature nuts to exact customer specifications. Fischer nuts, mass produced by unique automatic machines, cost no more than those made by less precise methods . . . but their uniform accuracy assures fewer problems and new savings in fastening and assembly operations. *That makes you the winner!*

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there's no premium for precision at



***Fischer* SPECIAL MFG. CO.**

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CIRCLE 324 ON READER-SERVICE CARD

NEW PRODUCTS

Cooling Units

Available in sizes from 10 to 50,000 w



Available in sizes from 10 to 50,000 w, these cooling units are used to cool electronic tubes and high-power resistors or as heat exchangers for calorimeters. Transformer oil OS45 or DC200 fluid can be used. Operation is from 28 v dc or 110 v ac. The heat exchanger, circulating pump, storage tank, and flow and pressure interlocks are contained in the unit. The model shown dissipates 1500 w.

Electro Impulse Laboratory, Dept. ED, 208 River St., Red Bank, N.J.

CIRCLE 325 ON READER-SERVICE CARD

NPN Germanium Transistors

For switching applications

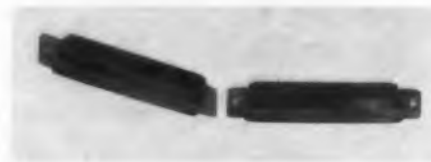
These npn germanium transistors are for switching and flip-flop circuits. Types 2N556 and 2N558 are for computer switching applications. Types 2N1000 and 2N1012 are for high-speed computer switching. Type 2N312 is for low-power switching in the audio and ultrasonic frequency spectrum. The transistors conform to the JETEC, TO-9 outline.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 326 ON READER-SERVICE CARD

Miniature Plugs

Four types available

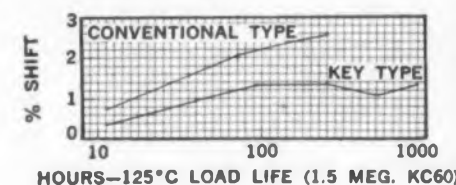


These miniature plugs, designated the Golden D series, are available with four types of contacts: miniature, grounded coaxial, ungrounded coaxial, and high voltage. The miniature contacts are for wire size 20 or smaller. The ungrounded coaxial contacts are snapped into the insulators after they are attached to cables. The plugs have one-piece



new
precision film
RESISTORS
—silicone oil filled
and hermetically
sealed for
long-term stability

To obtain maximum stability in these resistors, KEY uses new, automatic flux-free soldering techniques. These permit oil filling — an exclusive feature. Resistors are 100% X-ray inspected and seal tested. With this construction, KEY resistors give longer life under load . . . more stability under heat and high voltage.



Cool Running — Key units have up to 52% more resistor area than conventional types.

Meet all Mil. Specs. — including MIL-R-10509C, Characteristic B. Available in all military sizes, plus 1/8 watt and 1/10 watt . . . resistance values from 5 ohms to 20 megohms. Deliveries: 2 weeks most styles. Write for complete data in Bulletin 557.



KEY RESISTORS

KEY RESISTOR CORP.
321 W. Redondo Beach Blvd.
Gardena, California
FActory 1-4980

CIRCLE 327 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Stromberg-Carlson

"TELEPHONE QUALITY"

Relays



... featuring new high-voltage types for test equipment or other high-voltage applications.

THE insulation in the new relays withstands 1500 volts A.C.—3 times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

Type A: general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.

Type B: a gang-type relay with up to 60 Form "A" spring combinations.

Type BB: relay accommodates up to 100 Form "A" springs.

Type C: two relays on the same frame. A "must" where space is at a premium.

Type E: has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.

Complete details and specifications are contained in our new relay catalog, available on request. Write Stromberg-Carlson Telecommunication Industrial Sales.

STROMBERG-CARLSON
DIVISION OF GENERAL DYNAMICS
1 CARLSON RD. • ROCHESTER 3, N. Y.

insulators, and a finish of gold Iridite over cadmium plate. Low engagement and separation forces are required.

Cannon Electric Co., Dept. ED, P.O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 328 ON READER-SERVICE CARD

Variable Delay Lines

Resolution time is less than 0.08 μ sec



Delay times to 32 μ sec and resolution times of less than 0.08 μ sec are available in these two series of variable delay lines. Series 611a is a continuously variable and step variable delay line. Series 611b is a 12-position tapped step delay line. Rise time for both series is less than 7% of time delay. Both types have more than 150 sections of LC networks; each section produces linear phase shift of more than 70% of the cut-off frequency. Eight models are available having the following total delay: 8, 12, 16, and 32 μ sec. The output impedances are 150, 400, 750, 800, and 1300 ohms. The units measure 7-3/4 x 7-3/4 x 5-1/2 in.

Electronics Laboratory, Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.

CIRCLE 330 ON READER-SERVICE CARD

Miniature Motor

Has 1.5 hp



Model 38BG3 miniature 10-pole, 200 v, 400 cps motor has 1.5 hp. For application on a centrifugal blower, the motor has an output shaft speed of 4600 rpm and is designed for continuous duty. It measures 3 in. in diameter.

Western Gear Corp., Electro Products Div., Dept. ED, 132 W. Colorado Blvd., Pasadena, Calif.

CIRCLE 331 ON READER-SERVICE CARD

BUILD ON...

EASTERN

TEMPERATURE CONTROL EXPERIENCE:

AVIONIC COOLING

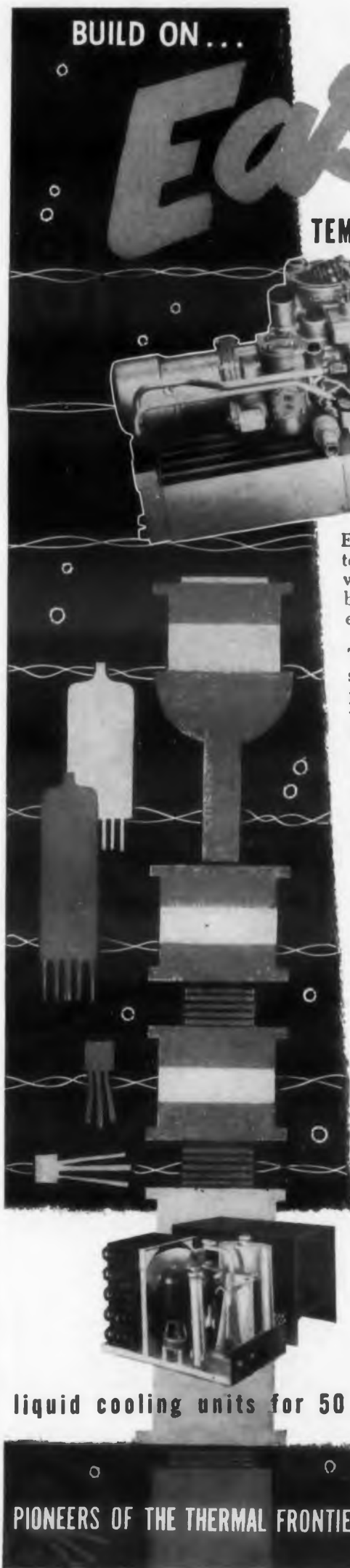
Eastern cooling packs for electronic subsystems extend operating ranges to altitudes where air cooling becomes ineffective. 'Black box' designs can be more compact—reliable even at five times the speed of sound.

These liquid cooling systems are completely self-contained—provide such components as pumps, heat exchangers, air impellers, reservoir, coolant flow and temperature interlocks and similar parts.

Cooling capacities of existing systems range from 1,000 to 22,000 watts dissipation rates. Eastern cooling packs take ambient temperatures from -55°C to $+55^{\circ}\text{C}$ in stride, and perform to altitudes of 60,000 ft.

Extensive experience in missile applications has enabled Eastern to develop systems unusually compact and light as well as highly reliable. At the same time, Eastern is able to provide at minimum cost equipment engineered to a specific need by using missile-proved components designed to your system configuration.

Turn to Eastern for space-, weight-, and cost-saving solutions to your hottest cooling problem. Write for New BULLETIN 360.



liquid cooling units for 50 to 50,000 watts dissipation

PIONEERS OF THE THERMAL FRONTIER

EASTERN INDUSTRIES INCORPORATED

100 SKIFF STREET
HAMDEN 14, CONN.



CIRCLE 332 ON READER-SERVICE CARD

CIRCLE 329 ON READER-SERVICE CARD

1959 ELECTRONIC DESIGN • October 14, 1959

139

BROWN MOTORS

... for chart drives, servos, balancing circuits



STACK-TYPE MOTORS

These newly designed motors have such maintenance saving features as: sectional housing . . . wick-type lubrication . . . printed circuits . . . ball bearings . . . shock absorbers . . . alignment keying rings. Any major part replaceable in two minutes.



OIL-SEALED MOTORS

These field-proven motors feature self-lubrication, have shock absorbers, are totally enclosed and oil sealed.



MILITARY MOTORS

These are oil-sealed-type motors, modified to comply with MIL-M-17059. Housing is treated as specified in MIL-C-5541, and leads are fungus resistant as per MIL-V-173.

... All motors are available in two phase and synchronous models

SPECIFICATIONS (applicable to all motors described above)

Two Phase Induction Motor

Nominal No Load R.P.M.*	Gear Ratio	Intermittent Rated Load (oz.-in.)	Maximum Starting Torque (oz.-in.)	Power (Watts) Loaded	Current (amp.) †Loaded	Temp. Rise °F
330	44:1	4	10	11.5	0.11	70
144	10:1	5	20	11.5	0.11	70
48	30:1	15	60	11.5	0.11	70
23	60:1	30	110	11.5	0.11	70

Synchronous

R.P.M.*	Gear Ratio	Pull-in Torque Minimum (oz.-in.)	Continuous Torque (oz.-in.)	Power (Watts) Loaded	Current (amps.) Loaded	Temp. Rise °F
180	10:1	12	12	24.0	0.21	100
180	10:1	2	2	11.5	0.11	65
90	20:1	14	12	11.5	0.11	65
60	30:1	21	18	11.5	0.11	65
30	60:1	42	36	11.5	0.11	65

*1/6 less at 50 cycles

†Field winding 11.0 watts, balance in amplifier winding

Note: Some speeds available at 25 cycles

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Aves., Phila. 44, Pa.

Honeywell



First in Control

CIRCLE 333 ON READER-SERVICE CARD

NEW PRODUCTS

VHF Transceiver

For aviation use



Designed for panel mounting in light and medium aircraft, this 360-channel transceiver model 618F-1, covers the range of 118 to 135.95 mc with 50 kc spacing. The transceiver provides pilots with a transmitter output of 6 w min. Model 427D-1 power supply, for use with the transceiver, contains the fixed if amplifier, audio amplifier-modulator, and power supply. It is adaptable to 13.75 or 27.5 v. The entire transceiver system weighs 12.6 lb and measures 3-3/4 x 5-3/4 x 9-7/32 in.

Collins Radio Co., Dept. ED, P.O. 1891, Dallas 21, Tex.

CIRCLE 334 ON READER-SERVICE CARD

Electro-Magnetic Clutch

Wet-type



For use in semi-automatic and fully automatic process machines and in program and tracer machines, type KA wet-type electro-magnetic clutch permits a wide variety of spindle speeds, feed and traverse movements, and directional changes. The capacity range is 0.25 to 34.5 hp at 100 rpm with maximum torque of 14.5 to 1812 ft-lb. Standard coils are 90 v dc; coils with other voltages can be supplied. The standard unit needs no transformer. The clutch operates with the annular flux through the plates. Eight sizes with diameters from 3.3 to 11.5 in. are available.

Twin Disc Clutch Co., Dept. ED, Racine, Wis.

CIRCLE 335 ON READER-SERVICE CARD

Scanning Printer

Scans one column in 0.25 sec



Made to print data from high impedance decimal sources, this solenoid-actuated, self contained scanning printer scans and prints numbers stored in glow counter tubes, digital ohmmeters, and Nixie display counters.

The printer makes simple listings, adds, subtracts, multiplies, and divides. In normal operation it scans one column in 0.25 sec. An additional 0.27 sec is added with non-totalizing printers and 0.35 with totalizing models. It operates on a minimum of 10 v dc. Models with special symbols can be supplied.

Victor Adding Machine Co., Dept. ED, 3900 N. Rockwell St., Chicago 18, Ill.

CIRCLE 336 ON READER-SERVICE CARD

Counter

Dual bank type



Model Y dual bank counter is for use in navigation and tracking equipment, machine tools, and all digital readout equipment where plus and minus readings are needed. It is available in right hand drive, left hand drive, clockwise, and counterclockwise rotation with 3, 4, and 5 digits.

It operates over the temperature range of -55 to $+75$ C and has nylon wheels and pinions to reduce torque and moment of inertia.

Durant Manufacturing Co., Dept. ED, 1993 N. Buffum St., Milwaukee 1, Wis.

CIRCLE 337 ON READER-SERVICE CARD

NEW TRANSISTORIZED PORTABLE OSCILLOSCOPE

Operates from $\left\{ \begin{array}{l} \text{Internal Battery,} \\ \text{External DC} \\ \text{and AC Line} \end{array} \right.$



TYPE 321

TRULY PORTABLE

- Battery Powered.
- Weighs only 13½ lbs. without batteries.
- Batteries weigh 2 to 4 lbs.
- Size only 5¼" x 8¼" x 16".

HIGH PERFORMANCE

- Vertical Response: DC to 5 MC, 0.07 μ sec risetime.
- Calibrated Sensitivity: 0.01 v/div to 20 v/div in 11 calibrated steps. Continuously adjustable from 0.01 v/div to 50 v/div.
- Calibrated Sweeps: 0.5 μ sec/div to 0.5 sec/div in 19 calibrated steps. Accurate 5x magnifier extends calibrated range to 0.1 μ sec/div. Continuously adjustable from 0.1 μ sec/div to 1 sec/div.
- Simplified Triggering: Fully automatic, or amplitude-level selection with preset stability control.
- 4-KV Accelerating Potential on 3" crt.
- 6-div by 10-div Display Area.
- Amplitude Calibrator.

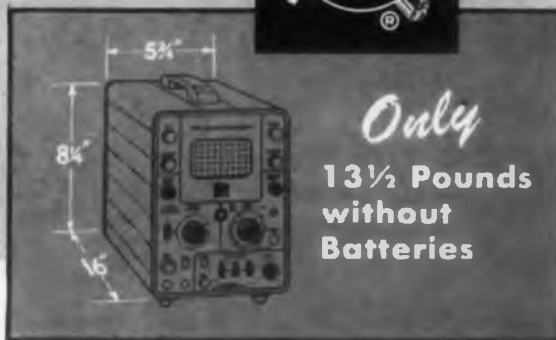
NO POWER SOURCE PROBLEMS

- Operates from:
1. Ten size D Flashlight cells, ½ hour continuous, more with intermittent, operation.
 2. Ten rechargeable cells, 2.5AH—3 hours continuous operation. Ten rechargeable cells, 4.3AH—5 hours continuous operation.
 3. 11 to 35 v dc (aircraft, auto, boat, etc.).
 4. 105 to 125 v ac or 210 to 250 v ac, 50 to 800 cps.

Price \$775.00
Built-in Battery Charger 35.00
Complete Set of 2.5AH Batteries 36.50
f.o.b. factory

If you missed the Type 321 at WESCON, see it at NEC, booth 193-194.

CIRCLE 338 ON READER-SERVICE CARD



Only
13½ Pounds
without
Batteries

It's so easy to take the Type 321 wherever an oscilloscope is useful. It's a convenient solution to many difficult situations, too . . . for example: Where power cords are apt to be a nuisance—where isolation from ground is desirable—where power-line fluctuations are troublesome—where hum pick-up is a problem. The Type 321 is sure to satisfy your portable oscilloscope needs.

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albertson, L.I., N.Y. • Albuquerque • Atlanta, Ga. • Buffalo
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Fla. • Stamford, Conn. • Syracuse • Towson, Md. • Union, N.J. • Washington, D.C. • Willowdale, Ont.

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon,
Seattle, Wash.; Hytronic Measurements, Denver, Colo.; Salt Lake City, Utah.

Tektronix is represented in 20 overseas countries by qualified engineering organizations.

ENGINEERS—Interested in furthering the advancement of the oscilloscope? We have openings for men with creative ability in circuit and instrument design, cathode-ray tube design, and semiconductor research. Please write Richard Ropiequet, V.P., Eng.

NEW GIANT narda SONBLASTER



Generator G-5001
500 watts output
Transducerized Tank NT-5001
Capacity: 10 gallons
Dimensions: 20" L x 11½" W x 10" D

Generator features tank selector and load selector switches on front panel to operate one or two NT-5001 tanks alternately. Other combinations of tanks and submersible transducers available from stock; larger tanks available on special order.

\$1325

For mass-production cleaning and high capacity chemical processing!

Here's a new Narda SonBlaster ultrasonic cleaner with tremendous cavitation activity and generating capacity! Featuring full 500 watts output, this SonBlaster is available with a fully transducerized giant 10-gallon capacity tank. In addition, it will operate from six to 10 Model NT-605 high energy submersible transducers, at any one time, in any arrangement in any shape tank you need up to 70-gallon volume.

Install this new Narda SonBlaster, and immediately you'll start chalking up savings over costly solvent, vapor or alkaline degreasing methods! You'll save on chemicals and solvents, cut maintenance and downtime, eliminate expensive installations, save on floor space, and release labor for other work. But perhaps most important, you'll clean faster, cut rejects, and eliminate bottlenecks.

Whether you're interested in mass-production cleaning or degreasing of mechanical, electronic, optical, or horological parts or assemblies... rapid, quantity cleaning of "hot-lab" apparatus, medical instruments, ceramic materials, electrical components or optical and technical glassware... or in speeding up metal finishing and chemical processing of all types—you'll find this new SonBlaster will do your work faster, better and cheaper. Write for more details now, and we'll include a free questionnaire to help determine the precise model you need. Address: Dept. ED-20.

Consult with Narda for all your ultrasonic requirements. The SonBlaster catalog line of ultrasonic cleaning equipment ranges from 35 watts to 2.5 KW, and includes transducerized tanks as well as immersible transducers which can be adapted to any size or shape tank you may now be using. If ultrasonics can be applied to help improve your process, Narda will recommend the finest, most dependable equipment available for immediate delivery from stock—and at the lowest price in the industry (\$175 up)!

For custom-designed cleaning systems, write to our Industrial Process Division; for information on Chemical processing applications, write to our Chemical and Physical Process Division; both at the address below.

the narda ultrasonics
corporation
625 MAIN STREET, WESTBURY, L. I., N. Y.
Subsidiary of The Narda Microwave Corporation

CIRCLE 339 ON READER-SERVICE CARD

NEW PRODUCTS

Laboratory Cabinet

Has 17 ft capacity



This laboratory cabinet automatically controls temperature and humidity to simulate changing environmental conditions for testing products and controlling research processes. Standard type LSC-16 cabinet has over 17 ft capacity. The temperature range is to 180 F and relative humidity is to 96%. A special version of this cabinet is available offering a temperature range of 0 to 300 F. Its cycling time pattern controls and cooling unit meet JAN and Mil specs. Made of polished stainless steel, these cabinets can be equipped with side ports for inspection of instrument leads to data recorders. The doors are sealed with heavy molded-rubber gaskets; a door with thermopane inspection window and built-in wiper can be supplied.

Anetsberg Brothers, Inc., Dept. ED, 186 N. Anets Dr., Northbrook, Ill.

CIRCLE 340 ON READER-SERVICE CARD

Rotary Switches

Handle shaft speeds to 1000 rpm



For use in missiles and aircraft systems, type P1280-11A precision rotary switches can handle up to 1000 rpm shaft speed. These components are used to sequence or switch circuitry as a function of time or of shaft position. They are suitable for sensitive relays or solid state switching.

NATVAR



ISOLASTANE TUBING and TAPE

**HEAT
RESISTANT**

—for continuous performance at temperatures up to 155°C

**RESILIENT,
ELASTIC**

— for sharp bends and irregular surfaces



Natvar Isolastane Fiberglass base tubing ▲ and bias tape ▼ fit snugly when applied, and retain their elasticity at continuous operating temperatures up to 155°C. They withstand higher temperatures during manufacturing processes without embrittlement.



*ISOLASTANE is Natvar's new elastomeric isocyanate type coating for Fiberglass braid and tape. Reg. U. S. Pat. Off.

Natvar Isolastane is now making important savings possible. It makes it unnecessary to use expensive Class H materials to solve temperature problems during the manufacture of products which do not require Class H rating.

Isolastane is outstanding in its

- ELASTICITY (EXTENSIBILITY)
- RESISTANCE TO HEAT
- RESISTANCE TO CRAZING AND CRACKING
- RESISTANCE TO SOLVENTS, INCLUDING THE ASKARELS
- TOUGHNESS AND ABRASION RESISTANCE
- WET DIELECTRIC STRENGTH
- LOW TEMPERATURE FLEXIBILITY
- FUNGISTATIC QUALITIES

Full technical data and samples are available on request.



Natvar Products

- Varnished cambric—sheet and tape
- Varnished canvas and duck—sheet and tape
- Varnished silk and special rayon—sheet and tape
- Varnished papers—rope and kraft—sheet and tape
- Varnished, silicone varnished and silicone rubber coated Fiberglass—sheet and tape
- Slot cell combinations, Aboglas®
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglass tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers *T.M. (Reg. U.S. Pat. Off.) OCF Corp.

We will be very happy to supply information on any of our products on request.

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE CABLE ADDRESS
FULTON 7-8800 NATVAR: RAHWAY, N.J.

241 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

CIRCLE 341 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

a direct line
from **AEL**



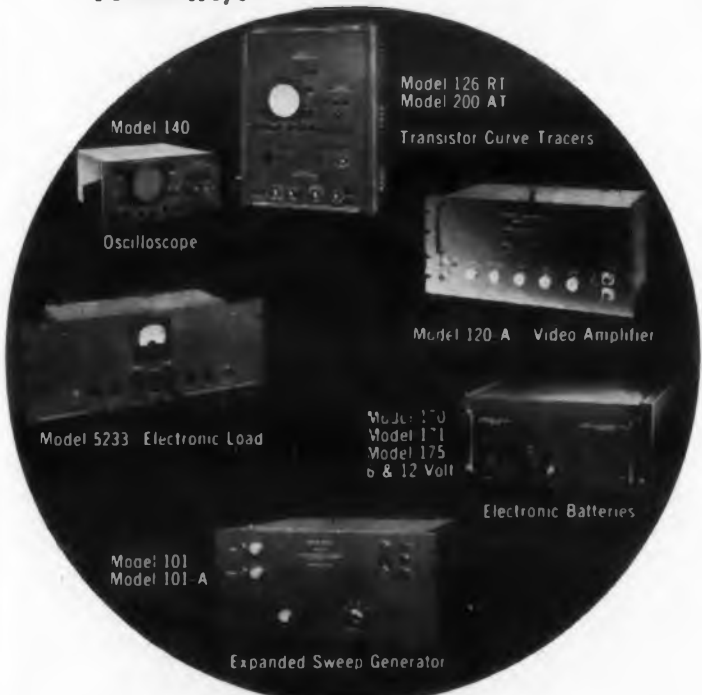
Model 138

PULSE GENERATOR
for use in

SONAR • VIDEO DESIGN • COUNTERMEASURES
• RADAR • ACOUSTICS • ANALOG and
DIGITAL COMPUTERS • PULSE THRESHOLD
CIRCUITRY • COMMUNICATIONS
• RELAY STUDIES • ETC.

The AEL "138"... A TRULY UNIVERSAL PULSER

- SINGLE OR RECURRENT PULSES
- PULSE PAIRS OR PULSE TRAINS
- PULSE WIDTHS FROM 1 μ SEC. TO 1 SEC.
- REVERSIBLE POLARITY
- 35 VOLTS into a 50 OHM LOAD
- ALL TYPES OF SYNCHRONIZATION
- REPETITION RATES FROM 1/2 CYCLE PER SEC. TO 250 KC/s



Model 140 Oscilloscope

Model 126 RT
Model 200 AT
Transistor Curve Tracers

Model 120 A Video Amplifier

Model 5233 Electronic Load

Model 170
Model 171
Model 175
6 & 12 Volt
Electronic Batteries

Model 101
Model 101 A
Expanded Sweep Generator

AEL offers a complete ENVIRONMENTAL TESTING FACILITY for your components or assemblies... PLUS a top-notch team of electronic and mechanical engineers to assist in solving your problems in instrumentation, communication or telemetry systems and microwave propagation and transmission.

• Investigate the opportunities at AEL for creative engineers

AMERICAN ELECTRONIC LABORATORIES, INC.

121 N. 7TH ST. PHILADELPHIA 6, PENNA.

CIRCLE 343 ON READER-SERVICE CARD

Each unit has two switching tracks. The starting and running torque is 0.1 oz-in. Current capacity is 50 ma at 28 v per brush.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 342 ON READER-SERVICE CARD

Power Supply

Provides three regulated outputs



Model 155 transistorized power supply provides three regulated outputs: 15 v dc at 300 ma, 8 v dc at 700 ma, and 30 v dc at 1.5 amp. Regulation is within 0.1%. The outputs are floating. Either the negative or positive side may be grounded and voltages are adjustable over about 10% of the range. Ripple is 0.1%, maximum recovery time is 50 μ sec, and overshoot is less than 1% of the voltage setting. The required input is 105 to 125 v 400 cps. Designed for a 19 in. relay rack, the unit is 7 in. high.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 344 ON READER-SERVICE CARD

Radar Display Tube

Electrostatic



For single-stage transistor drive, type K1868 cathode ray tube is focused and deflected electrostatically. This 12-1/2 in. diameter tube requires 10 v grid drive from extinction of a focused non-deflected spot or 7 v from raster cut-off for 50 μ a screen current. Maximum deflection factors of 125 v per in. are maintained in both scan directions at accelerator and post accelerator voltages of 5.5 and 9.5 kv.

Allen B. Du Mont Laboratories, Inc., Dept. ED, Clifton, N.J.

CIRCLE 345 ON READER-SERVICE CARD

Bristol miniature pressure switch features ultra-reliable precision pressure element. Exclusive design provides outstanding resistance to shock, vibration, acceleration and overpressures.

These Bristol miniatures, widely proved in modern aircraft, are designed for switching electrical circuits in response to pressure changes in air, fuels, lubricants, hydraulic fluids, other gases and liquids.

Bristol's specially designed Ni-Span element is silver brazed to the stainless steel base assuring greater reliability than ordinary soft-soldered construction. Result: accurate, reliable, repeatable performance in any position, at temperatures from -65°F to +250°F, and under Mil Spec environmental requirements.

Write for Bulletin AV2010 on Bristol Miniature Gage and Absolute, Adjustable and Differential Switches. The Bristol Company, Aircraft Components Division, 151 Bristol Road, Waterbury 20, Conn.

B-44



SPECIFICATIONS (Fixed pressure setting models)

Normal Working Range — 0 to 100 psi absolute, gage, or differential

Burst Pressure — exceeds 250% of normal working pressure

Electrical Ratings — 5 amp at 125 v, 60 cycle, inductive or resistive
4 amp at 30 vdc resistive
2.5 amp at 30 vdc inductive

Dielectric Strength — 500 v rms between terminals and from terminals to case (MIL-S-8801)

Life at Rated Electrical Load — 40,000 cycles at 125 vac
25,000 cycles at 28 vdc

High Temperature Exposure & Operating — (MIL-S-8801) 250°F

Low Temperature Exposure & Operating — (MIL-S-8801) -65°F

Shock, 30 g, 3 axes — (MIL-S-8801) no change

Vibration — (MIL-S-8801) no contact chatter, no switch damage

300-600 cpm at 0.050" d.a. — set point change — none
operating differential change — none

600-4500 cpm at 0.036" d.a. — set point change — 1/4 psi
operating differential change — 1/2 psi

4500-30,000 cpm at 10 g — set point change — 1/4 psi
operating differential change — 1/2 psi

Diameter — 1-5/16

BRISTOL FINE PRECISION INSTRUMENTS
FOR OVER 69 YEARS

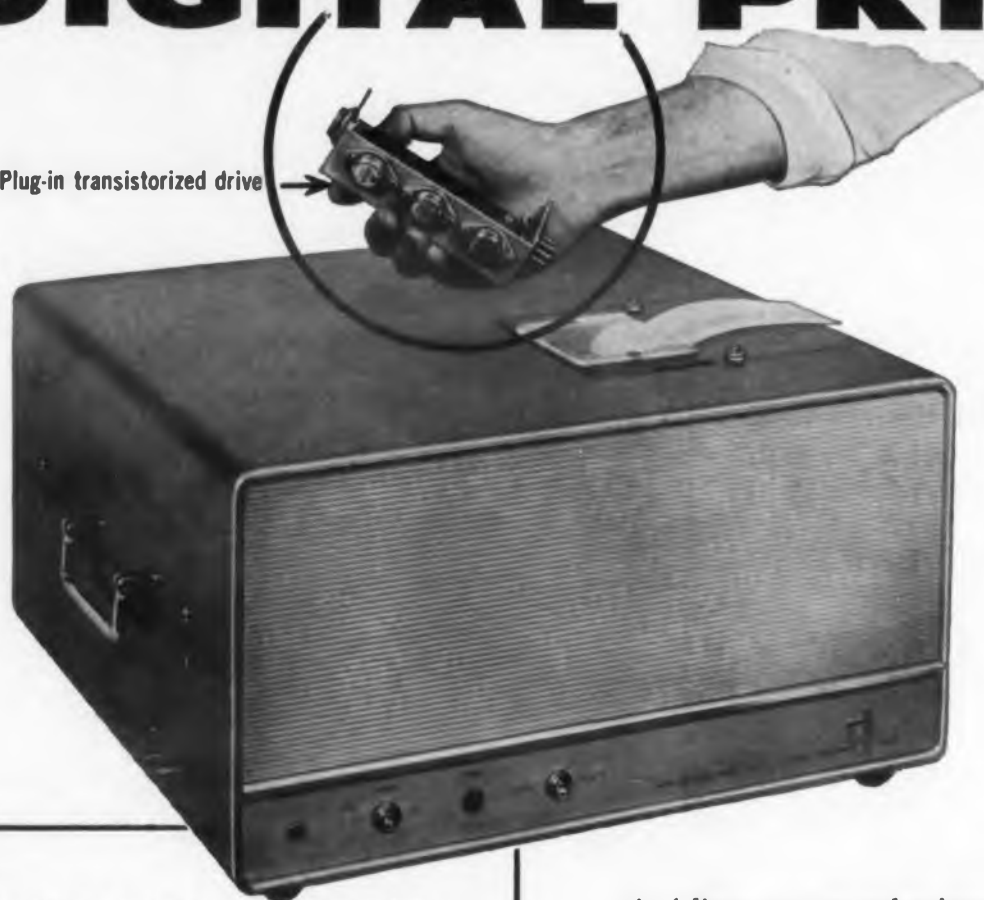
CIRCLE 346 ON READER-SERVICE CARD

only CMC makes a

SOLID STATE

DIGITAL PRINTER

Plug-in transistorized drive



*Announcing
the 400 CT-*

*The most versatile
digital printer
ever made*

SPECIFICATIONS

Printout capacity	6 digits standard.
Accuracy	determined by basic counting instrument.
Display time	0.2 seconds minimum, maximum controlled by the counter.
Weight	60 lbs.
Power requirements	115 volts $\pm 10\%$, 50-60 cps 25 watts
Dimensions	17" W x 8 1/2" H x 16 1/2" D. (Rack mounting available as option D.)
Warranty	One year on electronics; 1.5 million lines @ 4 lines per second on matrix; 10 million lines @ 4 lines per second on printer assembly, or 1 year, whichever occurs first.
Price	\$1350.00. Add \$10.00 for rack mount.

* 4 lines per second printout * Takes 1-2-2-4 or 1-2-4-8 four line code * No stepping switches * Operates from only 6 volt input * Parallel entry * Special options available including 10 line and analog output * 6 digit printout, up to 12 digits on special order * Rugged unitized construction * Completely compatible with CMC's new solid state frequency-period counters, and other types of transistorized counting equipment.

For a demonstration of this remarkable new printer and complete technical information, call your nearby CMC engineering representative or write to us direct. Please address Dept. 1910.



**Computer-Measurements
Company** A Division of Pacific Industries, Inc.

12970 Bradley Avenue • Sylmar, California

Phone: EMpire 7-2161

CIRCLE 347 ON READER-SERVICE CARD

NEW PRODUCTS

Servo Amplifier

Drives size 18 servo motor



Transistorized, 60 cps servo amplifier model 762A drives a size 18 servo motor from synchro, resolver, or ac pot data. Full output is obtained for 200 mv rms into the input impedance of 100 K. The carrier phase shift is $+90$ deg. Having a built-in power supply, the unit operates from a 117 v 60 cps line. Damping is adjustable. The weight is 3-1/4 lb and the dimensions are 6-1/8 x 2-7/8 x 4-1/4 in.

Industrial Control Co., Dept. ED, 805 Albin Ave., Lindenhurst, L.I., N.Y.

CIRCLE 348 ON READER-SERVICE CARD

Coaxial Plug

For crimping



This coaxial plug is assembled by crimping the cable braid between two concentric ferrules which are placed over the cable jacket. Once crimped, 101.5 lb of force are required to separate the cable from the plug. The plug is available in five cable sizes: RG-8/U, 9/U, 11/U, 58/U, and 59/U; it is interchangeable with MIL-PL-259 plugs and mates with the SO-239. Its applications include mobile communications equipment and TV master antenna sets.

Cannon Electric Co., Dept. ED, P.O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

CIRCLE 349 ON READER-SERVICE CARD

Power Supply

Output is 2 to 32 v dc at 0 to 10 amp



Made for laboratory use, model AA 1032 transistorized power supply has a fully adjustable range from 2 to 32 v dc at 0 to 10 amp. Regulation is better than 1% over the output range with

1 mv rms ripple. Recovery time is 100 μ sec. Square wave pulse loading is provided for. The input is 105 to 125 v dc 60 cps. Designed for bench use, the unit can be rack mounted without the chassis.

American Avionics, Dept. ED, 11513 W. Washington Blvd., Los Angeles, Calif.

CIRCLE 762 ON READER-SERVICE CARD

Noise Generators

Provide to 170 db noise

Capable of simulating the power level and sound pressure of a high thrust rocket engine, these noise generators are available in two sizes. The Stentor 205 generates 170 db sound power level for 6.7 lb per sec mass air-flow; the Stentor 204 delivers 160 db at 0.67 lb per sec. They have two or more overlapping rotors with different speeds for a sequence of rectangular pulses. The distances between the pulse and the width of pulses are variable. The sinusoidal rotors, a matching horn, drives, and controls are included with the units, which are usually made to customer specifications. Reverberant chambers and wave tubes are also available.

PAM Assoc., Inc., Dept. ED, 7315 Hartford Rd., Baltimore 14, Md.

CIRCLE 351 ON READER-SERVICE CARD

Voltage Divider

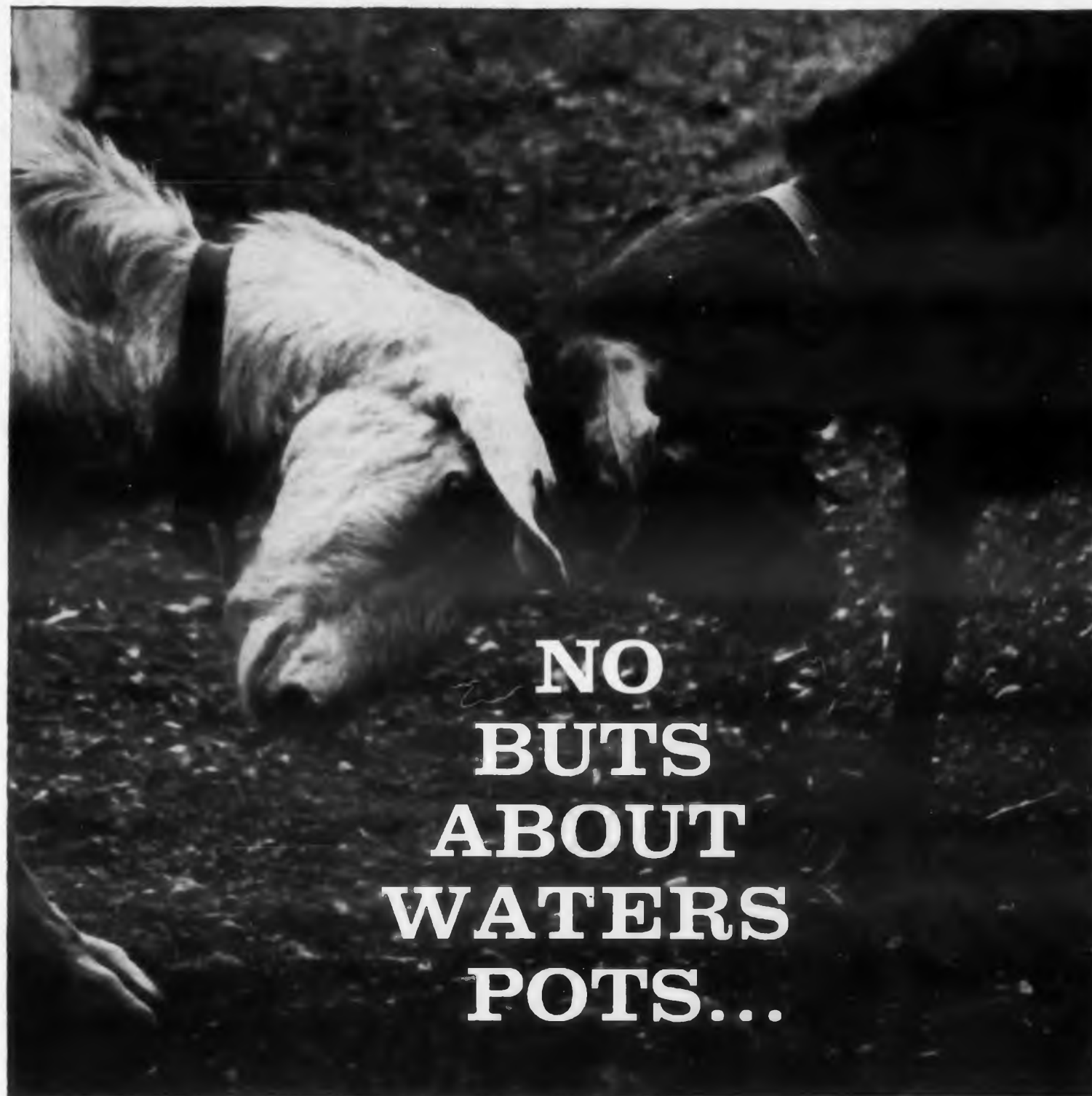
Linearity is 0.01%



This transformer type, relay operated voltage divider, called Dekamatic model X-551, has a linearity of 0.01% and a resolution of about 0.006%. Programming is by a standard binary code which can be supplied from punched cards or tape. Ten complete units can be mounted across a standard relay rack. Its applications include missile check-out devices and machine control systems and it can be used as a binary to analog converter as well as for calibration and inspection.

Electro Measurements, Inc., Dept. ED, 7524 S. W. Macadam Ave., Portland 1, Ore.

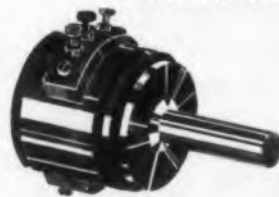
CIRCLE 352 ON READER-SERVICE CARD



NO BUTS ABOUT WATERS POTS...

Waters miniature precision potentiometers, exhaustively tested by an independent testing laboratory, must meet or exceed every applicable specification by a comfortable margin before a single potentiometer is shipped. Waters takes the speculation out of specs! Tests include operation with power, total immersion, salt spray, high humidity, temperatures from -65°C to $+150^{\circ}\text{C}$, high altitude, extreme vibration, and high shock. There is a reliable Waters miniature potentiometer for almost every precision application. Write for Catalog PF 1258.

New Waters sine-cosine pot takes almost 2/3 less space!



With the accuracy of a 3" pot in 1 1/4" diameter, the WPSC 1 1/4" provides two separate 360° sinusoidal voltages displaced 90° in phase, representing the sine and cosine of the angle of shaft rotation. Particularly useful in radar PPI displays and various types of computers. Terminal conformity is $\pm 1\%$ of sine-wave amplitude . . . $\pm 0.5\%$ peak-to-peak. Resistance range is 20K $\pm 5\%$ standard, 500 ohms to 50K as requested. Servo-type or tapped hole mountings, phosphor bronze bushing or ball bearings, "O" ring shaft seal if required, ganging up to 4 cups. Meets MIL-E-5272A, MIL-R-19A and other environmental specifications when sealed with "O" ring.



POTENTIOMETERS • SLUG TUNED COIL FORMS • RF COILS • CHOKES • POT HOODS • PANEL MOUNTS • TORQUE WATCH GAUGES • CONTROL METER/CONTROLLER • INSTRUMENTS

CIRCLE 353 ON READER-SERVICE CARD

What do you need in Battery Power?

ZINC-CARBON? MERCURY?
NICKEL-CADMIUM?
WATER-ACTIVATED?

**MORE THAN 5,000
BURGESS BATTERY TYPES**

each with the highest measure of uniform dependability! This is why 2 of 3 electronic engineers specify

BURGESS BATTERIES



BURGESS
IS THE MOST COMPLETE ONE-SOURCE
LINE OF *Portable Power!*



EXCLUSIVE WAFER CELL CONSTRUCTION

... offers compactness, long shelf life, exceptional service life. A 30% increase in battery life at no increase in size.

TRANSISTOR ACTIVATORS

Burgess Activator Batteries for transistor circuits are smaller and more compact in size! Yet they deliver 30% more power because of the patented "Wafer-Cell" construction! Burgess Activators give you compact power, uniform performance, longer shelf life... all combined with modern packaging.



RESERVE BATTERIES

High energy output in a compact power source. Can be stored dry for years! Activated only when immersed in water. No handling of dangerous electrolyte, no spilling or leaking! Wide range of efficient operating temperatures. Designed for your specific applications.



MERCURY ACTIVATORS

Burgess constructional features provide uniform quality and dependable service! Burgess exclusive patents offer sealed-in-steel protection, wide temperature range efficiency, controlled venting, patented inner cell connector, and flat discharge curve.



SEALED NICKEL-CADMIUM BATTERIES

A secondary rechargeable battery system which delivers high energy output from a small package! Hermetically sealed-in-steel cells eliminate annoying maintenance and addition of liquids. Can be recharged many times, by trickle or quick charge, for long lasting economical power!



Check with your Burgess Distributor for complete local stocks of fresh BURGESS BATTERIES! Or your distributor can order from Burgess the special battery needed for your specific application!

FREE DESIGN SERVICE

For special applications, skilled Burgess Engineers offer you a FREE battery design service. Burgess will manufacture the exact battery to fit your needs, regardless of quantity required.

NEW ENGINEERING MANUAL

New 100-page dry battery handbook now available! Engineers engaged in the design of battery-powered equipment are invited to write to Burgess Battery Company, Dept. ED, Freeport, Ill., to secure a copy. Others may buy the manual for \$1.00.



BURGESS BATTERY COMPANY

DIVISION OF SERVEL, INC.
FREEPORT, ILLINOIS

CIRCLE 354 ON READER-SERVICE CARD

NEW PRODUCTS

Epoxy Pellets

Aluminum-filled

These aluminum-filled epoxy pellets, designated E-Form, cure at temperatures as low as 85 C. They enable transistors to withstand shock and vibration to 100 g. The pellets may be used in all-epoxy packages or with a metal can and glass to metal seals. Many shapes and sizes are available for oval or JETEC packages.

Epoxy Products, Inc., Dept. ED, 137 Coit St., Irvington, N.J.

CIRCLE 355 ON READER-SERVICE CARD

Signal Generators

For use at 400 to 450 mc



For use as an fm radio receiver or wherever modulated rf carrier signals are required, type BSG-7 signal generators are available covering any consecutive 15 frequencies over the range of 400 to 450 mc. Variable carrier deviation is from 0 to ± 300 kc; the rf signal accuracy is 0.01%. Internal modulation providing the first six standard af channels or external modulation to 80 kc is included. The units can be bench type or standard 19 in. rack design.

Babcock Radio Engineering, Inc., Dept. ED, 1640 Monrovia Ave., P.O. Box 344, Costa Mesa, Calif.

CIRCLE 356 ON READER-SERVICE CARD

Prefabricated T-Sections

For panel-wiring raceways

Made to match the firm's line of channel sections and corners, these T-sections are reinforced, thermosetting plastic. Eliminating the need for mitering operations in the construction of wiring raceways, these sections have notches in the top of the sidewalls which permit the covers on the legs of each section to fit neatly. They have three elongated mounting slots in the bottom.

Stahlin Brothers, Inc., Dept. ED, 361 Maple St., Belding, Mich.

CIRCLE 357 ON READER-SERVICE CARD

Here's How You Can
DIRECTLY
Compare Impedances

Magnitude on One Meter — Phase Angle on Another Meter



IMPEDANCE RANGES:

Resistance: 2 Ohms to 20 Megohms
Capacitance: 40 μ f to 500 μ f
Inductance: 20 μ h to 10,000 μ h

METER RANGES:

Impedance-Magnitude Differences: 0.3%, 1% and 10%
Phase-Angle Differences: 0.003, 0.01, 0.03 and 0.1 radians

INTERNAL TEST FREQUENCIES:

100, 1000, 10,000 and 100,000 cycles

TYPE 1605-A Impedance Comparator: \$790

Write for Complete Information

GENERAL RADIO COMPANY

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. NEW YORK AREA 1000 N. Seward St. LOS ANGELES 38
8055 13th St. Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1182 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO 6605 W. North Ave., Oak Park, Ill. CHICAGO
In CANADA: 99 Floral Parkway, TORONTO 15

CIRCLE 358 ON READER-SERVICE CARD

FREE!

from
**Alpha
Metals**

New
**Flux Finder
Guide**

A valuable aid, ALPHA's exclusive *New Flux Finder Guide* contains such data as:

- Coatings for reducing oxides in solder baths
 - Preventing reoxidation of base metals
 - High-speed fluxing for printed circuit dip soldering
- For your copy, act now!



In Chicago, Ill.
ALPHA-LOY CORP.
2250 S. Lumber St.

Other ALPHA products:
Core & Solid Wire Solder
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ALPHAMETALS, INC., 58B Water St., Jersey City 4, N.J.
Send me free your *New Flux Finder Guide*.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

CIRCLE 359 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

INTRODUCED AT WESCON



NEW

TRANSISTORIZED

DC POWER SUPPLIES

0.5 TO 32 VDC
5 AND 10 AMP

CALIBRATED ADJUSTABLE
OVERLOAD PROTECTION

PUSH BUTTONS FOR
METER RANGE SWITCHING
AND OVERLOAD TRIP RESET



MODEL 62-141 5 AMPERES



MODEL 62-142 10 AMPERES

dressen-barnes corporation

250 NORTH VINEDO AVENUE, PASADENA, CALIFORNIA
MURRAY 1-0643 SYCAMORE 5-7731

CIRCLE 360 ON READER-SERVICE CARD

Pushbutton Switches

Life is rated at 500,000 operations



For console and instrument applications, the MBS series miniature pushbutton switches are rated at 100 ma with a life of 500,000 operations. Designed to match the firm's line of indicator lights, the switches have gold-plated contacts with wiping action. The unit mounts with a single nut in a 3/8 in. hole.

Transistor Electronics Corp., Dept. ED, 3357
Republic Ave., Minneapolis 26, Minn.

CIRCLE 361 ON READER-SERVICE CARD

Control Switch

Compact design

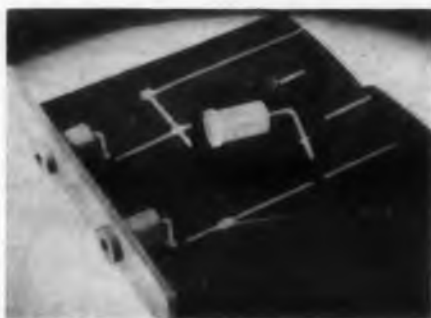
Type SBM compact control switch has two mechanically and electrically independent contacts per stage and has 1 to 10 stages. The switch is rated at 300 v ac or dc, 20 amp continuous. Its mechanical life is rated at 500,000 operations. The terminal connections are screw-type, positioned at an angle. A self-enclosing envelope, open at the bottom, houses each stage of cams and contacts.

General Electric, Dept. ED, Schenectady 5,
N.Y.

CIRCLE 362 ON READER-SERVICE CARD

Jacks

For printed wiring



Type SKT-100 PC Jack mounts in a metal angle-iron edging designed for the printed circuit board and the rear right-angle lug fits in a hole for the connection. It accepts a probe 0.08 in. in diameter and up to 0.25 in. long. The contacts are made of beryllium-copper and the insulator body is made of Teflon.

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

CIRCLE 363 ON READER-SERVICE CARD

Now...

DIALCO Pilot Lights

with **Built-in Resistor** (18,000 ohms)
(a patented DIALCO feature)

and the **NEW High Brightness
Neon Glow Lamp NE-51H**



A New Advance in Pilot Light Design by DIALCO:

Three basic advantages are incorporated in this series of DIALCO assemblies: (1) *Built-in resistor* for direct use on 125 to 250 volt circuits... (2) *New plastic lens* designed to give attractive "halo" effect...

(3) *New High Brightness Neon Glow Lamp NE-51H*. This lamp may be operated at about 3 times the level of current

that may be applied to the standard lamp, and it will produce 8 times as much light—with long life! Very low power is required, less than 1 watt on 250 volt circuit. Recommended for AC service only.

In the DIALCO assembly, the built-in current limiting (ballast) resistor (18,000 ohms) is completely insulated in moulded bakelite and sealed in metal (U. S. Patent No. 2,421,321)... Small space required—units are available for mounting in 9/16" or 11/16" clearance holes... A wide choice of optional features includes lens styles, shapes, and colors; terminal types; metal finishes, etc... Meet applicable MIL Spec and UL and CSA requirements.

All Assemblies Are Available Complete with Lamp
SAMPLES ON REQUEST—AT ONCE—NO CHARGE

DIALIGHT CORP., 46 Stewart Ave., Brooklyn 37, N. Y.

Send brochures on Pilot Lights for NE-51H Neon Lamp Sub-Miniatures Oil-Tight

Name Position

Company

Address



Foremost Manufacturer of Pilot Lights

DIALIGHT

CORPORATION

46 STEWART AVE., BROOKLYN 37, N. Y. • HYacinth 7-7600

CIRCLE 364 ON READER-SERVICE CARD

NEW
4 MILLIMICROSECOND
SILICON MESA DIODE
PUTS YOUR
COMPUTER CIRCUITS
A YEAR AHEAD!



UNIFORMLY FAST $t_{rr} = 4 \text{ m}\mu\text{s}$ MAXIMUM ALL TYPES

TYPE	Peak Reverse Voltage		Capacitance (@ -6 Volts)	Forward Voltage Drop (@ 25°C and 10 mA)
	@25°C & 1.0μA	@100°C & 10μA		
4226	20 Volts	20 Volts	1.0 μf	1.1 Volts
4223	30 Volts	30 Volts	1.0 μf	1.0 Volt
4222	40 Volts	40 Volts	1.0 μf	1.0 Volt
4227	20 Volts	20 Volts	2.5 μf	1.0 Volt
4228	30 Volts	30 Volts	2.5 μf	1.0 Volt
4229	40 Volts	40 Volts	2.5 μf	1.0 Volt

A newly developed silicon mesa diode gives millimicrosecond recovery time (*in normal, forward switching*) with high breakdown voltage. These characteristics can be the solution to many of last year's, this year's, — and next year's computer circuit problems.

The six diodes in the table below are in current production and available. Contact our sales department for immediate quotations.



MICROWAVE ASSOCIATES, INC.
 BURLINGTON, MASSACHUSETTS • BRowing 2-3000

CIRCLE 365 ON READER-SERVICE CARD

NEW PRODUCTS

Servomotors

Size 18



These three models of size 18 servomotors are for missile and high-speed aircraft applications. Type 422012-1 operates at temperatures of -54 to +175 C, has a no load speed of 5300 rpm, and 2.4 oz-in. stall torque. Type 422013-1 operates at -54 to +175 C, has a no load speed of 9800 rpm, and 2.8 oz-in. stall torque. Type V112-32 operates at temperatures of -54 to +200 C, has a no load speed of 9800 rpm, and 3.7 oz-in. stall torque. The stator assemblies of all units are integrally cast in a thermosetting resin. Each unit weighs 12.2 oz.

Kearfott Co., Inc., Dept. ED, 1500 Main Ave., Clifton, N.J.

CIRCLE 366 ON READER-SERVICE CARD

Voltage Regulating Transformer

Keeps voltage within $\pm 3\%$ of rated output



This voltage regulating transformer keeps voltage within $\pm 3\%$ of rated output with line variation from 100 to 130 v. Type PF-50 requires 275 v dc at 50 ma, type PF-110 requires 385 v dc at 110 ma, and type PF-250 requires 380 v dc at 250 ma. Other models can be made to customer specifications.

Raytheon Co., Industrial Apparatus Div., Dept. ED, Manchester, N.H.

CIRCLE 367 ON READER-SERVICE CARD

Ceramic Transducer Element

Resonant frequency is constant to 200 C

Type US600 ceramic transducer element has a resonant frequency that is constant to 200 C. The dielectric constant is 1350, the radial coupling coefficient is 0.46, and the linear coupling coefficient is 0.67. The Curie temperature is 310 C. For use as a sensor or a high power driver, it has applications in underwater sounding, thickness gage detectors, and in filter or ladder networks.

U.S. Sonics Corp., Dept. ED, 625 McGrath Highway, Somerville, Mass.

CIRCLE 368 ON READER-SERVICE CARD

Switch

Rated at 250 ma



Series 200 tone switch has a current rating of 250 ma at 115 v ac and 1.75 amp at 24 v dc. Combining the mounting and the index frame die cast as a single unit, this switch can be supplied with two or three positions and with 3, 4, 6, or 9 contact clips. The insulation is laminated phenolic type as specified in MIL-P-3115. Voltage breakdown between critical parts is at 100 v, rms.

Centralab, Div. of Glove-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 369 ON READER-SERVICE CARD

Glass-Bonded Mica

For continuous operation at 1100 F

This glass-bonded synthetic mica, designated Mykroy 20-7, is for continuous operation at 1100 F. The volume resistivity at 1100 F is greater than 1 meg. The specific gravity is 2.4. It is molded to customer specifications and can be used in high temperature feed-through bushings, molded-in thermocouple devices, relay spacers, and coil forms. Stainless steel, monel, and nickel inserts may be molded within the material.

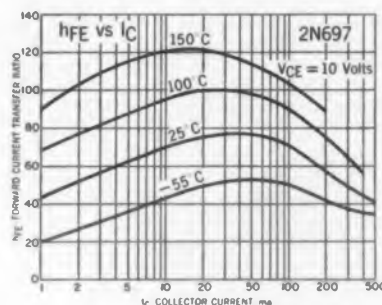
Electronic Mechanics, Inc., Dept. ED, 101 Clifton Blvd., Clifton, N.J.

CIRCLE 370 ON READER-SERVICE CARD

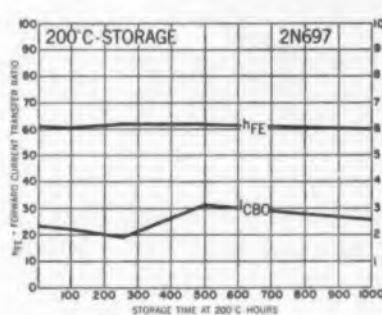
DIFFUSED SILICON TRANSISTORS

A report on mesa transistors at Fairchild

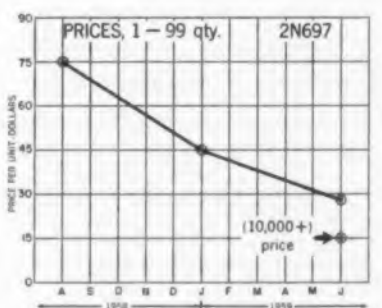
What do they mean to the circuit designer working on next year's transistorized equipment? The superior speed-power combination attainable with this new type of transistor has caused virtually every semiconductor manufacturer to give them top R & D priority. Meanwhile Fairchild has been producing diffused silicon transistors in quantity for over a year and can answer the important questions.



Are they replacing existing types? Some customers have replaced four to five types with one Fairchild type. This is readily possible because the diffused silicon transistor retains its high performance characteristics over a wide spread of collector current and operating frequency. Graph shows, for example, the range of useful current gain in the Fairchild 2N697. A few such diffused silicon devices could cover the entire range served by present transistors, and complementary NPN and PNP devices are feasible.



Are they reliable? Reliability is one of their top advantages. A 60-hour pre-aging of all units at 300° C accomplishes a stabilization equal to thousands of operating hours at 200° C. At the 200° C temperature, parameters are relatively unaffected by extended storage as shown on the graph. Also, mesa construction eliminates suspended masses, hence Fairchild units have survived mechanical shocks as high as 20,000 g. Customers' tests have consistently proven these transistors more reliable than any other type.



Are they economically practical? Prices were reduced by over 60% in just nine months after they were first introduced, making them competitive with lower performance units of other types. But most important for the future: the diffusion process is inherently controllable, hence well suited to automated production. The result: far better and more versatile devices at a price equal to or lower than prices on today's predominant types of transistors.

Are they being accepted by users? In less than one year after announcing the diffused silicon mesa transistor, Fairchild opened a new manufacturing plant approximately six times larger than the company's original facility. This was in response to demand. And already additional expansion is being planned.

May we keep you up to date on further developments? Write Dept. B-10-14



545 WHISMAN ROAD • MOUNTAIN VIEW, CALIFORNIA • YORKSHIRE 8-8161
CIRCLE 371 ON READER-SERVICE CARD

...IT GLOWS when
the FUSE BLOWS!

NEW INDICATING 3AG FUSE POSTS

EXAMINE THESE FEATURES



- 1 New patented knob design to assure high degree of illumination for instant blown fuse indication.
- 2 Positive finger grip for knob extraction.
- 3 Quick service bayonet lock.
- 4 Constant tension beryllium copper coil & leaf spring for positive contact & lower millivolt drop.
- 5 Optional—at extra cost—neoprene "O" ring to assure splash-proof feature.
- 6 New high degree vacuum neon lamp for greater brilliance & visibility.
- 7 Impact black phenolic material in accordance with MIL-M-14E type CFG.
- 8 One piece brass hot tin dipped non-turning bottom terminal.
- 9 Double flats on body to permit mounting versatility.

SPECIFICATIONS:



PART #	VOLTAGE RANGE
344006	2 1/2 - 7 volts
344012	7 - 16 volts
344024	16 - 32 volts
344125	90 - 125 volts
344250	200 - 250 volts

Maximum current rating 20 amps.

PHYSICAL CHARACTERISTICS—Overall length 2 3/8" with fuse inserted • Front of panel length 1 3/16" • Back of panel length 1 1/16" • Panel area front 1 3/16" dia. • Panel area back 1 1/16" dia. • Mounting hole size (D hole) 5/8" dia. flat at one side.

TERMINAL—Side—one piece, .025 brass—electro-tin plated • Bottom—one piece, lead free brass, hot tin dipped.

KNOB—High temperature styrene (amber with incandescent bulbs—2 1/2 thru 32 volts—and clear with high degree vacuum neon bulbs—90 thru 250 volts) • Extractor Method—Bayonet, spring grip in cap.

HARDWARE—Hexagon nut—steel, zinc cronak or zinc iridite finish • Interlock lock washer—steel, cadmium plated • Oil resistant rubber washer.

MILITARY SPECIFICATIONS—MIL-M-14E type CFG. Fungus treatment available upon request per Jan-T-152 & Jan-C-173.

TORQUE—Unit will withstand 15 inch lbs. mounting torque.



LITTELFUSE

DES PLAINES, ILLINOIS

CIRCLE 372 ON READER-SERVICE CARD

NEW PRODUCTS

EIR Meter

Dc accuracy is 1.5% of full scale

Model 270 volt-ohm-milliammeter has a dc accuracy of 1.5% of full scale and an ac accuracy of 2% of full scale at 77 F. The temperature range is 67 to 87 F and the resistance accuracy is ± 1.5 deg of arc. Similar to the model 260, model 270 has, in addition, a mirror scale, gold bonded diodes, a polarity switch, and a knife edge pointer.

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

CIRCLE 373 ON READER-SERVICE CARD

120 w Transformer

Is 1-3/16 in. thick



This 120 w transformer is 1-3/16 in. thick and has widely distributed, shallow windings of wire providing a short thermal path. The standard units operate on 115 v 400 cps and have secondary voltages from 5 to 2000 v. Regulation is 5% max, no load to full load, and the ambient temperature range is -55 to +100 C. Life expectancy is 10,000 hr. Weighing 15 oz each, these units are fully encapsulated and hermetically sealed in a steel container. They meet the requirements of MIL-E-5272C and MIL-T-27A, class S.

Arnold Magnetics Corp., Dept. ED, 4613 W. Jefferson Blvd., Los Angeles, Calif.

CIRCLE 374 ON READER-SERVICE CARD

Potentiometers

Are rated at 2 w

These 7/8 in. in diam, 10-turn potentiometers are available in two models: type 7220 has a power rating of 2 w at 25 C, derating to zero at 5 C; type 7230 is rated at 2 w at 65 C, derating to zero at 125 C. Both have a minimum operating temperature of -55 C. Standard resistance range of the 7220 is 10 ohms to 125 K $\pm 5\%$, for the 7230, 300 ohms to 90 K $\pm 5\%$. The standard linearity tolerance for both models is $\pm 0.5\%$; a linearity of 0.05% can be obtained. The moment of inertia is 0.02 g-cm² and starting torque is 0.5 oz-in. Re-

See us at the
Metals Show
BOOTH #1019

- Reduce costs
- Simplify assembly
- Improve appearance with

GRC

DIE CAST ZINC ALLOY
& MOLDED NYLON

FASTENERS

Round Head THUMB NUTS

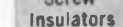
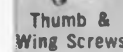


GRC's exclusive wide grip; generous width tops have deep fluted edges for firm, comfortable grip, corrosion resistant, rust-proof. Smart design for added sales appeal.

Head Diameters:
1/2" thru 1 1/8"
Thread Sizes:
#4 to 7/16"

GRIES REPRODUCER CORP.
World's Foremost Producer of Small Die Castings
40 Second St., New Rochelle, N.Y. • NEW Rochelle 3-8600

CIRCLE 375 ON READER-SERVICE CARD



- High in quality
- Uniformly accurate
- Low in cost
- Wide range of stock styles, types, sizes and threads

Produced in one high speed automatic operation, GRC's exclusive methods assure uniformity, smooth, rustproof & corrosion resistant surfaces and the lowest possible cost. New kinds of fasteners never before available . . . modifications in stock fasteners for specialized use . . . infinite variety in styles, types and sizes, have been made possible by GRC's special automatic die casting and molding machines.

Write, wire, phone
RIGHT NOW for
prices, your copy
of GRC's NEW
DETAILED
FASTENER CATALOG



HI-POWER • HI-FREQUENCY TRANSMISSION LINE SYSTEMS

CABLE Connector

FOR RG-117/U CABLE



The Tamar USAF approved Captive Pin Connector embodies a captivated center conductor and dimensionally stable Teflon dielectric. Can be supplied in assemblies guaranteed to your specs., 100% tested for power and VSWR.

SPEC. SHEETS AVAILABLE UPON REQUEST

TAMAR ELECTRONICS, INC.

1805 COLORADO AVE. • SANTA MONICA, CALIF.

CIRCLE 376 ON READER-SERVICE CARD

Q: What is a Kodak Ektron Detector?

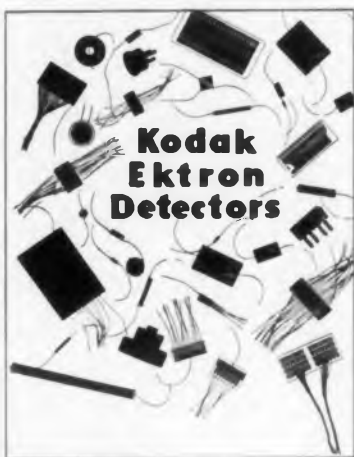
A: It is a semi-conductive resistor. The photosensitive area can be laid down in any pattern. Response extends to 3.5 microns in the infrared. Unaffected by vibration; high signal-to-noise ratio.

Q: What can it be used for?

A: For such applications as an infrared sensor in weapons systems, and in instrumentation for process control, analysis, and safety.

Q: How can I get the facts about spectral response, types, availabilities, and the like?

A: By writing for a new brochure called "Kodak Ektron Detectors."



Write to:

Apparatus and Optical Division
EASTMAN KODAK COMPANY, Rochester 4, N. Y.
 CIRCLE 377 ON READER-SERVICE CARD

**A
 GUIDE TO
 PREFORM
 SOLDERING**

FREE! NEW 8 PAGE GUIDE

Complete information on solder preforms, their selection and use. Technical diagrams. Send for your copy today.

21-01 43rd AVENUE, LONG ISLAND CITY 1, N. Y.



CIRCLE 378 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

quirements of NAS 710 and MIL-R-19 are met or exceeded. Three mounting styles are available with the 7220: bushing mount with sleeve bearing, servo mount with sleeve bearing, and servo mount with ball bearing. The 7230 has servo mount and ball bearing.

Beckman Instruments, Inc., Helipot Div., Dept. ED, 2500 Fullerton Rd., Fullerton, Calif.

CIRCLE 379 ON READER-SERVICE CARD

Relays

Miniature type



For dry circuit and high level switching, series 700 miniature relays are of resilient bifurcated contact construction. Type R700, dpdt, and type RS700, spdt, are current-sensitive units; type R750 dpdt is a magnetic-latch unit; and types R780 dpdt and RS780 spdt are voltage sensitive units. The contact life is rated at 100,000 operations, at 125 C at 2 amp, 28 v dc or 115 v ac. The dry circuit life is rated at 5,000,000 operations at 20 cps, 125 C at 10 μ a, 10 mv dc or ac.

Iron Fireman Mfg. Co., Electronics Div., Dept. ED, 2838 S.E. Ninth Ave., Portland 2, Ore.

CIRCLE 380 ON READER-SERVICE CARD

Environmental Chamber

Provides -80 to +180 F

This 3 cu-ft test chamber has an adjustable temperature range of -80 to +180 F. Altitudes from sea level to 100,000 ft can be simulated in 15 min control time. A steam vapor generator provides to 100% relative humidity. The water supply is mounted on the unit. Radiation is provided by a 1 in. in diam tube; other special accessories include program controllers for wet and dry bulb temperatures and for absolute pressure. The chamber has interior illumination, a 2 in. entrance port, and an 8 x 8 in. observation window. External dimensions are 66 x 54 x 28 in.

Cincinnati Sub Zero Products, Dept. ED, 3932 Reading Rd., Cincinnati 29, Ohio.

CIRCLE 381 ON READER-SERVICE CARD

You're looking
 at just one
 reason why
 engineers
 specify...

HANDLEY WEEPOTS



The metal clad Handley Wee Pot offers many unusual design features... including a different configuration and long leads, many methods of mounting, high friction loading for minimum back-lash, extreme accuracy, low impedance, and the Wee Pot can be sealed to meet MIL E 5272A. Inductive reactance is not measurable... under 900 KC. Exceeds NAS 710 for impedance. Other characteristics make the Wee Pot worth considering for your next design.

ACCELERATION
 Exceeds MIL-R-19, 100 G's at 11 milliseconds duration

SHOCK
 Exceeds NAS-710, proc III, withstands 50 G's meeting MIL-202

VIBRATION
 Exceeds NAS-710, proc III, 30 G's at 20000

TEMPERATURE
 Range is from -55 C to 140 C with 1.3 watts at 40 C



Here's another reason why engineers specify Weepot... every Handley Potentiometer wound to .000003" accuracy

When no winding machine was available to meet Handley's manufacturing standards, Handley developed its own winding machines so that Handley potentiometers may be wound to .000003, using wire as small as .0045 in diameter. Winding lengths are maintained at ± 3 millionths of an inch per 1000 turns.



These leads adjustable to many applications

HANDLEY, INC.

2030 Colorado Ave.
 Santa Monica,
 California

Write for more information—
 (or check the reader service card)

Attach to your letterhead

NAME

TITLE

CIRCLE 382 ON READER-SERVICE CARD

When you think of

SILVER

Think of Handy & Harman
Because . . .

- Handy & Harman is the leading manufacturer of silver and silver alloys for industry.
- During 90 years in precious metals, Handy & Harman has helped develop many of the uses of silver by industry.
- Experience and research have established Handy & Harman as the Number 1 authority on silver.

This experience and knowledge is at your call. Whatever your silver requirements, Handy & Harman is anxious to be of service.

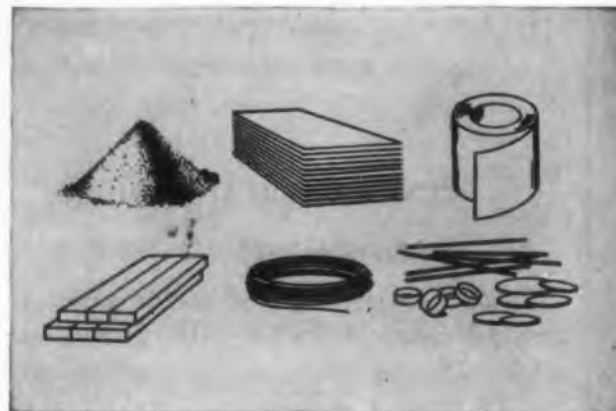
Here are some of the forms Handy & Harman manufactures:

- | | |
|---------------------------------------|--------------------------------|
| ● Fine Silver (wire, strip and foil) | ● Silver electronic solders |
| ● Silver anodes and grain for plating | ● Silver sintered metals |
| ● Silver contact alloys | ● Solder-flushed silver alloys |
| ● Silver powders | ● Silver chloride and oxide |
| ● Silver flakes and paints | ● Coin Silver (wire and strip) |
| ● Silver brazing alloys | ● Silver Bi-metals |

For your information file

We have four Technical Bulletins giving engineering data on the properties and forms of Handy & Harman Silver Alloys. We would like you to have any or all of those that particularly interest you. Your request, by number, will receive prompt attention.

Fine Silver	Bulletin A-1
Silver-Copper Alloys	Bulletin A-2
Silver-Magnesium-Nickel	Bulletin A-3
Silver Conductive Coatings	Bulletin A-4



Your No. 1 Source of Supply and Authority on Brazing Alloys



HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.
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Providence, R. I. • San Francisco, Calif. • Montreal, Canada • Toronto, Canada

DISTRIBUTORS IN PRINCIPAL CITIES

CIRCLE 383 ON READER-SERVICE CARD

NEW PRODUCTS

Cycle Timer

For any timing sequence

Designed for interrupting electric circuits on prearranged time settings, this cycle timer can be used to set up any sequence of on and off combinations within a basic cycle of 150 sec. Having a contact rating of 15 amp at 115 v ac, the unit can be used in pulsing circuits, cleaning equipment, and many laboratory and industrial processes. Dual and multi-circuit models are also available and special timers can be built to customer specifications.

Signatrol, Inc., Dept. ED, Danville, Ill.

CIRCLE 384 ON READER-SERVICE CARD

Module Building Blocks

Transistorized



These transistorized module building blocks, called the series 200 Logiblock, include NOR circuits, flip-flops, one-shot multivibrators, blocking oscillators, coupling circuits, and drivers for indicators or electro-mechanical devices. Each unit performs different functions by using different connections on the socket. Floating sleeves and pins are used for the plug-in connection. The blocks are rated at 200 kc; some operate at 400 kc or higher. Two voltage supplies are needed: -12 v and +6 v.

Wang Labs., Inc., Dept. ED, 12 Huron Dr., Natick, Mass.

CIRCLE 385 ON READER-SERVICE CARD

Wirewound Potentiometer

Has 5/16 in. diam

Having a 5/16 in. diam, the Comp-U-Trim model F wirewound linear trimming potentiometer is designed for mounting through the front panel of equipment or below the chassis. Rated at 0.75 w at 85 C and 0.5 w at 125 C, the potentiometer is available in resistance ranges from 10 ohms to 50 K with a tolerance of $\pm 10\%$ and a temperature coefficient of ± 20 ppm. It meets

or exceeds applicable parts of MIL-R-19, MIL-202, and MIL-5272. The unit is encapsulated.

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

CIRCLE 336 ON READER-SERVICE CARD

Acoustic Test System

For airborne equipment



Designed for testing aircraft and missile parts, this acoustic test system consists of a reverberation chamber and a control console which contains the audio power equipment. The control console provides for three noise source inputs: a sine wave, random noise, or an external source such as a tape recorder. Sound pressure levels to 150 db are produced. Interlocking switches allow adjustment of passband and bandwidth over the range of 20 to 20,000 cps in 0.5 octave increments. Model TS-5201 system, consisting of the TE-5205 test chamber and the TE-5215 control console, tests small components. For larger components, model TS-5202 system consists of the TE-5206 test chamber, having a volume of 2 cu ft, and the TE-5215 control console. Model TS-5203 system is made up of the TE-5216 control console and the TE-5207 test chamber, shown here, which has a 6 cu ft volume. Control console model TE-5217 has detailed instrumentation for sound synthesis and analysis and can be used with any of the larger test chambers.

Stromberg-Carlson, Div. of General Dynamics Corp., Dept. ED, Rochester 3, N.Y.

CIRCLE 387 ON READER-SERVICE CARD

Circuit Breaker

Rated at 200 amp

Type SE33 circuit breaker is rated at 200 amp. The two poles are located in separate compartments and are externally linked by a single handle. Magnetically actuated, it reacts only to load current changes produced in a solenoid sensing coil. Instantaneous tripping is at least 10 times the breaker rating. Rated at 120 or 240 v ac, it has an interrupting capacity of 10,000 amp. It is also available in ampere rating of 125, 150, and 175 amp.

Heinemann Electric Co., Dept. ED, 355 Plum St., Trenton, N.J.

CIRCLE 388 ON READER-SERVICE CARD

Build extra value into Citizens Band radios with Mallory vibrators

Mobile, two-way Citizens Band radios bring new simplicity and convenience to communication for thousands, and open brand new markets for you.

If you're now building Citizens Band radios or planning to, Mallory vibrators deserve a place in your power supply design. Their exceptionally long life, quiet operation and constant output are the result of more than 25 years of Mallory pioneering in vibrator design. More Mallory vibrators have been used in mobile radios than all other makes combined. Mallory engineers have helped develop efficient, economical power supply circuits for many set manufacturers.

Make use of this experience. Let Mallory help you choose and apply the vibrator model that best fits your needs, as well as assist in the design of your power supply circuitry. Write today for a get-together with a Mallory vibrator specialist.



Series 1600 Vibrator

Contact buttons have been eliminated for far greater contact area . . . lower rate of erosion . . . steadier voltage . . . and an end to contact sticking. Light mechanical mass of vibrating reed assures quiet operation.

Elkon Division, Du Quoin, Ill.
Electromagnetic Department

P. R. MALLORY & CO. Inc.
MALLORY

CIRCLE 389 ON READER-SERVICE CARD

LATEST ADDITION TO THE PACIFIC FAMILY OF ACCELEROMETERS...



new!

smallest on the market!

Pacific's
inexpensive

POTENTIOMETER -TYPE MODEL 4205

ACCELEROMETER

Replacing another accelerometer twice its size in an air to air missile, this tiny new addition to Pacific's family of accelerometers delivers 2% accuracy over a -10 to $+30G$ range, and has the smallest envelope on the market — measuring only 1.1"W x 1.5"L x .8"D! Designed as an inexpensive instrument for telemetering and control it features silicon fluid damping for unsurpassed shock and vibration immunity.

Each of Pacific's basic models illustrated is representative of a series of similar units that vary only in output characteristics. They are fully tooled, tested and approved production models that can meet most acceleration measurement requirements.

In the design and production of accelerometers and other electro-mechanical components — Pacific's creative ability, engineering skills, experience and production facilities, can save you money — and time!



Creative Manufacturing
and Development
in Airborne Controls

TRADE MARK



For complete information on Pacific's standard accelerometers — or on specific models designed to your own requirements, write today!

PACIFIC SCIENTIFIC COMPANY

P. O. Box 22019, Los Angeles 22, Calif.

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REPRESENTATIVES: Eastern U. S.—Aero Eng. Co.
Canada—Garrett Mfg. Corp.



Series 4202

Unique Torsion Bar Suspension and restraining system provides very low hysteresis with exceptionally rugged, long life. Automatic caging mechanism. Single or dual potentiometer pick-off and/or switches provide versatility. Available in a wide variety of G ranges.



Series 4201

Lightweight, Miniature — combines wide flexibility of design and performance characteristics with a proven, high production instrument. Potentiometer pick-off . . . wide selection of G ranges with an operating range of $0- \pm 1G$ to $0- \pm 50G$.



Series 4206

For Increased Accuracy to 1% or less under rugged environmental conditions. Originally designed for use in an anti-missile missile, this unit features temperature compensated damping mechanism using silicon fluid.

CIRCLE 395 ON READER-SERVICE CARD

NEW PRODUCTS

15 W RESISTOR.—High temperature, wirewound type PW15 with all inorganic materials for protection against flame or decomposition at overload conditions. Available in values from 1 ohm to 25 K with tolerances of 10% or, on special order, 5%.

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

CIRCLE 396 ON READER-SERVICE CARD

SOCKET.—Type S416 eliminates mechanical and electrical problems in designing the 416B/6280E tube into military equipment, permits fixed indexing of the base pins by the adjustable grid ring. Comes with self-contained power lead filters and heat dissipating plate cap; has provisions for addition of circuit components.

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

CIRCLE 397 ON READER-SERVICE CARD

INTERVAL TIMER. — Programmer model 640A for scientific, medical, missile, or industrial research and

product development. Unit can turn three separate electrical loads on and off at predetermined times, may also be programmed for momentary switch closings.

Camera equipment Co., Inc., Dept. ED, 315 W. 43rd St., New York, N.Y.

CIRCLE 398 ON READER-SERVICE CARD

MOISTURE INHIBITOR.—Chemical liquid type CRC drives absorbed moisture out of electrical equipment, eliminates effect of wicking, reduces electrical failure, prevents corrosion, preserves insulation. Can be applied by immersion, pouring, brushing, or spraying on motors, controls, switches, solenoids, relays, electronic circuits.

Corrosion Reaction Consultants, Inc., Dept. ED, 116 Chestnut St., Philadelphia 6, Pa.

CIRCLE 399 ON READER-SERVICE CARD

STEPPING SWITCH.—Spring driven type 211 accommodates twelve 11-

New Exclusive
IRON CORE Development

Saves: Production Costs

Reduces: Breakage Loss

Corrects: for Non-uniformity of torque in phenolic impregnated coil forms

*Trademark

EQUI-TORQUE®

Process #25

... Developed by

RADIO CORES, INC.

Originators of

ENGINEERED ECONOMY IRON CORES

Get even, smooth-running, satisfactory torque control in application of threaded cores to coil forms with EQUI-TORQUE PROCESS #25!

- ★ Specially processed tacky wax
- ★ Impregnated in cores
- ★ Covers all thread form
- ★ Wax withstands 200°F.
- ★ Recycling excellent
- ★ Lubricates to ease torque
- ★ Compensates for low torque
- ★ Uniform running torque
- ★ Equalizes initial and running torque
- ★ No deterrent in function with aging

Operational tested and now being used by leading television, radio and coil manufacturers.

Write for samples and further information today!

Radio Cores, Inc.

Phone: GARDEN 2-3353

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CIRCLE 400 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

point levels and up to four 33-point levels, operates for about 100 million steps between adjustments.

C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

CIRCLE 401 ON READER-SERVICE CARD

CONSOLE UNIT.—Converts a standard relay rack cabinet into a slope-front console with flat writing surface and slanted instrument panel. Standard unit is 19 in. wide, but is also available in 2, 3, or 4 section widths. Sloped front is angled 15 deg from vertical and may be 12-1/4, 14, or 17-1/2 in. high. Writing surface may be 12-1/4, 14, or 17-1/2 in. deep.

Western Devices, Inc., Dept. ED, 600 W. Florence Ave., Inglewood 1, Calif.

CIRCLE 402 ON READER-SERVICE CARD

INTEGRATOR.—Converts the air pressure input from pneumatic process control equipment into a proportionate electrical output of contact closures. The output, up to 500 cpm, can then be indicated or recorded. The unit operates on a 115 v, 60 cps.

Royson Engineering Co., Dept. ED, Hatboro, Pa.

CIRCLE 403 ON READER-SERVICE CARD

SPEED REDUCER.—Available in 34 ratios from 1:1 to 27:1. The 5A series handles 16 oz-in. of torque at the low speed shaft. Speeds up to 3600 rpm on the high speed shaft may be obtained without excessive wear. It weighs 2-1/4 oz.

Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

CIRCLE 404 ON READER-SERVICE CARD

RF CABLE RECEPTACLE.—Right-angle bulkhead type. When the type 3009 receptacle is engaged with a straight plug, the cable is only 3/16 in. away from the panel.

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

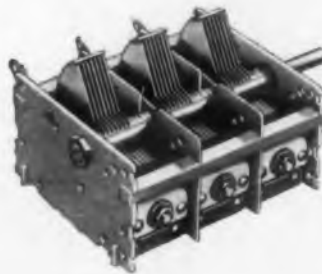
CIRCLE 405 ON READER-SERVICE CARD

SUBMINIATURE FEEDTHROUGH TERMINAL.—Teflon insulated. Type FT-SM-36 TUR-L has a current rating of 10 amp continuous duty, and an operating voltage of 1750 v dc.

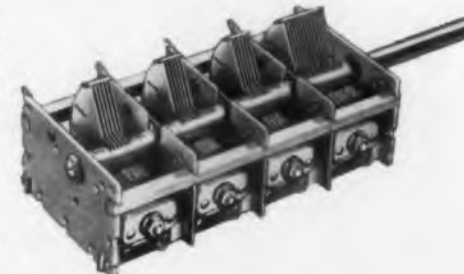
Sealectro Corp., Dept. ED, 610 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 406 ON READER-SERVICE CARD

OAK Variable Capacitors



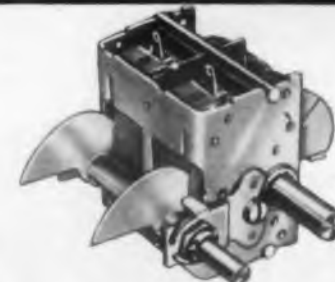
442.2 MMF max capacity per section; 13.5 MMF min (1, 2, 3, or 4 sections). Rugged frame has heavy tie-bars staked to end plates and shields. Soldered or brazed joints optional . . . MODEL 50



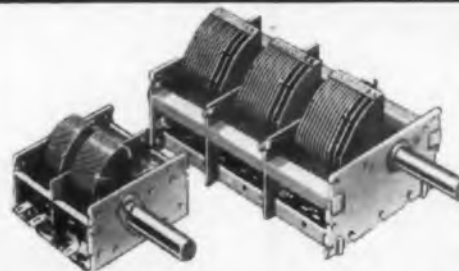
603 MMF max capacity per section; 13.5 MMF min (1, 2, 3, or 4 sections). Largest of Oak capacitors. Has same rugged construction as Model 50 shown at left MODEL 60



530 MMF max capacity per section; 14 MMF min (2 or 3 sections). High capacity in a medium size unit. Frame is strong, one-piece cradle type with reinforcing tie-bars MODEL 240



BAND SPREAD, MODEL 240—One or two sections only. Effective capacity of main section is 485.8 MMF max; of band spread section, 20.0 MMF max. Other data same as regular Model 240.



SPLIT STATOR, MODELS 240 and 60—Capacity must be worked out for each combination of split stator. Dimensions are the same as for regular Models 240 and 60, except terminal location.

Still Available as Quality Custom-Built Units

Yes, you can still get these well-known variable capacitors for your more *demanding applications*. Oak units meet today's most rigid electrical and mechanical requirements—including MIL specifications. They are widely used in quality test equipment and receivers for general communications. Designs are standard, but many variations are possible with little or no extra tooling. Call your Oak representative for a copy of the engineering bulletin shown at right or request one direct.



OAK MFG. CO. 

1260 Clybourn Avenue, Dept. D, Chicago 10, Illinois Phone MOhawk 4-2222

CIRCLE 408 ON READER-SERVICE CARD

YOKE

specialists



COMPLETE LINE for every Military and Special purpose . . . in PRODUCTION QUANTITIES . . . or CUSTOM DESIGNED to your specific requirement.

syntronic

INSTRUMENTS, INC.

100 Industrial Road, Addison, Ill., Phone Kingswood 3-6444

CIRCLE 407 ON READER-SERVICE CARD

Guidance and Control Instruments by Humphrey



FREE AND VERTICAL GYROS

New interchangeable motors make it possible to power these instruments with d-c, 400-cycle a-c or 1500-cycle inverter. Offered with a variety of pick-offs, including potentiometer, synchro or switch. Electrical or manual caging.



RATE GYROS

The Humphrey design provides a wide dynamic range with precision potentiometer or variable transformer output. Three basic units available, all in hermetically sealed cases with choice of a-c or d-c motors.



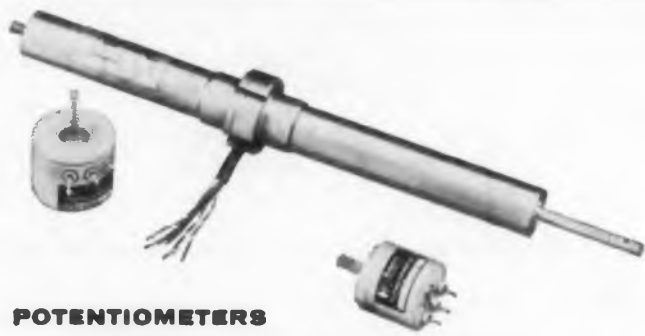
RATE SWITCHES

These specialized gyros operate switches when a pre-determined rate of turn is reached. Extremely light weight. Dry gas filled and employing dry gas dampers that remain constant over full temperature range. Wide selection of rates available.



ACCELEROMETERS

These precision inertial sensing devices offer practically zero cross-talk, extra wide temperature range and precision potentiometer or magnetic pickoffs. Models available for angular or linear measurement. Dry gas damped, hermetically sealed.



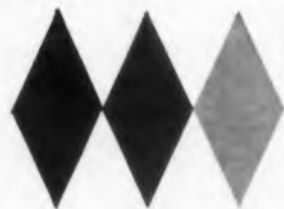
POTENTIOMETERS

Precision rectilinear and rotary instruments. Wire wound. For direct mounting in aircraft or missiles. Operational to 400°F. Able to take tough environmental conditions, such as vibration 25G, 10 to 2,000 cps, and shock of 100G while operating.



NEW INTEGRATING RATE GYRO WITH POTENTIOMETER OUTPUT

For many applications, a Humphrey integrating rate gyro can replace a costly free gyro. This new instrument can be furnished to cover the ranges from zero to $\pm 10^\circ$ rotation up to zero to $\pm 100^\circ$ rotation for full output. AC or DC motor.



Humphrey Inc.

ELECTRO-MECHANICAL INSTRUMENTS

DEPT. ED-109, 2805 CANON STREET
SAN DIEGO 6, CALIFORNIA

WRITE TODAY FOR MORE INFORMATION ON ANY OF THESE PRODUCTS

CIRCLE 409 ON READER-SERVICE CARD

NEW PRODUCTS

Transistor

High frequency type

Models ST6006 and 2N1205 high frequency transistors are for if and video amplifiers. Model ST6006 has a typical power gain of 25 db at 12.5 mc and model 2N1205 has a typical power gain of 30 db at 4.3 mc. Both units have a low noise figure.

Transitron Electronic Corp., Dept. ED, 138 Albion St., Wakefield, Mass.

CIRCLE 410 ON READER-SERVICE CARD

Ultrasonic Cleaner

Has 5-gal capacity



For high energy density ultrasonic cleaning, model 240 cleaner has a 5-gal heavy-gage stainless steel tank measuring 12 x 12 x 9 in. Driving elements cover 44.5% of the tank bottom. Radiating surface is 48 sq in. Designed for continuous operation, the 115 v ac, single-phase generator delivers 250 w avg and 1000 w peak. Other features of the unit are: a 0 to 60 min timer, a one tube oscillator, provisions for remote control, and front panel switching which permits a choice of either of two transducers and circuit breaker.

National Ultrasonic Corp., Dept. ED, 111 Montgomery Ave., Irvington 11, N.J.

CIRCLE 411 ON READER-SERVICE CARD

Pulse Transformers

Have pulse widths of 0.05 to 5 μ sec

For use with transistorized blocking oscillator and interstage coupling circuits, type AME miniature pulse transformers are available with pulse widths from 0.05 to 5 μ sec at repetition rates to 500 kc. Three grades of environmental characteristics can be obtained: a commercial grade having an operating temperature of -25 to $+105$ C, a military grade having an operating temperature of -55 to $+105$ C and exceeding most of the requirements of MIL-T-27A, and X grade which operates to $+150$ C and meets all Mil specs. The units are wound on ferrite cup cores

and are epoxy encapsulated in cylindrical aluminum cases 1/2 in. long and 0.369 in. in diameter. They are available with two or three windings; connections are through pig-tail leads 1-7/8 in. min. length.

Technitrol Engineering Co., Dept. ED, 1952 Allegheny Ave., Philadelphia 34, Pa.

CIRCLE 412 ON READER-SERVICE CARD

Bias-Voltage Regulator

Dual type



For use in transistor or tube circuit design, model RK 60 transistorized bias regulator consists of two independent bias-voltage regulators. Each regulator provides 0 to -6 or -6 to -30 v dc, continuously variable. The outputs can be metered with automatic range switching. The maximum input is 35 v dc; the minimum input is 5 v greater than desired output. The load regulation is 0.3% from zero to full load; there is 0.1% regulation for $\pm 10\%$ change of input v dc. Minimum load resistance is 1000 ohms and ripple reduction is 40 db.

Arkay Engineering, Inc., Dept. ED, 225 Santa Monica Blvd., Santa Monica, Calif.

CIRCLE 413 ON READER-SERVICE CARD

Servo Amplifiers

Three types available

Designed to drive any standard size 11, 15 or 18 servo motor with a 40 v center-tapped control winding, these servo amplifiers are available in three types. Type T1000 has a 2500 v gain, 3.5 w output, and measures 1-3/8 x 1-3/8 x 3 in. Type T4000 has a 1500 v gain, 6.2 w output, and measures 1-7/8 x 1-5/8 x 3-1/2 in. Type T7000 has 3000 v gain, 9.3 w output and measures 2-3/8 x 1-3/4 x 3-3/4 in. All three types feature stabilized stages to prevent thermal runaway and internal negative feedback. They operate in an ambient temperature of -55 to +75 C, require a 28 v dc power supply, and have a 10,000 ohm input impedance.

Magnetico, Inc., T. A. Div., Dept. ED, 6 Richmond Court, E. Northport, N.Y.

CIRCLE 414 ON READER-SERVICE CARD

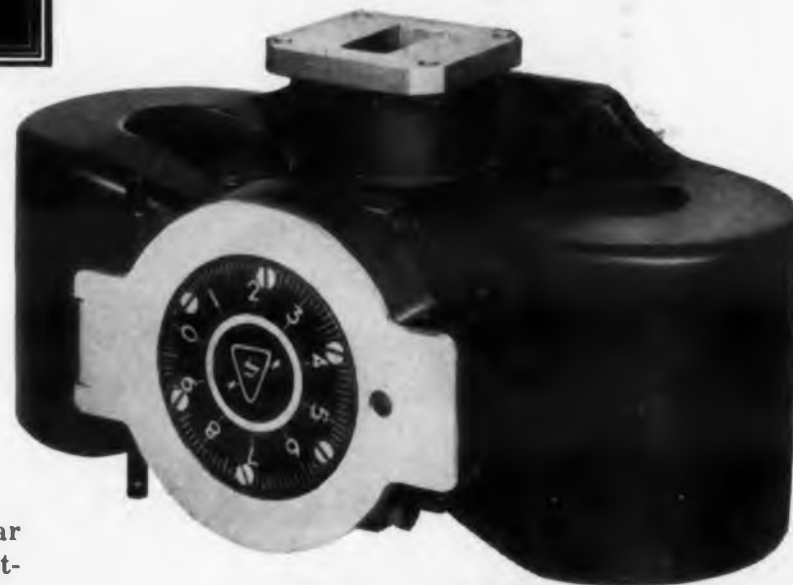
Microwave Component News

from SYLVANIA

New line of X-band magnetrons, servo-tunable over 1100 mc

M4164, M4193, M4163
cool without special ducts

These three rugged new magnetrons, like the familiar 6874 and 7006, feature the same size, accessible mounting points, and high reliability of the fixed-frequency 4J50. The unique tapered-pin tuner, already proven highly successful in severe applications of the 6874 and 7006, has been incorporated in this line. Servo-tuning without a special oversized gear box and no change in outline is available in all five types on request. Easy tuner-dial readability and ruggedness, flexibility of tuner location, and standard through-bolt lug mounting from the top are regular benefits featured by Sylvania. 1.5 mismatch at full power and atmospheric pressure is made possible by a new window design. Fin placement permits cooling without special ducting.



SPECIFICATIONS

TYPE	FREQUENCY RANGE, MC	AVER. POWER AT 1 US		STATUS
		MIN., WATTS	RRV KV/US	
M4163	8500-9600	190	180	Pilot production
M4164	8500-9600	200	200	Pilot production
M4193*	8500-9600	200	225	Pilot production
6874	8800-9400	190	180	In production
7006	9000-9600	190	225	In production

*Has leading edge mode stability specification.



For more information write your nearest Sylvania tube sales office or Sylvania Electric Products Inc., Special Tube Operations, 500 Evelyn Ave., Mountain View, Calif.

New ruggedized beacon magnetron delivers 100 watts peak power

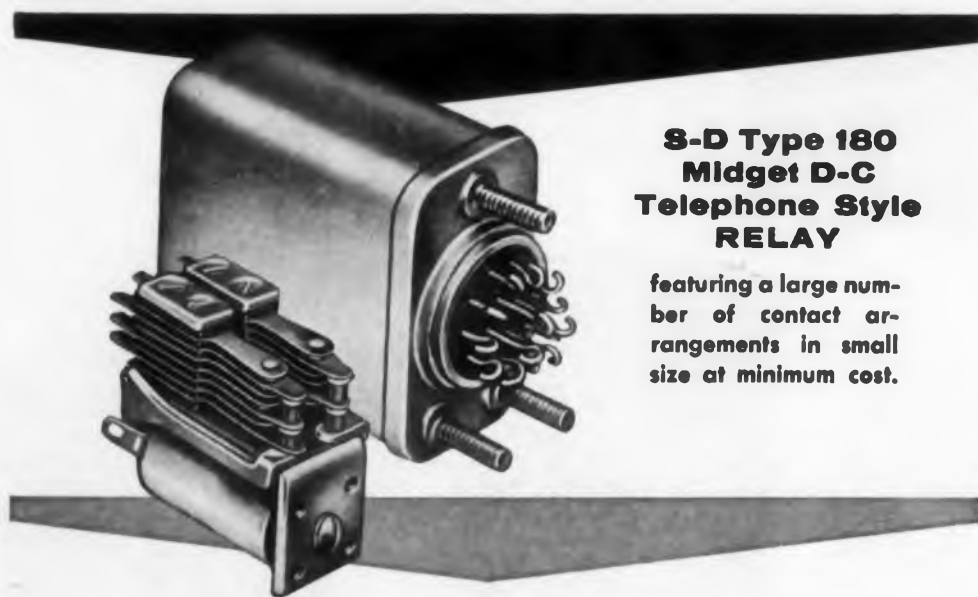
Addition of TNC connector improves output

Sylvania type 7503 is a beacon magnetron specially ruggedized for missile applications. An advanced-design version of the 7098, the new tube delivers a minimum peak power of 100 watts and employs a TNC output connector which increases efficiency. Since the connector feeds into a broad-band coupler, it eliminates the need for adjusting for optimum power when the frequency is changed. The tubes withstand a 500 g, 1 millisecond shock. Additional ruggedness has been designed into the mounting bracket and tuner structure to increase the outstanding reliability of the tube.

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS



CIRCLE 415 ON READER-SERVICE CARD



**S-D Type 180
Midget D-C
Telephone Style
RELAY**

featuring a large number of contact arrangements in small size at minimum cost.

NEW RELIABILITY
for a popular
multi-contact relay type

The big story about this popular midget relay type is not that it is new . . . but that Struthers-Dunn now makes it. Material and design improvements scored by S-D engineering spell maximum dependability and long life—yet at no price increase.

As illustrated, 16 flexing contact springs can be supplied with 8 springs in each of two stacks. Standard relays withstand ambient temperatures to 85°C. Special types for ambients of 125°C. are available. Minimum power requirements are on the order of 100 milliwatts per pole.

A-C VERSIONS for continuous duty can be supplied.

FOR MILITARY APPLICATIONS, SD Type 180 Relays are widely used for ground and aircraft electronic and communications equipment.

FOR COMMERCIAL USES. Type 180 relays provide maximum dependability for the numerous contact arrangements required for computers, instruments, signalling and annunciator systems and similar low power uses.

Data Bulletin No. 2180 request

Now!

STOCK DELIVERIES from the factory on many of the S-D 5,348 relay types.

IMMEDIATE LOCAL DELIVERIES on many of the most popular types. Write for name of your nearest distributor.



STRUTHERS-DUNN, Inc.

Pitman, N. J.

Makers of the world's largest selection of relay types

Sales Engineering Offices in: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Dallas • Dayton • Detroit • Kansas City • Los Angeles • Montreal • New Orleans • New York • Pittsburgh • St. Louis • San Francisco • Seattle • Toronto

CIRCLE 416 ON READER-SERVICE CARD

NEW PRODUCTS

MAGNIFIER.—Equipped with swivel clamp, this magnifier is 4-in., +5 diopter type. The precision ground lens has an 8-in. focal length. It can be used on assembly lines and inspection benches.

Edmund Scientific Co., Dept. ED, Barrington, N.J.

CIRCLE 417 ON READER-SERVICE CARD

ANALOG COMPUTER.—Incorporates high-speed memory and automatic iteration capability. Called Dystac, the new system has logic elements that operate with a frequency adequate for 50 solutions per sec.

Computer Systems, Inc., Dept. ED, 611 Broadway, New York 12, N.Y.

CIRCLE 758 ON READER-SERVICE CARD

POROUS SPONGE TEFLON.—Used in filtration, for thermal insulation, and for vibration absorption. Liquids can be passed through the product to help

control temperature in extreme temperature applications.

Liquid Nitrogen Processing Corp., Dept ED, 451 Booth St., Chester, Pa.

CIRCLE 418 ON READER-SERVICE CARD

PHOTOCONDUCTIVE CELL.—Type 7536 is a side-on version of head-on type 7412. Illumination sensitivity is 300 μ a per ft-c at 25 C.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 419 ON READER-SERVICE CARD

TERMINAL BOARDS.—For resistor mounting. They are 1/16 in. thick fibre glass, with eight lugs. No. 1450 is 7/8 x 23/32 in. with terminal rows 1/2 in. apart; No. 1451 is 1-7/32 x 1-1/32 in. with rows 3/4 in. apart; No. 1452 is 1-1/2 x 1-5/32 in. with rows 7/8 in. apart. Terminals extend 3/16 in. above boards.

Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 420 ON READER-SERVICE CARD

DESIGN ENGINEERS . . .

your: | "time saving"
"accurate" answer to . . .

TRANSISTOR TRANSFORMER PROBLEMS

DESIGN — RESEARCH — DEVELOPMENT

JAMES C-2450 KIT

A unique kit of 12 transformers gives 96 different designs covering 93% of all applications

NET \$44.50



PILOT AND FULL PRODUCTION

Each of 12 kit models available in 5 different case designs



Write or order direct from

ED-10

JAMES VIBRAPOWR COMPANY

4050 N. Rockwell, Chicago 18, Illinois
CO 7-6333

CIRCLE 421 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

PORTABLE COMPUTER.—Used as training instrument, or to simulate processes. Programming is plug-in type; input is 110 v ac. Unit has dual power supply.

Ebex Sales Inc., Dept. ED, Orem, Utah.

CIRCLE 422 ON READER-SERVICE CARD

STRIPPING TOOLS.—Kit K-500 consists of 6 wire strippers and 5 extra bits. They handle sheath diameters of 0.025 to 0.25 in. The strippers can be used in die holders. The cutting operation is in full view.

Continental Sensing, Inc., Dept. ED, 1950 N. Ruby St., Melrose, Ill.

CIRCLE 759 ON READER-SERVICE CARD

CAPACITANCE BRIDGE.—Reads capacity and dissipation factor of electrolytic capacitors up to 100,000 μ f, at 60 and 120 cps.

Electronic Applications, Inc., Dept. ED, 194 Richmond Hill Ave., Stamford, Conn.

CIRCLE 423 ON READER-SERVICE CARD

GAS MONITOR.—Detects low levels of radio-active gas in the atmosphere.

The unit is portable and self contained.

Land-Air, Inc., I & E Div., Dept. ED, 2133 Adams Ave., San Leandro, Calif.

CIRCLE 424 ON READER-SERVICE CARD

CHROMATOGRAM SCANNER.—Simultaneously counts both sides of one or more continuous radio-chromatogram strips up to 50 ft long.

Atomic Accessories, Inc., Dept. ED, 244-02 Jamaica Ave., Bellrose 26, N.Y.

CIRCLE 425 ON READER-SERVICE CARD

DIFFUSION FURNACE.—Temperature control to within 1 deg C. It has a 15-in. effective heating length with a 2-in. quartz tube.

A. D. Alpine, Inc., Dept. ED, Culver City, Calif.

CIRCLE 756 ON READER-SERVICE CARD

TELEMETRY VOLTAGE CALIBRATOR.—For subcarrier oscillators. It operates under extreme variations of altitude, temperature and shock.

Dynatronics, Inc., Dept. ED, Box 2566, Orlando, Calif.

CIRCLE 426 ON READER-SERVICE CARD

*The EG&G Type 2236A Milli-Mike Oscilloscope ...
... the only oscilloscope capable of measuring the performance of high-speed semiconductors.*

The Milli-Mike Oscilloscope reproduces pulse rise time on the order of a tenth of a millimicrosecond at relatively low signal voltages without the use of amplifiers. Frequencies as high as 3,000 megacycles and voltage levels of 40 to 50 millivolts can be detected and recorded.

PERFORMANCE DATA

	Vertical (TW)	Horizontal
Sensibility	.054 v/trace width	0.30 v/trace width
Nominal Spot Size (trace width)	0.002 inch	
Deflection	27 v/inch (nominal)	150 v/inch
Frequency Response	DC to greater than 3,000 mc (-3db at approx. 2,000 mc)	
Input Impedance	50 or 100 ohms	
Writing Speed	3 x 10 ¹¹ trace widths/sec.	

Let EG&G's experience in sub-millimicrosecond measurements assist you in the development, inspection and quality control of high-speed semiconductors.

The EG&G Milli-Mike Oscilloscope—one of a family of millimicrosecond instruments—is now being used to solve problems in measurement of recovery time of diodes, decay times of scintillators, discontinuities in transmission lines and as a synchroscope in high resolution radar systems.

milli mike

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CIRCLE 428 ON READER-SERVICE CARD

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CIRCLE 427 ON READER-SERVICE CARD



CERAMASEAL SAPPHIRE-TO-METAL SEALS STAY HIGH VACUUM-TIGHT EVEN AT 450c BAKE-OUT

Do you need windows for radar equipment wave guides? Or for high-temperature, high-vacuum furnaces or infra red detection equipment?

CERAMASEAL has solved the problems involved in brazing synthetic sapphire to metal parts—is the country's leading producer. Sapphire discs or tubes are readily sealed to tubular type metal parts of kovar, nickel-iron or platinum. The seals are mass spectrometer-tight and the assemblies can be soldered, brazed or welded in place without damaging the seal.

FOR COMPLETE INFORMATION, write CERAMASEAL, INC., New Lebanon Center, N. Y. or phone: West Lebanon 3-5851.

Hermetic Ceramic Terminals, Magnetron Wells, Sapphire-to-Metal Seals

CERAMASEAL, inc.

CIRCLE 429 ON READER-SERVICE CARD

NEW PRODUCTS

NPN Transistors

Are hf type

These three types of npn hf computer transistors conform to the JETEC, TO-9 outline. Types 2N377 and 2N388 have a collector to base voltage of 25 v dc, a collector to emitter voltage of 20 v dc, and an emitter to base voltage of 15 v dc. Type 2N385 has a collector to base voltage of 25 v dc, a collector to emitter voltage of 25 v dc, and an emitter to base voltage of 15 v dc. For all three types, the total dissipation is 150 mw; de-rating per deg C increase in ambient temperature is 2 mw; and the operating and storage temperature range is -55 to +100 C.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 432 ON READER-SERVICE CARD

Interval Timer

Has intervals to 180 min



Type AT-31 interval timer, having intervals of 1, 5, 15, 30, 60, 120, and 180 min, is a totally enclosed motor-driven switching device for use with fans, heaters, battery chargers, and photographic equipment. The timer is manually set. The housing is molded phenolic; terminal and blade configurations are heavy gage spring brass and have no welded or stacked joints. Operation is at 120 or 240 v, 50 or 60 cps.

General Time Corp., Haydon Div., Dept. ED, 245 E. Elm St., Torrington, Conn.

CIRCLE 433 ON READER-SERVICE CARD

Interval Timer

With ranges of 1 sec to 3 hr

Series PAF panel-mounting interval timer is available in 12 models with a time cycle from 1 sec, having minimum setting of 1/60 sec, to a time cycle of 3 hr, having a minimum setting of 3 min. Started from a momentary pulse, the unit has a load rating of 15 amp, rated at 115 v 60 cps non-inductive. The timer resets at the end of each cycle; reset time is less than 0.02 sec over the complete time scale, regardless of time cycle. Re-

ELECTRONIC DESIGN • October 14, 1959

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► Illustrated: Model 45-P clear plastic 4 1/2" meter, one of a family of acrylic-cased instruments, directly interchangeable with standard phenolic-cased units of similar size. **PACE** also offers a wide range of phenolic-cased meters in 2 1/2" to 7" sizes.

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ELECT

repeat accuracy is ± 3 to ± 5 msec over a complete 1 sec scale. The unit can be supplied for 115 and 230 v at 25, 50, 60, and 400 cps.

Industrial Timer Corp., Dept. ED, 1407 McCarter Highway, Newark, N. J.

CIRCLE 434 ON READER-SERVICE CARD

Filament Transformers

For use with magnetrons



These magnetron filament transformers use fluorochemical gas as the dielectric and have nominal capacitances of 10 μf . They meet most filament voltages and operating pulse voltages from 15 to 30 kv. Model L3-2D, shown here, is used with a 4J52 magnetron. The input is 115 v, 400 cps and the output is 12.9 v at 2 amp. The operating pulse is 16 kv, capacitance is 11 μf , and temperature range is -55 to $+125$ C. It weighs 16 oz and measures 2-9/16 in. in diameter and 5-3/8 in. long. The complete line of filament transformers have been tested to MIL-T-27A.

RS Electronics Corp., Dept. ED, P.O. Box 368, Station A, Palo Alto, Calif.

CIRCLE 435 ON READER-SERVICE CARD

Precision Differentials

For heavy-duty electro-mechanical systems

For heavy-duty electro-mechanical systems such as computers and fire control devices, these precision differentials are available in hollow or solid shaft types. Typical of this line, the 5/16 in. solid shaft model has a backlash of 5 min and a break-away torque of 0.1 oz-in. The working circle is 2.375. Other models include a 1/16 in. hollow shaft, 1/8 in. hollow and solid shafts, 3/16 in. hollow and solid shafts, and a 1/4 in. solid shaft.

Arch Instrument Co., Inc., Dept. ED, 101 Holmes St., N. Quincy 71, Mass.

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468 Elm St., Sycamore, Ill.
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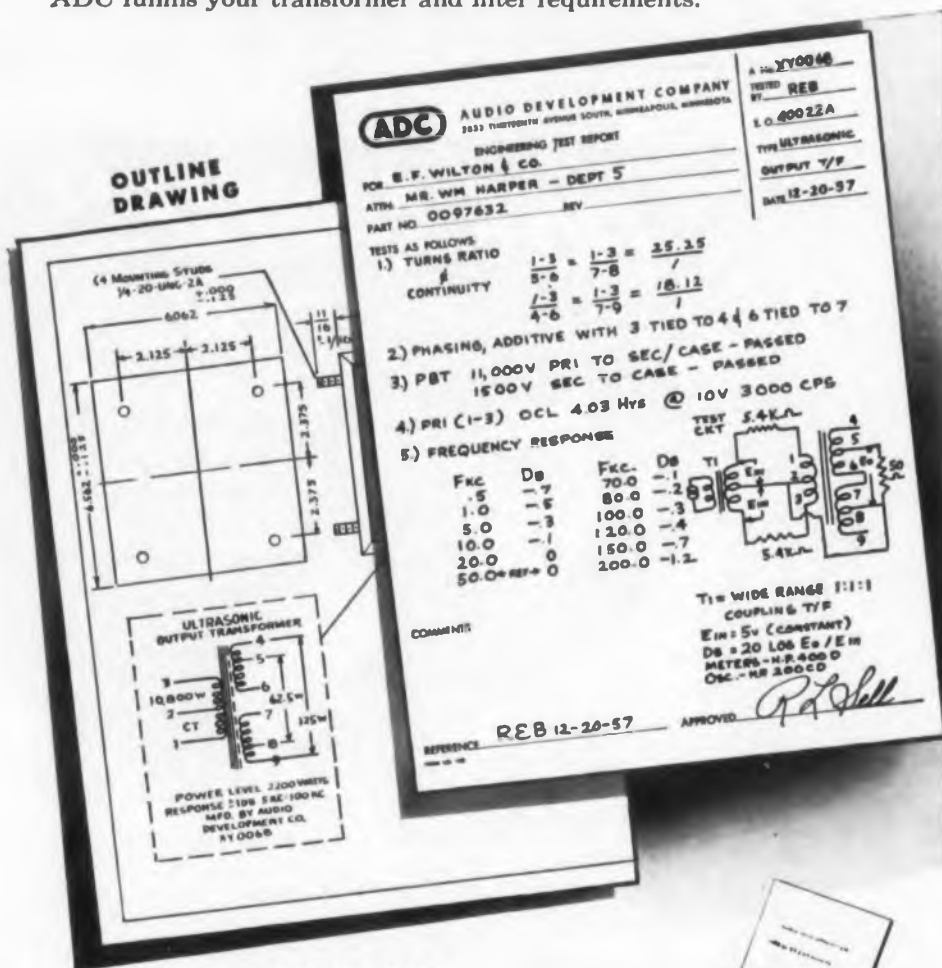
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CIRCLE 440 ON READER-SERVICE CARD

NEW PRODUCTS

Connectors Rectangular type

These miniature, rectangular type environmental connectors, series WP, P, and J, have stainless steel shells, molded sealing gaskets, and glass-fiber jackscrews which exceed MIL-C-8384. The closed entry beryllium copper contacts meet applicable parts of MIL-C-5015. The connectors are available with up to 104 contacts and have face sealing gaskets for high voltages. They have been tested to 200,000 ft.

Airborn Connectors, Inc., Dept. ED, 2618 Manana Drive, P.O. Box 13251, Dallas, Tex.

CIRCLE 441 ON READER-SERVICE CARD

Pulse Modulators For transmitting tubes



Designed to pulse magnetrons, klystrons, traveling wave tubes, and other transmitting tubes, series 223 pulse modulators have built-in repetition rate and pulse width generators. They also have metered low capacity filament supplies and continuously variable output power levels. Units are available for either 60 or 400 cps operation and all circuits are interlocked. Typical of this series, model 223-A, illustrated, operates at 115 v 400 cps and generates 19 kv peak at 15 amp peak at 2 μsec, 600 pps pulse. The filament power is 0 to 15 v dc at 5 amp.

Burmac Electronics Co., Inc., Dept. ED, 142 S. Long Beach Rd., Rockville Centre, N.Y.

CIRCLE 442 ON READER-SERVICE CARD

NPN Transistors For switching circuits

These npn hf computer transistors are for switching and flip-flop circuits. Types 2N438, 2N439, and 2N440 have 100 mw dissipation and derate 1.7 mw per deg C increase in ambient temperature. Types 2N438A, 2N439A, and 2N440A have 150 mw dissipation and derate 2.5 mw per deg C. All types have a collector to base voltage of 30 v dc, and an emitter to base voltage of 25 v

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dc. Types 2N438 and 2N438A have a rise time of 0.7 μ sec, types 2N439 and 2N439A, 0.5 μ sec, and types 2N440 and 2N440A, 0.3 μ sec. The temperature range is -55 to $+85$ C.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 445 ON READER-SERVICE CARD

Pumping Systems For high-vacuum use



For high-vacuum use, series 1400 pumping systems use diffusion pumps with mechanically refrigerated or liquid-nitrogen cooled traps. The valves are manual or air-operated; standard instrumentation may be indicating type or fully-automatic. Types 1402, 1404, and 1406 are 2, 4, and 6 in. caster-mounted portable units. Types 1410, 1416, and 1432 are 10, 16, and 32 in. skid-mounted assemblies. Type 1410 is shown here.

General Vacuum Corp., Dept. ED, 400 Border St., E. Boston 28, Mass.

CIRCLE 446 ON READER-SERVICE CARD

NPN Germanium Transistors For switching circuits

Made for switching and flip-flop circuits, types 2N356, 2N357, and 2N358 npn hf computer transistors have a welded package which conforms to JETEC, TO-9. All three types have the following ratings at 25 C: collector to base voltage, 20 v dc; emitter to base voltage, 20 v dc; total dissipation, 100 mw; and derating per deg C increase in ambient temperature, 1.67 mw. The operating and storage temperature range is -55 to $+85$ C. Maximum rise time is 2 μ sec for 2N356, 1.2 μ sec for 2N357, and 0.8 μ sec for 2N358.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 447 ON READER-SERVICE CARD

Announcement

GARLOCK NOW OFFERS BROADEST LINE OF INDUSTRIAL PLASTICS FOR THE ELECTRONICS INDUSTRY

Effective June 29, 1959, Fluorocarbon Products Inc., a division of United States Gasket Company, Plastics Division of The Garlock Packing Company was dissolved as a corporation. Products of the former division are now marketed as GARLOCK ELECTRONIC PRODUCTS.

One Source For All Your Needs. The product line of GARLOCK ELECTRONIC PRODUCTS has now been expanded to include:

- Teflon® and nylon raw stock, machined, fabricated and injection molded parts
- Molded and extruded silicone
- Chemelec® Teflon Feed-thru and Stand-off Insulators
- Chemelec Teflon Sockets
- Chemelec Teflon Connectors
- Chemelec Separators
- Chemelec Teflon Spaghetti Tubing
- Chemelec Copper-Clad Teflon for printed circuits
- Chemelec Teflon Grommets
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Now, you can make GARLOCK ELECTRONIC PRODUCTS your *headquarters for Teflon* and other industrial plastics and components.

65 Trained Electronic Specialists to Serve You! GARLOCK ELECTRONIC PRODUCTS is represented by a team of experts who are thoroughly familiar with your problems. Their knowledge and this expanded line will save you time for other important problems.

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CIRCLE 448 ON READER-SERVICE CARD





In Electrical Circuitry Tests

DIT-MCO Is Faster and More Reliable Than Other Methods

Take tape read-out tests, for example. This method requires extra machines to translate test information or a genius to remember the code used on the tape. Either way, it's a costly process. Compare this to the DIT-MCO Automatic Circuit Analyzer and its exclusive Matrix Chart.

The DIT-MCO Circuit Analyzer performs the entire test itself. There's no need for complex machines to translate test information. All data concerning errors, circuit numbers, type of flaws, etc., appears on the Matrix Chart, so there's no need for complicated wiring diagrams or charts! And, the DIT-MCO Circuit Analyzer checks one circuit against all others... over 2,000 in about three minutes... with accuracy never before possible in any test system.

Some testers are a maze of colored, flashing lights. Operators of such test machines must refer to 100, 500 or even 1,000 miniature lights to try and locate errors. Charts and diagrams must also be used... with a resultant high number of human errors.

The DIT-MCO Circuit Analyzer injects human decision into every test but in such a way that chances of human errors are nil. The easy-to-read Matrix Chart employs only two lights to quickly pinpoint every circuitry flaw. Yet, anyone, with less than one hour's instruction, can operate the DIT-MCO Automatic Circuit Analyzer and perform test functions once thought impossible!

DIT-MCO, Inc. employs an experienced staff of sales engineers in the field. Contact your field sales engineer or write for important facts about DIT-MCO Automatic Electrical Circuit Analyzers.



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CIRCLE 449 ON READER-SERVICE CARD

NEW PRODUCTS

NPN Germanium Transistors

Three types available

Types 2N634, 2N635, and 2N636 npn germanium transistors are for switching and flip-flop circuits and conform to JETEC, TO-9. They have the following ratings at 25 C: collector to base voltage, 20 v dc; collector to emitter voltage, 20 v dc; emitter to base voltage, 15 v dc; total dissipation, 150 mw; and derating per deg C increase in ambient temperature, 2.5 mw. The temperature range is -65 to +85 C.

CBS Electronics, Dept. ED, 100 Endicott St., Danvers, Mass.

CIRCLE 450 ON READER-SERVICE CARD

Induction Heating Unit

Has 10 kw output



Made for processing semiconductor materials, model LI-10C-1 induction heating unit operates at about 4 mc and has an output of 10 kw. The power input is 230 to 460 v 60 cps, three phase and the power consumption is 20 kva max at 90% power factor. Three meters for monitoring the oscillator tube plate current, grid current, and plate voltage are mounted on the front of the cabinet. A total time meter indicating filament hours is inside the enclosure. Over-all dimensions are 40 x 40 x 76 in.

Lindberg Engineering Co., Dept. ED, 2450 W. Hubbard St., Chicago 12, Ill.

CIRCLE 451 ON READER-SERVICE CARD

Resistor Networks

Are matched to 0.01%

These resistor networks are matched to 0.01% resistance. Temperature coefficients are matched to 1 ppm per deg C. Nine resistors with up to



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Specify G-E vitreous-enamelled resistors when your designs require dependable performance. G-E resistors are designed to eliminate failures! Non-crazing vitreous enamel effectively seals out corrosive atmospheric conditions. You pay nothing extra for this G-E quality! Follow instructions below for the G-E Resistor Catalog. General Electric Co., Roanoke, Virginia.

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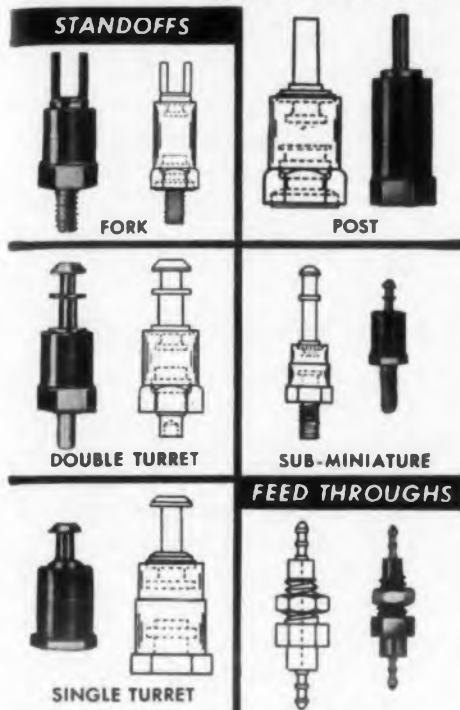
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GENERAL ELECTRIC

CIRCLE 452 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

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

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

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

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

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

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

PROMPT DELIVERY IN ECONOMICAL QUANTITY RUNS

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10 meg occupy less than 1 cu in. They can be used as: feedback networks, of which the ratio determines the gain of an amplifier; voltage dividers for instrument input or reference voltage selection; and summing networks, for adding multiples of several input voltages.

Pyrofilm Resistor Co., Dept. ED, U.S. Highway 46, Parsippany, N.J.

CIRCLE 454 ON READER-SERVICE CARD

Voltage Regulator

Has 99% efficiency



This electro-mechanical automatic voltage regulator, designated Stabiline EM4108MR maintains a constant output voltage regardless of line or load changes and has an efficiency of 99%. Speed of response is 0.1 sec per v, accuracy is $\pm 1\%$, and waveform distortion is claimed to be zero. The input is 105 to 135 v, 45 to 65 cps; the output is 120 v rms nominal and is adjustable from 115 to 125 v. The output current is 66.6 amp. The unit meets MIL-E-4158B and is suitable for rack mounting. It weighs 75 lb.

Superior Electric Co., Dept. ED, 83 Laurel St., Bristol, Conn.

CIRCLE 455 ON READER-SERVICE CARD

Frequency Detector

Accuracy is 0.1%

This solid state frequency detector, called Magmeter, delivers a dc output proportional to the input frequency at an accuracy of 0.1%. It covers a 10% bandwidth at any center frequency to 10,000 cps at a linearity better than 0.25%. The output will operate any 0 to 50 ma device. Its uses include instrumentation, tachometry, telemetering, and automatic control. The temperature range is -55 to $+72$ C. The weight is less than 4 oz and the height is 2 in.

Airpax Electronics Inc., Seminole Div., Dept. ED, Fort Lauderdale, Fla.

CIRCLE 456 ON READER-SERVICE CARD



BOTH ends of today's jets—hot and cold—are easy infrared targets through TI silicon optics.

BIRD'S IR VIEW... of a Hot Stove Pipe

The wedding of optics to electronics may well be the marriage of the century... a TI-fostered union producing infrared guidance systems capable of finding, evaluating, rejecting false targets, and directing its "bird" to point-of-impact. Texas Instruments—leading producer of silicon optics for infrared applications—has achieved an intimate understanding of this and other unusual materials for specific portions of the spectrum.

In one of the nation's best equipped facilities, TI optics specialists design, grind, polish, and coat silicon lenses, prisms, windows, and other elements with the precision accuracy necessary for even the feeblest IR signals. Backed by a full-time engineering service with fast computers for design execution, the Texas Instruments optics team has the "know-how" to carry through your project from sketch pad ideas to custom-made systems. For detailed information on any phase of precision optics technology, contact SERVICE ENGINEERING.



OPTICS DEPARTMENT
TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS

CIRCLE 457 ON READER-SERVICE CARD

When Top Quality Capacitors Are Required Specify Pyramid Mylar® or Tantalum

UP TO 1000 MFD-VOLTS IN LESS THAN 2/100
OF A CUBIC INCH

...PYRAMID TANTALUM CAPACITORS

Miniaturized to provide maximum space economy.

New Pyramid Tantalum slug capacitors have cylindrical cases and contain a non-corrosive electrolyte. Due to the special construction of materials used in the manufacture of Pyramid Tantalum slug capacitors, these units are both seep and vibration proof. In addition, this type of capacitor assures long service life and corrosion resistance—made to meet MIL-C-3965 Specifications.

Commercially available immediately, these new Pyramid Tantalum capacitor units have an operating range between -55°C to 100°C for most units without any de-rating at the higher temperature.

PYRAMID MYLAR...
—30° C to +125° C...
SMALLEST FILM CAPACITORS MADE!

Pyramid new Mylar capacitors have extremely high insulation resistance, high dielectric strength and resistance to moisture penetration.

Commercially available immediately, Pyramid Mylar capacitors have an operating range between -30°C to $+125^{\circ}\text{C}$ with voltage de-ratings above $+85^{\circ}\text{C}$. Pyramid wrapped Mylar capacitors—Series Nos.: 101, 103, 106 and 107 have the following characteristics:

Construction Styles:	Basic No.	Type Winding	Shape
	101	Inserted Tabs	Flat
	103	Extended Foil	Flat
	106	Inserted Tabs	Round
	107	Extended Foil	Round

Tolerance: The standard capacitance tolerance is $\pm 20\%$. Closer tolerances can be specified.

Electrical Characteristics: Operating range for Mylar capacitors—from -55°C to $+85^{\circ}\text{C}$ and to $+125^{\circ}\text{C}$ with voltage de-rating.

Dissipation Factor: The dissipation factor is less than 1% when measured at 25°C and 1000 CPS or referred to 1000 CPS.

Insulation Resistance:	Temperature	IR x mfd	Maximum IR Requirements
	25°C	50,000	15,000 megohms
	85°C	1,000	6,000 "
	125°C	50	300 "

Pyramid Mylar capacitors are subject to the following tests:

Test Voltage—Mylar capacitors shall withstand 200% of rated D.C. voltage for 1 minute at 25°C .

Life Test—Mylar capacitors shall withstand an accelerated life test of 250 hours with 140% of the voltage rating for the test temperature. 1 failure out of 12 is permitted.

Humidity Test—Mylar capacitors shall meet the humidity requirements of MIL-C-91A specifications.

Complete engineering data and prices for Pyramid Mylar and Tantalum Capacitors may be obtained from Pyramid Research and Development Department.

DU PONT REGISTERED TRADEMARK

CAPACITORS—RECTIFIERS
FOR ORIGINAL EQUIPMENT—
FOR REPLACEMENT

ELECTRIC CO.
NORTH BERGEN, N. J.

EXPORT: 458 Broadway, N. Y. 13, N. Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal

CIRCLE 458 ON READER-SERVICE CARD

NEW PRODUCTS

DUAL TRIODES.—Types 6DE7 and 10DE7 have 9-pin miniature design and contain a low- μ unit and a high- μ unit in a single envelope. They are for use in vertical-deflection-oscillator and vertical-deflection-amplifier applications in TV receivers.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 459 ON READER-SERVICE CARD

POWER SUPPLY MOUNTING KIT.—Permits use of power supply modules from breadboard through mass production stages. Model 70-101 will mount up to four modules.

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

CIRCLE 460 ON READER-SERVICE CARD

COMMUNICATIONS TOWER.—Provides rigidity at heights to 630 ft. Sec-

tions of the No. 60 tower are galvanized after fabrication and are 10 ft long. Each section is a 26-1/4 in. equilateral triangle with 5/8 in. solid steel rod cross-bracing attached to 2 in. 11-gage tubing.

Rohn Manufacturing Co., Dept. ED, 116 Limestone, Bellevue, Peoria, Ill.

CIRCLE 461 ON READER-SERVICE CARD

TUBE SPACERS.—For photomultiplier tubes. Made of chemically etchable glass, they can withstand the high operating temperatures of photomultipliers, and can be produced to ± 0.002 in. hole diam specs.

Corning Glass Works, Dept. ED, Corning, N.Y.

CIRCLE 462 ON READER-SERVICE CARD

ANALYZER.—Optional feature in model 34-2 200-channel analyzer is the



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CIRCLE 463 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

multi-channel scaler mode of operation. In this mode, analyzer will store information in one channel for preset time. At the end of this time interval, the address will automatically advance to the next channel and the analyzer will again store information.

Radiation Instrument Development Laboratory, Inc., Dept. ED, 5737 S. Halstead St., Chicago 21, Ill.

CIRCLE 464 ON READER-SERVICE CARD

SILICON DIODES.—For circuitry where bank-mounting or other close-quarter mounting procedures are used. The entire range of silicon pigtail diodes are available with an insulating Teflon coating over the diode case. The transparent insulating jacket will maintain its electrical and mechanical properties from -67 to $+250$ C.

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

CIRCLE 760 ON READER-SERVICE CARD

ETCHED RETICLES.—For use as space filters to process infrared target information and other precision optical systems.

Thompson Ramo-Wooldridge Inc.,

Dept. ED, P.O. Box 90534 Airport Sta., Los Angeles 45, Calif.

CIRCLE 465 ON READER-SERVICE CARD

CONNECTORS.—For cables such as RG-68 C/U and RG-59 A/U, ConheX types 3040 and 3050 plugs mate with 75-ohm ConheX receptacles and jacks.

Sealectro Corp., Dept. ED, 139 Hoyt St., Mamaroneck, N.Y.

CIRCLE 466 ON READER-SERVICE CARD

TWIN TRIODE.—For use in tv receivers, type 6CN7 9-pin miniature, high-mu triode operates from a 6.3 or 3.15 v supply.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 467 ON READER-SERVICE CARD

SILICON ZENER VOLTAGE REGULATORS.—Available in ratings of 0.75, 1, 3.5, and 10 w, the Gold Crown units extend the control range to 100 v.

International Telephone and Telegraph Corp., Dept. ED, 67 Broad St., New York 4, N.Y.

CIRCLE 468 ON READER-SERVICE CARD



... sign here!

If you want top-quality pots when you need them, you could make your own! Of course, you'll need Swiss screw machinery to produce the cases necessary to complete the job. So plunge right in — sign up for those highly precision screw machines . . . and hang the cost!

But before you deplete the family exchequer with a grand flourish of the pen, come to Ace! We've already taken the plunge, and it's paid off. These machines automatically deliver, at high speed, cases with mechanical tolerances closer than .0002. This also means the most flexible production operation in the industry. No sub-contracted parts to wait for — we design our own cams to any special size and shape, and we run the cases ourselves, on a 24-hour day basis! So for dependable delivery, see your ACErep!



Here's one of our automatic-production cases, on a servo mount A.I.A. size 1-1/16" ACEPOT®. In-plant production on cases up to 6".

ACE ELECTRONICS ASSOCIATES, INC.
99 Dover Street, Somerville 44, Mass.
SOMerset 6-5130 TmX SMVL 181 West. Union WUX

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AXIAL-LEAD
PRECISION
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RESISTORS
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STANDARD SIZES OF
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and 20 WATTS

MINIATURE SIZE
ALL WELDED CONSTRUCTION
MEETS STRINGENT
MILITARY REQUIREMENTS
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MINIMUM SPACE
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CIRCLE 469 ON READER-SERVICE CARD

COMPACT, 3-OUNCE TIME DELAY RELAY

with silicone-controlled
delay from 1/4 to 120 seconds



Worth a closer look . . . the Heinemann Type A Silic-O-Netic Relay. Despite its small overall size, the relay offers many big performance features.

For example, double-pole, double-throw switching . . . at fast snap-action contact speed.

The relay is a load carrier in itself: it may be energized continuously . . . does not require auxiliary lock-in circuits.

And it has a hermetically sealed time element that is forever free from the effects of aging or fatigue. The Type A Relay has proven itself in countless applications; it will give you reliable service over a long, long operational life.

BRIEF SPECS

Time Delays: from 1/4 to 120 seconds

Overall Dimensions: 2-1/16" x 2" x 1-9/16"

Contact Capacity: 3 amps at 120V AC, 1.5 amps at 240V AC (non-inductive load), 1 amp at 50V DC, 0.5 amp at 125V DC.

For full details, refer to Bulletin T-5002. A copy will be sent on request.

HEINEMANN

ELECTRIC COMPANY

Plum St., Trenton 2, N. J.



CIRCLE 471 ON READER-SERVICE CARD

B.A., 1078

NEW PRODUCTS

TWIN DIODE AND POWER TETRODE.—Type 12DS7-A, 9-pin miniature design, contains two diodes and a high-perveance power tetrode in a single envelope. It is used in hybrid automobile radio receivers.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 472 ON READER-SERVICE CARD

WIRE-WOUND CONTROL.—Has terminals suitable for printed circuits requiring dip-soldering. The series 43, 1-1/8 in. diam control is used in circuits requiring up to 2 w of power.

Clarostat Manufacturing Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 473 ON READER-SERVICE CARD

SPLIT OUTS.—Feed a single source to two or more fully isolated loads.

They are used to combine networks for complete recordings of two or more independent sources.

Studio Supply Co., Dept. ED, 711 S. Victory Blvd., Burbank, Calif.

CIRCLE 474 ON READER-SERVICE CARD

PRINTED CIRCUIT BOARD HOLDER.—Can be turned to horizontal, vertical or angular working positions. Called the Little Joe No. 160, it has a holding spread of 8-1/2 in. max and takes 9 x 10 in. work space on table. Clamps are aluminum.

Macdonald & Co., Dept. ED, 1324 Ethel Ave., Glendale 7, Calif.

CIRCLE 475 ON READER-SERVICE CARD

BEAM POWER TUBE.—Type 7027-A, glass-octal design, high-per-

Trans Electronics, Inc.

7349 CANOGA AVENUE
CANOGA PARK, CALIFORNIA
Diamond 0-3334

SPECIFICATIONS

Filament Output: 6.3 volts CT AC
© 3 amperes (unregulated).
Current Range: 0-100 milliamperes, continuous duty; floating output.
Ripple and Noise: 3 millivolts peak-to-peak maximum.
D.C. Voltage Range: 0-110 volts, continuously adjustable.
Transient Response: Less than 50 millivolts no load to full load.
Input Voltage: 105-125 volts, 55-400 cps, AC.
Internal Impedance: Less than 1 ohm.
Load Regulation: 0.1%
Line Regulation: 0.1%
Dimensions: 7 1/4" x 5 1/2" x 5 3/4" height overall
RACK MOUNTED \$128.00
RACK MOUNTED WITH METERS \$156.00

OTHER MODULES

- For EASY substitution — bench, rack or OEM
- Floating output
- Barrier Type Terminal Strip 55-400 CPS

model	voltage range	current ma	filament volts/amps	dimensions h" w" d"	price
RS 205	150-225	0-50	6.3/3	5 x 4 1/8 x 6 1/2	\$ 49.50
RM 205				3 1/2 x 19 x 8 5/8	99.50
RR 205				3 1/2 x 19 x 8 5/8	69.50
RS 305	225-325	0-50	6.3/3	5 x 4 1/8 x 6 1/2	49.50
RM 305				3 1/2 x 19 x 8 5/8	99.50
RR 305				3 1/2 x 19 x 8 5/8	69.50
RS 217A	150-225	0-175	6.3/8	6 1/2 x 5 1/2 x 7 1/4	79.50
RM 217A				5 1/4 x 19 x 9 3/4	134.50
RR 217A				5 1/4 x 19 x 9 3/4	99.50
RS 317	225-325	0-175	6.3/8	6 1/2 x 5 1/2 x 7 1/4	79.50
RM 317				5 1/4 x 19 x 9 3/4	134.50
RR 317				5 1/4 x 19 x 9 3/4	99.50
RS 410A	400-550	0-100	6.3/8	6 1/2 x 5 1/2 x 7 1/4	105.00
RM 410A				5 1/4 x 19 x 9 3/4	158.00
RR 410A				5 1/4 x 19 x 9 3/4	130.00
RS 210	100-200	0-100	6.3/3	5 1/2 x 5 1/2 x 7 1/4	77.50
RM 210				5 1/4 x 19 x 8	132.50
RR 210				5 1/4 x 19 x 8	97.50

CIRCLE 476 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

veance tube is used in push-pull power-amplifier circuits of Hi-Fi audio equipment.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 477 ON READER-SERVICE CARD

SLIDE RULE.—The 1776 "Redirule" slide rule is made of nonwarping, acrylic plastic with 15 deep-etched scales: K, A, B, T, ST, S, D, DI, and DF, CF, CIF, CI, C, D, L. It comes with a complete instruction manual, and is pocket size.

Eugene Dietzgen Co., Dept. ED, 2425 N. Sheffield Ave., Chicago 14, Ill.

CIRCLE 761 ON READER-SERVICE CARD

RESIN SOLVENT.—Cleans components that have been embedded in epoxy or polyester resins and equipment used for casting or potting.

Resin Consultants & Mfg. Co., Inc., Dept. ED, 132 Nassau St., New York 38, N.Y.

CIRCLE 478 ON READER-SERVICE CARD

ROLLER-WELDER.—Seam welds light gage aluminum sheets at speeds

greater than 30 ft per min. This ultrasonic splicing technique is used with sheets ranging from 0.006 to 0.010 in. thick.

Aluminum Company of America, Dept. ED, 1501 Alcoa Bldg., Pittsburgh 19, Pa.

CIRCLE 479 ON READER-SERVICE CARD

CLEANER AND LUBRICANT.—For tuners and controls, type Rx cleans and lubricates with each rotation.

Superex Electronics Corp., Dept. ED, 4-6 Radford Place, Yonkers, N.Y.

CIRCLE 480 ON READER-SERVICE CARD

PENTODES.—Types 4EW6 and 6EW6 are 7-pin miniature, sharp-cut-off tubes for use in TV receivers at an if of about 40 mc. Transconductance is 14,000 μ mhos. Type 6EW6 has a 6.3 v, 0.4 amp heater; type 4EW6 has a 4.2 v, 0.6 amp heater with controlled warm-up time.

Radio Corporation of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 481 ON READER-SERVICE CARD

PROBLEM:

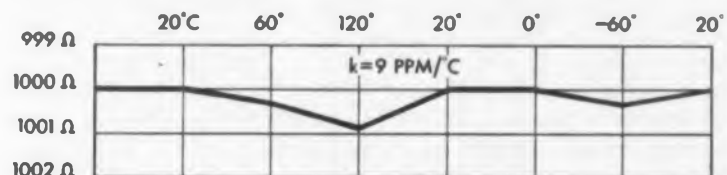
Miniature precision wirewound resistors with maximum stability and minimum temperature coefficient

ANSWER:

NEW
ULTRONIX
Ultraminatures

Ultronix Ultraminatures have a temperature coefficient within 15 parts per million per degree Centigrade. In actual tests conducted by Donner Scientific Company, a random selection of Ultronix miniature resistors averaged out at 9 ppm, the only resistors tested to fall within the often advertised 20 ppm.

Ultronix resistors are encapsulated by compression molding in an alkyd resin whose coefficient of linear thermal expansion matches that of the resistance wire without sacrifice of other qualities. Strain coefficient is completely eliminated insuring maximum stability. The TC of each Ultronix resistor is the same as that of the wire used. Ultronix resistors are available with solder lugs and axial, radial, printed circuit, or special leads. Ultronix resistors exceed the requirements of MIL-R-93B and MIL-R-9444



Typical resistance vs. temperature curve of Ultronix miniature precision resistors. Tests conducted by Donner Scientific Company, Concord, California.

OTHER FEATURES OF ULTRONIX ULTRAMINIATURES

- Close Tolerance and Wide Range:** 1 ohm to 2 megohms within $\pm 0.05\%$
- Wide Temperature Range:** -65°C to $+125^{\circ}\text{C}$, derate 5% for each degree increase in ambient temperature above this point.
- Altitude:** Unlimited
- Small Size:** Ultronix type 102 measures only $1/4" \times 1/4" \times 1/8"$
- Frequency Characteristics:** Standard time constant .2 μ sec

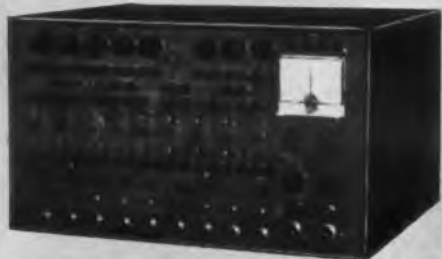
Ultronix makes a complete line of precision wirewound resistors. For complete technical information including the new ultraminatures and the name of your nearest Ultronix engineering representative, please address Dept. B10.

ULTRONIX

111 E. 20th Avenue, San Mateo, Calif. Telephone Fineside 5-7921
CIRCLE 483 ON READER-SERVICE CARD

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FREE CATALOG describes over 100 easy-to-build Heathkit products including test equipment, ham radio gear, marine equipment and hi-fi components.

how HIGH is "high reliability"?



here's sheer torture for a Pot!

PROBLEM: Preco Inc. needed a high reliability, pendulum-actuated sector potentiometer for its Automatic Blade Control to serve as the reference for controlling the transverse slope of the cutting blade in road-grading equipment. The pot would be subjected to operating conditions rarely encountered even in the most severe military applications. In addition, no technical assistance would be available for maintenance or replacement.

SOLUTION: Using precious metal alloy wire, a specially formed mandrel and a precious-metal wiper assembly, Fairchild engineers developed an extremely high resolution pot which has performed effectively through more than 30 million cycles with a linearity of 0.15% and a resolution of 0.5 miliradian. Another example of Fairchild ability to custom tailor precision potentiometers and sensing devices to solve complex problems over a wide range of applications.

CUSTOMER'S TEST RESULT

Other designs failed after only
2 months' wear
FAIRCHILD'S POT has exhibited
an equivalent of 5 to 10 years' life



FAIRCHILD CONTROLS CORPORATION

COMPONENTS DIVISION Dept. 347D
225 Park Avenue Hicksville, L. I., N. Y. • 6111 E. Washington Blvd. Los Angeles, Cal.
A Subsidiary of Fairchild Camera and Instrument Corporation

CIRCLE 484 ON READER-SERVICE CARD

GYROS
PRESSURE
TRANSDUCERS
POTENTIOMETERS
ACCELEROMETERS

NEW PRODUCTS

Transistors

Come in 11 types

Among the transistors available are types 2N1386 through 2N1390 npn diffused base silicon transistors. Types 2N1386 and 2N1387 switching transistors have frequency cut-off ratings of 60 and 50 mc, respectively. Types 2N1388, 2N1389, and 2N1390 are hf and video amplifiers.

Raytheon Co., Semiconductor Div., Dept. ED, 215 First Ave., Needham, Mass.

CIRCLE 763 ON READER-SERVICE CARD

Vibration Testing System

Operates over range of 5 to
10,000 cps

The Randomatic random wave vibration testing system for automatic programming operates over the frequency range of 5 to 10,000 cps. It provides a peak random force of 2500 lb and sine wave vector force of 1500 lb when used with model A-174 shaker. The power

generator, field and degaussing supply, cycling oscillator, servo system and stop-start controls are housed in a metal console measuring 4 x 10 ft; the electro-dynamic shaker is external.

Ling Electronics, Inc., Dept. ED, Culver City, Calif.

CIRCLE 485 ON READER-SERVICE CARD

Dual Polarized Antennas

For 1700 to 1850 and 1850 to
1990 mc ranges

These four dual polarized parabolic antennas cover two frequency ranges: 1700 to 1850 mc and 1850 to 1990 mc. They are available with a six- or ten-foot parabolic reflector. The reflector can withstand 100 mph wind loads and a 2 in. radial ice load. The feed horn is a water-tight assembly having a fiberglass window across its aperture. Cross talk is kept at a minimum by the use of vanes located to act as short-

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LOOK-
ALIKES



Adherence to tightest specifications by skilled assemblers—100% inspection for perfect construction—precision parts—closely controlled spacing guarantees RELIABLE PERFORMANCE in every SUPERIOR electron gun mount.

At your service for any type of electron gun mount. Samples, catalogs, prices available on request.



Superior Electronics Corporation

208 Piaget Avenue, Clifton, New Jersey • GRegory 2-2500

CIRCLE 487 ON READER-SERVICE CARD

ing plates for the probe closest to the horn aperture.

Prodelin Inc., Dept. ED, 307 Bergen Ave., Kearny, N.J.

CIRCLE 486 ON READER-SERVICE CARD

Ferrites

For 100 to 2000 mc applications

These three types of ferrites were developed for devices which operate in the 100 to 2000 mc range. Type MCL 1110 has a saturation magnetization of 1200 gauss per cc; type MCL 1116, 600 gauss per cc; and type MCL 1118, 800 gauss per cc. All types are available in standard sizes and shapes.

Microwave Chemicals Laboratory, Inc., Dept. ED, 282 Seventh Ave., New York 1, N.Y.

CIRCLE 488 ON READER-SERVICE CARD

Thermocouple Tubes

Stabilized zirconia

Thermocouple tubes made of high-purity stabilized zirconia are

available in OD measurements down to 0.030 in. with single and double holes as small as 0.007 in. ID. The grade of zirconia used is free from contaminating elements such as cadmium and boron and is spectrographically low in hafnium.

Saxonburg Ceramics, Inc., Dept. ED, Saxonburg, Pa.

CIRCLE 489 ON READER-SERVICE CARD

Connectors

For plug-in connections

The designated Tub-Plug connectors, for use in master TV antenna systems, are easily installed because of plug-in design. Type EP-600 fits all 300-ohm twin lead wires. Two types are available for RG-59/U cable: type EP-700 with insulated plastic pull-out grip and type EP-700A, a precision aluminum version of EP-700. All types provide matched impedance.

Entron, Inc., Dept. ED, P.O. Box 287, Bladensburg, Md.

CIRCLE 490 ON READER-SERVICE CARD

EDDYSTONE TUNES 19-500 Mc.



19-165 Mc
Model 770R

150-500 Mc
Model 770U

EDDYSTONE Receivers have die-cast frames and turrets, condensers milled from solid, silky fly-wheel tuning with no backlash. Sensitivity, selectivity and image rejection are controlled and guaranteed. These precise laboratory instruments monitor telemetering, aircraft and mobile radio. They have been chosen for tracking "Explorer" and "Discoverer" Satellites.

- ★ Continuous coverage in 6 bands
- ★ Receive FM or AM
- ★ Continuous duty cycle
- ★ Accurate freq. cal. 34 foot vernier
- ★ 2.5 and 600 Ω outputs, with muting
- ★ Effective noise limiter
- ★ IF and AF gain controls
- ★ Table-top or rack mounting

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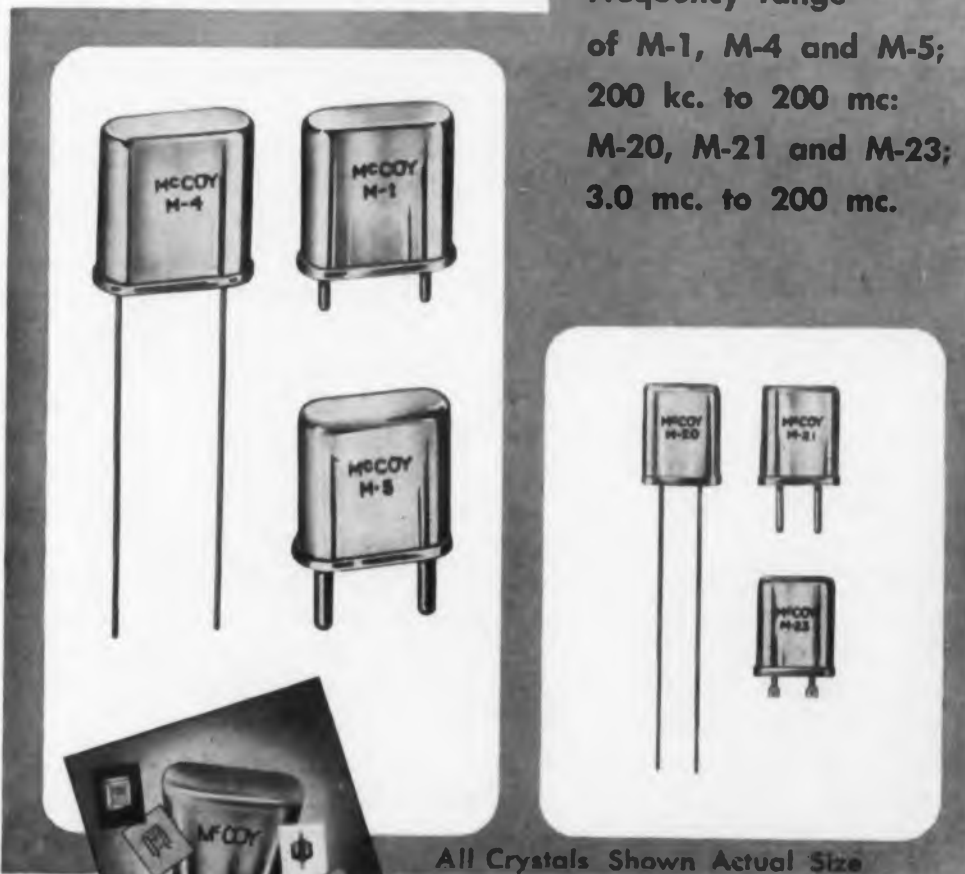
CIRCLE 491 ON READER-SERVICE CARD

McCoy...

A SYNONYM FOR QUALITY, STABILITY AND DEPENDABILITY IN CRYSTALS

Regardless of size, weight, or shape, a McCoy crystal will deliver the utmost in stability under extreme conditions of shock and vibration.

Frequency range of M-1, M-4 and M-5; 200 kc. to 200 mc; M-20, M-21 and M-23; 3.0 mc. to 200 mc.



All Crystals Shown Actual Size

Free...

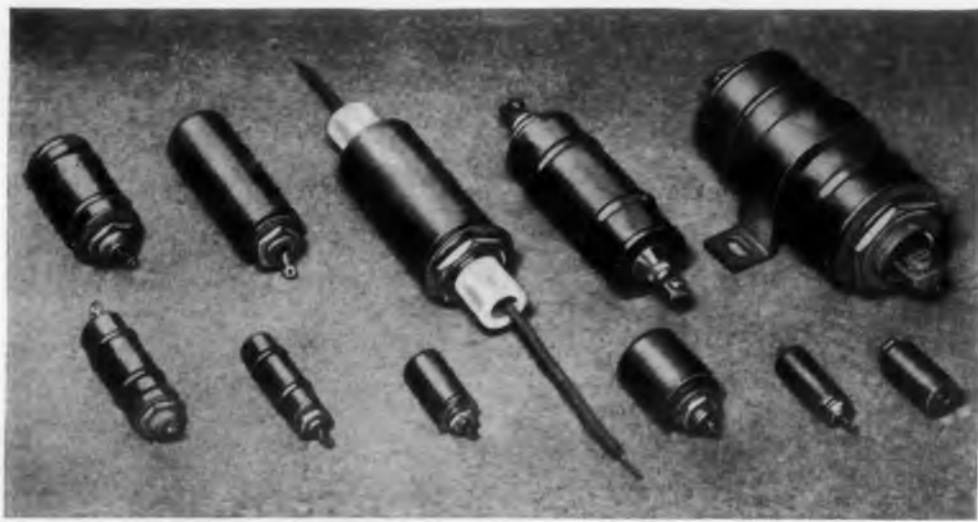
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DEPT. ED-10
Phone HUnter 6-3411

CIRCLE 492 ON READER-SERVICE CARD



New Series of Sprague Cylindrical-Style Radio Interference Filters: top row, l. to r.—4JX14, 5JX94, 1JX115, 20JX15, 50JX20 bottom row—5JX27, 1JX54, 1JX113, 1JX117, 2JX49, 1JX118.

New Series of Small, Light Radio Interference Filters

The new cylindrical-style radio interference filters recently announced by Sprague Electric Company are the smallest and lightest filters of their type available for military and industrial electronic and electrical equipment. Their basic design was pioneered by Sprague in order to achieve maximum miniaturization.

This new series of standard filters, believed to be the largest in the industry, ranges in current rating from 5 milliamperes to 50 amperes to cover the great majority of application needs.

The natural shape of the rolled capacitor section and of the toroidal inductors dictates the cylindrical form. All filters have threaded-neck mountings for use on panels or bulkheads. This assures both the proper isolation between input and output terminals as well as a firm peripheral mounting with minimum impedance to ground.

Listed in Sprague Engineering Bulletin 8100 (available upon request to the Technical Literature Department) are 68 of the more popular low-pass filter designs intended for use as three-terminal networks connected in series with the circuits to be filtered. The excel-

lent interference attenuation characteristics reflect the use of Thrupass® capacitor sections.

Since maximum effectiveness of filtering involves elimination of mutual coupling between input or noise source and output terminals, filters should be mounted where the leads being filtered pass through a shielded chassis or bulkhead. The threaded neck mounting is designed to give a firm metallic contact with the mounting surface over a closed path encircling the filtered line and to eliminate unwanted contact resistance so that the theoretical effectiveness of these units is realized in practice.

Typical insertion loss is determined by measurements made in conformance with Military Standard MIL-STD-220. Minimum curves for specific filters are available upon request.

For assistance in solving unusual interference, rating, or space problems, contact Interference Control Field Service Manager, Sprague Electric Co., at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 17 Marshall Street, North Adams, Massachusetts.

CIRCLE 493 ON READER-SERVICE CARD

NEW PRODUCTS

Multi-Unit Tube

Triode and three-plate tetrode

For harmonic-generator applications, type 6FH8 multi-unit tube is a 9-pin miniature type containing in one envelope a medium- μ triode and a sharp-cutoff tetrode with a pair of additional plates. The tetrode unit utilizes three separate plates; the cathode and grids are common to all three plates. Maximum dissipation ratings are 2.3 w for one plate and 0.3 w for the other two. Filament voltage is $6.3 \text{ v} \pm 10\%$. The triode unit has an amplification factor of 40 and a transconductance of $5400 \mu\text{mhos}$.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.
CIRCLE 494 ON READER-SERVICE CARD

Potting Compound and Adhesive

Is a heat conductor

This electrical potting compound and adhesive, called Temporell 1501, is both a heat conductor and an electrical insulator. The temperature range is -65 to $+1500 \text{ F}$. It is cured at 180 F until volatiles are removed; a 1 in. cube requires about 6 hr. It adheres to metal, glass, ceramics, but not to rubber.

Orell, Inc., Dept. ED, Box 527, South Gate, Calif.

CIRCLE 495 ON READER-SERVICE CARD

Laminate

Track resistant

This fiberglass, polyester laminate, called Resistrac, is for use in apparatus operating at voltages above one kv or in applications with short creep distances. It is especially suitable where humidity and surface contamination conditions are present. The track resistance is rated at

200 hr when tested according to ASTM requirements. The laminate is flame retardant; its other characteristics meet NEMA GPO-1 specifications. Standard sizes are 36×72 in. and 24×36 in., with thicknesses of $1/8$ to $3/4$ in.

Glastic Corp., Dept. ED, 4321 Glenridge Rd., Cleveland 21, Ohio.
CIRCLE 496 ON READER-SERVICE CARD

Time Delay Relay

Has solid state components

Available in six models, this time delay relay uses a solid state timing system, eliminating cycling and repeatability problems. Three time delay ranges and tolerances may be obtained in either of two types of operation: model EL 102 is normally closed; model EL 101 is normally open. The ranges are: general purpose—0.05 to 950 sec, 20% accuracy; special purpose—0.05 to 90 sec, 10% accuracy; precision—0.30 to 60 sec, 5% accuracy. The relay weighs 4 oz and measures $1-1/2 \times 1-5/16 \times 1-5/8$ in. Standard operating voltages are 24 to 3 v dc; contact resistive load is 2 amp.

George Harmon Co., Inc., Dept. ED, 18232 Parthenia St., Northridge, Calif.

CIRCLE 497 ON READER-SERVICE CARD

Converters

Dc-to-dc type

Series 200 dc-to-dc converter handles up to 500 w. The unit has conversion efficiencies to 85% at temperatures to 80 C . Regulation is available to 1%. Designed to OEM specifications, it also meets Mil specs for radio interference.

Standard Electronics Co., Dept. ED, 1611 W. 63rd St., Chicago 21, Ill.

CIRCLE 498 ON READER-SERVICE CARD

Vibration Isolation System

For gyroscopes

For gyroscopes and other navigation equipment, this vibration isolation system provides for omni-directional rectilinear motion, but maintains high-stiffness constraint against rotation. The mount assembly uses metal C-shaped springs. System damping is provided by elastically supported unit dampers. The mount provides good shock attenuation, improved vibration isolation at high frequencies, low resonant peaks, decoupled angular and translational modes, and good angular alignment characteristics.

Allied Research Associates, Inc., Dept. ED, 43 Leon St., Boston 15, Mass.

CIRCLE 499 ON READER-SERVICE CARD

Motor-Driven Switch

Weights 7 lb

This motor-driven power change-over switch weighs 7 lb and exhibits no contact chatter over the vibration spectrum of from 5 to 2000 cps, 40 g. Voltage drop across switch contacts is less than 10 mv at 22 amp. Once the switch is transferred, no power is required to hold it in position. The switch is available in almost any size required and may be adapted to most missile systems.

Kinetics Corp., Dept. ED, 410 S. Cedros Ave., Solana Beach, Calif.

CIRCLE 500 ON READER-SERVICE CARD

Controlled Rectifiers

Outputs to 500 kw

This line of fully automatic selenium, germanium and silicon rectifiers are available with outputs from 50 w up to 500 kw with normal convection, forced air, oil convection or oil circulating cooling. These dc sup-

plies provide constant voltage or constant current within ± 0.01 with load variations from 0 to 100% or line variations within $\pm 10\%$. The power factor is up to 1 and the efficiency is up to 96%.

Djordjevic Engineering Co., Dept. ED, 1933 N. Damen, Chicago 47, Ill.

CIRCLE 501 ON READER-SERVICE CARD

DC Reset Timer

Accuracy to 0.25%

For automatic control of industrial and machine process functions, the series 305 dc reset timer controls dc loads within variable timed intervals or sequences with a repeat accuracy of 0.25%. It resets full scale length in less than 0.1 sec and stops on power failure or interruption. The unit has seven basic circuit arrangements, a metal-to-neoprene impingement clutch, and heavy-duty silver contacts. The power requirements are 6, 12, 24, 28, 32, 42, 125, or 250 v dc.

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

CIRCLE 502 ON READER-SERVICE CARD

Medium-Mu Triode

Transconductance is 8000 μ mhos

For use as an rf-amplifier tube in vhf tuners of TV receivers, type 68N4-A medium-mu triode is similar to the 6BN4 but has a transconductance of 8000 μ mhos. A 7-pin miniature type, the tube has double base-pin connections for both cathode and grid. Input and output circuits are isolated. The filament voltage is 6.3 v ac or dc $\pm 10\%$. Direct interelectrode capacitances are: grid to plate, 1.2 μ f; grid to cathode and heater, 3.2 μ f; and plate to cathode and heater, 1.4 μ f.

Radio Corp. of America, Electron Tube Div., Dept. ED, Harrison, N.J.

CIRCLE 503 ON READER-SERVICE CARD

G-M TACHOMETER-GENERATOR

Built to all applicable Government Specifications.
In production—available for prompt delivery.



BuOrd Mark 12 Mod 0 SERVO MOTOR Tachometer Generator 115 volts / phase, 4500 RPM (min).



BuOrd Mark 16 Mod 0 SERVO MOTOR Tachometer Generator 115 volts / phase, 4500 RPM (min).



BuOrd Mark 16 Mod 3 SERVO MOTOR Tachometer Generator for transistor operation 115 volts fixed phase 30/18 volts control phase, 4500 RPM (min)

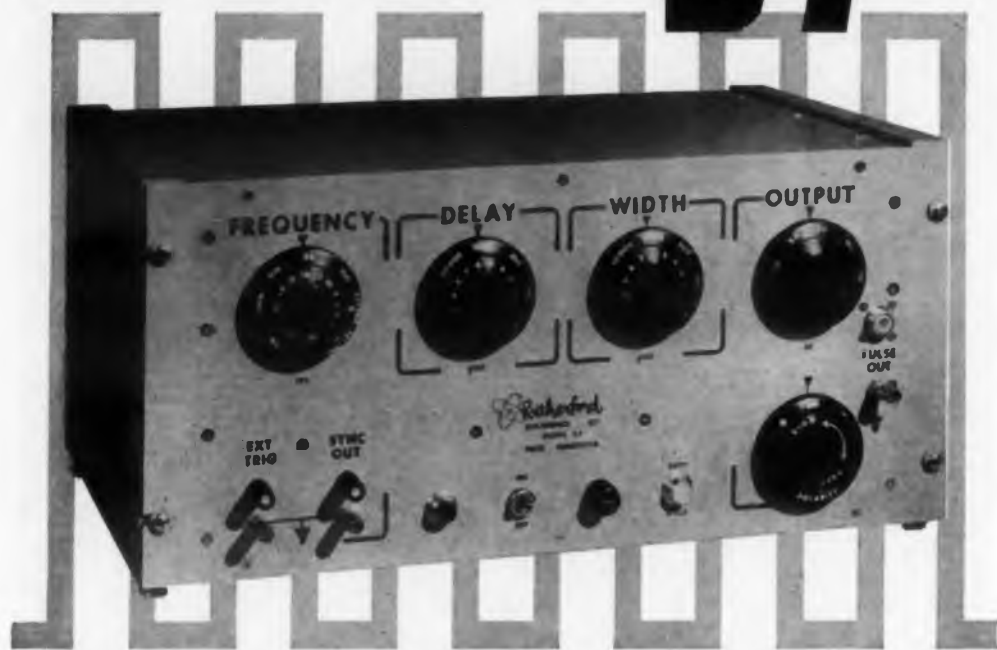
G-M Servo Motors
Manufactured by the Components Division of
G-M LABORATORIES INC.
4284 N. Knox Avenue • Chicago 41



CIRCLE 504 ON READER-SERVICE CARD

THE NEW RUTHERFORD PULSE GENERATOR

B-7



**built for HIGH PERFORMANCE
WIDE VERSATILITY**

LOW COST

Today's basic research *demand*s the finest. The Rutherford B-7 Pulse Generator is precisely engineered to meet the rigid standards of research and development—from biological research at low repetition rates, to transistors, transistor circuits, and magnetic core research at high repetition rates.

The one-unit Rutherford B-7's rack-mountable dimensions are compact: 19 $\frac{3}{4}$ " wide, 8 $\frac{3}{4}$ " high, and 12" deep. Amplitude is 50 volts delivered into a 50 Ohm load. Delay with respect to Sync. Out: 0-10,000 μ s. Width: .05 μ s-10,000 μ s. Repetition rate: 20 c to 2 mc. Cost: A budget-conscious \$720.

Your "space-age" research and development grows steadily more important, your equipment more strategic. On the results of research performed with Rutherford equipment rest many of America's scientific achievements. If you play a part in those still to come, put Rutherford on your scientific team. Write for complete information.

PULSE CIRCUITRY ENGINEERS: For a brighter future, send your resume to Rutherford Electronics.

Rutherford ELECTRONICS CO.

*pulse generators • pulse systems
accurate time delay generators*

8944 LINDBLADE STREET, CULVER CITY, CALIFORNIA

CIRCLE 505 ON READER-SERVICE CARD

NEW PRODUCTS

Ultrasonic Cleaner

Operates automatically

Made for cleaning pellets, wafers, and headers, this ultrasonic cleaning unit cleans, rinses, and dries automatically. The unit features precise control of the timing cycles in each stage.

L & R Mfg. Co., Dept. ED, 577 Elm St., Kearny, Arlington, N.J.

CIRCLE 764 ON READER-SERVICE CARD

Vibration System

Provides 70 lb of force

This 70-lb force, sine wave vibration system consists of model RA-250 power generator driving a model 227 electro-dynamic shaker. The generator can also be used to drive an acoustic vibration system. Power generator components are housed in a metal cabinet measuring 2 x 2 x 4 ft. The system provides continuous operation over a frequency range of 5 to 2000 cps. No imped-

ance changing or manual power factor correction is required over this range. The shaker has a maximum output force of 150 lb. It measures 1-1/2 x 1-1/2 x 2 ft.

Ling Electronics, Inc., Dept. ED, Culver City, Calif.

CIRCLE 506 ON READER-SERVICE CARD

Test Stand

For differential transformers

Model PMB-100-C test stand is used to obtain precise measurements of linear variable differential transformer response to linear core motion. The transformer case is clamped in the mount, and a non-magnetic, non-conductive core rod is used to position and support the core as the micrometer is adjusted. Base and micrometer mounting block are constructed of silver-anodized aluminum. There are five push-type binding posts mounted on the terminal strip for interconnect-

SIGN OF RELIABILITY



TECHNIC produces the world's best soluble precious metals for electroplating... yet without competent service behind them, even quality products lose value. Only TECHNIC offers both.

Technic inc ST 1-6100

P.O. BOX 965 PROVIDENCE, R. I.
7001 NO. CLARK ST. CHICAGO 26 ILL.

CIRCLE 508 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

ing the transformer and the test circuitry.

Schaevitz Engineering, Dept. ED, Pennsauken, N.J.

CIRCLE 507 ON READER-SERVICE CARD

Tape Editing Console

Has speed of 60 characters per sec

This tape preparation and editing console automatically verifies and duplicates paper tapes. The unit consists of a numerical keyboard, a control and comparison section with 6-digit decimal readout, two tape readers and one tape perforator. Tape-to-Tape duplication and verification is at 60 characters per sec. The unit accepts standard tape widths of 0.687, 0.875, and 1.00 in.

Tally Register Corp., Dept. ED, 5300 14 Ave., N.W., Seattle 7, Wash.

CIRCLE 509 ON READER-SERVICE CARD

Tantalum Capacitors

Solid anode type

Type S solid anode capacitors maintain their reliability and stable

characteristics through the operating temperature range of from -55 to +125 C. These miniature components are hermetically sealed and use a sintered tantalum anode with a solid electrolyte. This provides protection against moisture, atmospheric pressure extremes, and other adverse environments.

International Telephone and Telegraph Corp., Components Div., Dept. ED, Palo Alto, Calif.

CIRCLE 510 ON READER-SERVICE CARD

Memory Tape

Has 50 channels

This 50-channel memory tape is for production testing of electrical circuits, voltages, and stepping switches. It can produce 50 electrical impulses simultaneously using only one line of the tape's capacity. The over-all capacity of one tape is 15,000 horizontal lines.

American Automatic Typewriter Co., Dept. ED, 2323 N. Pulaski Road, Chicago 39, Ill.

CIRCLE 511 ON READER-SERVICE CARD

NOW...VTVM's for all applications

... panel-mounted ...
small-size
**ELECTRONIC
VOLTMETERS**



SEND FOR CATALOG 10A which gives complete specifications and prices on panel-mounting, relay-rack and plug-in models.

Build accuracy into all your equipment, test and production alike, with Metronix DC and AC Electronic Voltmeters.

These Metronix instruments are no larger than conventional voltmeters, cost little more. They offer higher accuracy because they don't load the circuit. In AC applica-

tions, they respond accurately over a frequency range of 20 CPS to 100 KC.

Selective, step-ranges run from 0-10MV, to 0-300V AC, and 0-1 to 0-1000V DC. Metronix Electronic Voltmeters can be furnished in MIL-spec, rack-mounting and plug-in models.

Metronix INC

A SUBSIDIARY OF
ASSEMBLY PRODUCTS, INC.
Chesterland 17, Ohio

api

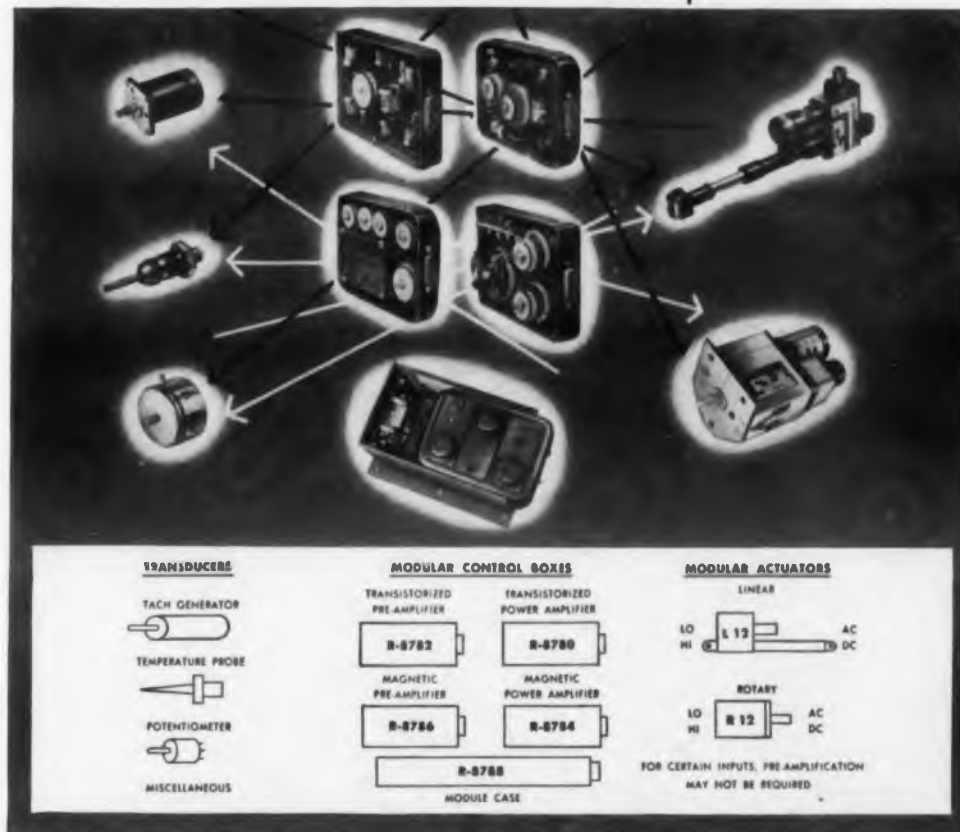
EST. 1978

CIRCLE 512 ON READER-SERVICE CARD

1959 ELECTRONIC DESIGN • October 14, 1959

Now - Modular Control Systems

New Airborne concept saves design time, helps you get faster delivery



Heart of Airborne's new modular control systems is a contactorless control package consisting of a standardized case (3 x 3½ x 5 in.) into which packaged preamplifier and power amplifier subsystems are plugged. Amplifiers drive actuators having maximum operating loads up to 500 lb. (linear) or 100 in.-lb. (rotary). Modular design permits delivery of relatively complex systems in minimum time.

Over the past 6 years, Airborne has designed and produced a number of special electromechanical control systems for aircraft-missile use. While these have differed in their functions, many of them have nevertheless employed essentially similar components. Thus our policy has been to seek increasing standardization of parts through modular design—to the point where we can now offer complete systems engineered under this concept.

From transducer through actuator, these new Airborne systems are assembled entirely from standardized, interchangeable components. For many applications, you can de-

sign around these packaged systems as they stand—and thus reduce engineering time, lead time, and costs. In other instances, slight modifications of the modular units provide the basis for immediately available systems.

Get complete information on this latest Airborne development by requesting new Bulletin PS-5A. If you feel your requirements are unique and cannot be met with standardized units—however flexible—we still invite your inquiry. As mentioned, Airborne offers an extensive background in custom systems—for temperature control, servo control, and positioning.

See Airborne's new modular control systems at the Aircraft Electrical Show in Los Angeles

AIRBORNE

Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION
HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas
CIRCLE 513 ON READER-SERVICE CARD

**C.E.C.
FILTERS AND
SONIC DELAY LINES
ANSWER CHALLENGING
ASSIGNMENTS***



* The ASW use depicted here is typical.

FILTERS and DELAY LINES



C.E.C. specializes in the design and production of Custom and Standard Delay Lines and Filters in varied configurations to meet MIL or Commercial Specs.

Electromagnetic Delay Lines: Lumped & Distributed Constant • Fixed • Multi-tapped • Mechanically Variable • Electrically Variable • System Delays

Magnetostrictive Delay Lines: Fixed • Multi-tapped • Variable
Standard Filters: High, Low and Band Pass, Inter-Stage
Special Filters: 90° Phase Shift, Null "T", Ultra-Stable, Band Suppression, Constant Delay



CONTROL ELECTRONICS CO., INC.
Ten Stepar Place, Huntington Station, New York

NOTE:
Data Sheets on request

CIRCLE 514 ON READER-SERVICE CARD

NEW PRODUCTS

Wiring Channel

Has rounded corners

This wiring channel provides rounded corners and is grooved on one side to slip onto the ends of two channel sections set at right angles. It is supplied in 6 in. lengths that can be cut to the required size.

Stahlin Brothers, Inc., Dept. ED, Belding, Mich.

CIRCLE 515 ON READER-SERVICE CARD

Accelerometer

Has 15/16 in. diam and 7/8 in. length

Designed for measurement of linear acceleration in missiles and aircraft, type TA-400 accelerometer measures 15/16 in. in diam and 7/8 in. in length. It withstands 100 g shock and 20 g vibration over the range of 50 to 2000 cps. The unit is hermetically sealed and measures accelerations from ± 14 to ± 50 g with an accuracy of 0.5% of full scale to half scale. The undamped fre-

quency range is 10 to 175 cps. The unit weighs less than 2.5 oz.

Fairchild Controls Corp., Components Div., Dept. ED, 225 Park Ave., Hicksville, N.Y.

CIRCLE 516 ON READER-SERVICE CARD

Fastener

Completely self-contained

Having applications in electrical, hydraulic, and pneumatic lines, type TA5000 fastener is completely self-contained and can be opened and closed without being removed from its fixed mount. Available in diameter sizes from 1/4 to 6 in, the fastener is made of No. 321 stainless steel. Four cushioning materials are offered: asbestos-teslon, neoprene rubber, fuel and weather resistant cushion, and corrugated stainless steel.

TA Manufacturing Corp., Dept. ED, 4607 Alger St., Los Angeles 39, Calif.

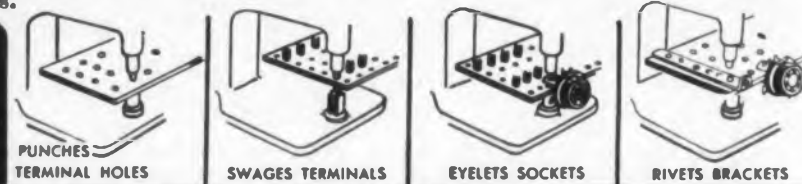
CIRCLE 518 ON READER-SERVICE CARD

**NEW \$49.⁹⁵ KIT
MOVES YOU FROM
SCHEMATIC TO CIRCUIT
FAST & RELIABLY!**

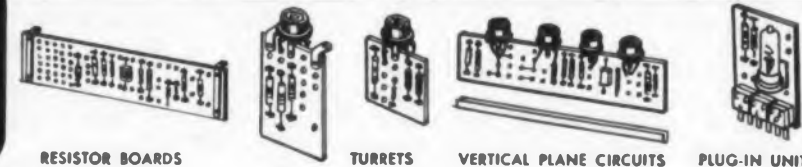


Here's an all-in-one tool for prototype and small production runs that makes it simple to organize and mount circuitry in compact planes. It quickly swages Alden terminals, eyelets, brackets and tube sockets, and punches .101" terminal holes in Alden XXP phenolic cards or any 1/16" cold punch card. You can make up circuitry turrets in minutes — complete with terminals, brackets and sockets.

Does ALL these operations:



Makes ALL these parts:



SAVE \$10 on kit over individual part prices. Contains Alden Universal Staking Tool and assortment of prepunched terminal cards, terminals, tube sockets, brackets and eyelets to get started immediately. Order Kit #42 — \$49.95 complete.

ALDEN PRODUCTS CO., 9139 N. Main Street, Brockton, Mass.
CIRCLE 517 ON READER-SERVICE CARD

Precision Resistors

Have accuracies to 0.005%

These encapsulated precision resistors are available in sizes as small as 1/4 in. in diam and 9/16 in. long, and have absolute accuracies from 0.005% to 0.1%, with a stability of 0.003% per year. Resistances are from 1 ohm to 4 meg. Accuracy over military temperature ranges (-30 to +85 C) is $\pm 0.02\%$, and matched sets which track within 0.005% from -45 to +85 C can be provided.

Julie Research Laboratories Inc.,
556 W. 168 St., New York 32, N.Y.

CIRCLE 519 ON READER-SERVICE CARD

Power Supply

Ac, dc type

Model 154 transistorized power supply has four regulated outputs: 200 v dc at 50 ma, 100 v dc at 50 ma, -50 v dc at 5 ma, and 6.3 v ac at 5 amp. All outputs are regulated to within 0.25%. The input power is

105 to 125 v 60 cps. Ripple is 0.01%, recovery time is less than 50 μ sec, and overshoot is less than 1% of voltage setting. The panel is 8-3/4 in. high and fits in a standard 19 in. rack.

Mid-Eastern Electronics, Inc.,
Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 520 ON READER-SERVICE CARD

Silicon Rectifiers

Maintain 4 amp

These 18 silicon rectifiers maintain 4 amp avg rectified current even at room temperature, low reverse current ratings, and piv through 600 v. Three mechanical configurations are offered: six types have fully insulated mounting studs, six have studs connected to anode, and six have studs connected to cathode.

Raytheon Co., Semiconductor Div., Dept. ED, 215 First Ave., Needham, Mass.

CIRCLE 765 ON READER-SERVICE CARD

for maximum reliability

KEEP TRANSISTORS COOL

Keep transistors at or below maximum operating temperatures with these new Birtcher Transistor Radiators. Provides the transistor with its own heat sink and a greatly increased radiating surface. Easy to install in new or existing equipment. Modifications to fit hundreds of popularly used transistors.



FOR MOST JETEC 30 TRANSISTORS
(Jetec Outline TO-9)

with NEW
BIRTCHE
TRANSISTOR
RADIATORS



BIRTCHE COOLING AND RETENTION DEVICES ARE NOT SOLD THROUGH DISTRIBUTORS. THEY ARE AVAILABLE ONLY FROM THE BIRTCHE CORPORATION AND THEIR SALES REPRESENTATIVES.

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CIRCLE 521 ON READER-SERVICE CARD

FOR CATALOG
and
test data
write:



STUD MOUNTED INSULATED BASE

a new solution to an old rectifier problem

The first engineer who "integrated" an eraser with a pencil inspired Bradley's latest accomplishment. Our boys took a hard look at the mess of washers, grease, and sundry hardware required in a conventional rectifier heat sink assembly, and decided to make engineering history again. Between coffee breaks, they tested 163 varieties of alumina-loaded ceramic wafers, found the right combination of electrical insulation + heat transfer characteristics, and brazed together a one-piece, insulated base rectifier that cuts assembling labor, shrinks bridge size, and out-performs other heat sink methods. *If you'd like to unfold the sheet that bares the facts about our new 6 and 12-amp REDTOP® rectifiers, drop us a card.*

BRADLEY SEMICONDUCTOR CORPORATION

Formerly Bradley Laboratories Inc.

radley®

275 WELTON STREET, NEW HAVEN 11, CONNECTICUT
CIRCLE 522 ON READER-SERVICE CARD

STATHAM
INSTRUMENTS, INC.,
ANNOUNCES A
DEVELOPMENT THAT
IS SAVING
THOUSANDS OF HOURS
IN INSTRUMENT
CHECKOUT AND
DATA REDUCTION:

ELECTRICAL STANDARDIZATION OF TRANSDUCERS

After three years of operation on rocket test stands and months of extrapolation to the missile airborne instrument calibration problem, the method of *Statham Standardization* is ready for general use.

Briefly, it is an electrical technique whereby any number of Statham unbonded strain gage pressure transducers and accelerometers can be made to have: (a) the same transfer function, and (b) single shunt calibrating resistor standardization over a wide temperature range, with a fixed percentage of accuracy. The following benefits are obtained:

- 1 Immediate access to meaningful data after test.
- 2 Elimination of calibration curves.
- 3 Fast, complete system electrical calibration.
- 4 Easy transducer system sensitivity checks.
- 5 Free interchangeability of transducers from a pre-calibrated stock.

For full details write for Data File ED-754-2.

STATHAM INSTRUMENTS, INC.
12401 West Olympic Boulevard
Los Angeles 64, California



CIRCLE 523 ON READER-SERVICE CARD

TINY TEAMMATE FOR STRAIN GAGES



STATHAM CA 9 Strain Gage Signal Amplifier

Through the use of modern design techniques, Statham has succeeded in drastically reducing the size and weight of strain gage signal amplifiers. Completely transistorized, the CA 9 is more reliable in adverse environments than larger and heavier amplifiers, and retains the precision needed in current aircraft and space vehicles. Write for Data File ED-601-2.

STATHAM INSTRUMENTS, INC.
12401 West Olympic Boulevard
Los Angeles 64, California



CIRCLE 524 ON READER-SERVICE CARD

NEW PRODUCTS

Dial

Dual type

Type 4838 calibrated-band dial has two pointers, one for band selection and one for band spread. The fitted scale is printed in degrees; the user may calibrate the band spread. Search is about 8:1 and band spread is 50:1. The unit is supplied with black crackle escutcheon and glass.

Jackson Bros., Dept. ED, 258 Broadway, New York 7, N.Y.

CIRCLE 526 ON READER-SERVICE CARD

variable permeance circuitry and operates on a 400 cps carrier frequency. It is made for use as a servo angular position feedback element or for angular position instrumentation where total shaft rotation is less than 3600 deg. Mounting is standard size 15 synchro type.

Crescent Engineering and Research Co., Dept. ED., N. Peck Rd., El Monte, Calif.

CIRCLE 528 ON READER-SERVICE CARD

Photomodulators

Modulating frequency is from
dc to 400 cps

Types M-10 and M-20 photomodulators are used where a low level dc signal must be modulated into square-waves or ac form to allow amplification, and demodulated back to dc. The modulating 1% linearity and ± 15 deg max

Rotary Transducer

Temperature range is -65 to
 $+500$ F

Operating at temperatures from -65 to $+500$ F, type RK3600 electromechanical rotary transducer has phase shift. This 10-turn model has

relays designed especially for

VIBRATION
and SHOCK

The rotary-balanced armature design of Hi-G relays assures efficient operation of these important components even under severe vibration and shock — up to 20 or 30G out to 2000 cps. By design, very little momentum is built up in moving parts. For more complete information on the complete line of Hi-G relays, send for New 1959 Hi-G CATALOG.



HI-G THE ONLY COMPLETE LINE OF ROTARY BALANCED RELAYS

Hi-G offers complete engineering and production facilities to manufacture relays for specific applications. Your inquiries are invited.



S & R TYPES



SL TYPES



SM TYPES

BALANCED
HI-G
ROTARY

HI-G INC.,

BRADLEY FIELD/WINDSOR LOCKS, CONN.

CIRCLE 527 ON READER-SERVICE CARD

frequency is variable from dc to 400 cps. Models are available for operation in circuits with impedances from 1 K to 10 meg. The sensitivity is 2 μ v and the drift is less than 1 μ v. Both spst and dpst switching is available. The units operate in a temperature range of -20 to +100 C. Life is in excess of 5000 hr. Dimensions are 2-1/2 in. in length and 5/8 in. in diameter and the weight is 1 oz.

Cambridge Electronics Corp., Dept. ED, Box 23, Newton Lower Falls 62, Mass.

CIRCLE 525 ON READER-SERVICE CARD

Digital Transport

For low speed applications

Specifically designed for low speed applications, model 3280 digital transport may be used as a coupling device to digital communication circuits or as a recorder of long term data. The speed range is 10

to 0.1 in. per sec. Dual speed combinations are available with standardized ratios. The unit has fast start-stop capability. It is completely transistorized and is adaptable to various reel configurations.

Potter Instrument Co., Inc., Dept. ED, Plainview, N.Y.

CIRCLE 529 ON READER-SERVICE CARD

Linear Actuator

Has load capacity of 100 lb tension

This linear actuator provides load capacities of 100 lb tension up to 600 lb compression with little change in ram speed. The ram operates at 0.3 to 0.6 in. per sec; signals are transmitted accurately to 0.001 in. Potentiometer resistance is 10,000 ohms \pm 5% for a 1.65 in. stroke. The actuator operates on 25 to 29 v dc; maximum current is 12 amp. It weighs 3 lb.

Hydro-Aire Co., Dept. ED, 3000 Winona Ave., Burbank, Calif.

CIRCLE 530 ON READER-SERVICE CARD

NEW "STANDARD" with SPECIAL CAPABILITIES



- Rugged Anodized Aluminum Housing
- Operation Up to 150°C
- 5.5 watts @ 85°C (derated to 0 @ 150°C)
- Resistance Range from 250 ohms to 300K ohms

Those are just a few of the important performance features you get with the new Gamewell RVG-14-MT10 multi-turn potentiometer. It fully meets applicable sections of MIL-E-5272A and NAS-710 — and much more. It gives you extras that often save you the cost of a "special."

Available in 10, 5, or 3 turns, with tap locations limited only by physical spacing. Write for detailed specifications and catalog of other stand-

ard Gamewell potentiometers. Special pots supplied whenever necessary. Bring *all* your pot problems to THE GAMEWELL COMPANY, Dept. 14G, Newton Upper Falls 64, Mass.

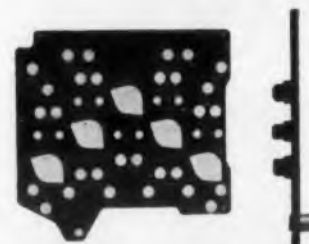
Gamewell

PRECISION POTENTIOMETERS

"Integrals of High Performance"

CIRCLE 531 ON READER-SERVICE CARD

PRODUCT DIGEST from U.S. RADIUM



EDGE-LIGHTED PANELS

Special-purpose panels and dials accurate to MIL spec are available from United States Radium Corporation. Standard edge-lighted and integral edge-lighted products by Lackon® provide optimum legibility and contrast, with high resistance to humidity, surface abrasion.

CIRCLE 728 ON READER-SERVICE CARD

DIALS, PANELS AND NAMEPLATES

Metal dials and panels include a greater variety of finishes, colors and processes than ever before.

New lithographed nameplates and panels featuring special hard, abrasion-resistant finish are available with or without adhesive backing in various thicknesses.



CIRCLE 729 ON READER-SERVICE CARD



CATHODE-RAY TUBE PHOSPHORS

USR offers a variety of phosphors for TV and industrial cathode-ray tube applications.

CIRCLE 730 ON READER-SERVICE CARD

RADIATION SOURCES FOR ELECTRON TUBE IONIZATION

Specially-fabricated isotope sources—Ni⁶³ plated electrodes and radium foil—are now being produced as ionization sources for electron tubes.



ISOLITE LIGHT SOURCES

New 360° light source and high-brightness one-way lamps use luminescent bulbs energized by Kr⁸⁵ gas. Units visible at 500-2000 ft., depending on model, size, color; service life to 10 years. New Isolite markers, signs and placards now available.

CIRCLE 731 ON READER-SERVICE CARD



CIRCLE 732, 733, 734 ON READER-SERVICE CARD

RADIATION SOURCES

Sealed beta, gamma and neutron sources for research, gauging, radiography and related applications are available with varying intensities and energies.

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UNITED STATES RADIUM CORPORATION

MORRISTOWN, N. J. | Offices: Chicago, Illinois and North Hollywood, Calif. Subsidiaries: Radelin Ltd., Port Credit, Ont., Canada and U. S. Radium Corp. (Europe), Geneva, Switzerland.

Visit U.S. Radium Booths 226-227 Aircraft Electrical Society Display, Los Angeles, October 28-30
CIRCLE 728 THROUGH 734 ON READER-SERVICE CARD

A NEW PERSPECTIVE ON THE NEWS



Look for the *new* news in **ELECTRONIC DESIGN**—news specially gathered and written, interpreted and edited for one group only, electronic design engineers.

The news section of **ELECTRONIC DESIGN** has been expanded and fortified to give design engineers news they cannot get elsewhere: first reports on design trends; developments that spell change for designers; news from Washington, from technical meetings, from military sources and from overseas—all written from the design point of view.

To report this **ELECTRONIC DESIGN NEWS**, two new editors have joined the staff:



Alan Corneretto
Interest in electronics started with military radio schools and service as radio technician. After journalism studies at Columbia, began 10 year career in technical writing on business papers, including Petroleum Processing and Product Engineering. Has traveled widely in industry writing news and feature articles.

Howard Bierman
B.E.E. from City College of New York. Former electronic design chief engineer in audio and hi fi equipment at Mark Simpson Mfg. Co., senior engineer in TV design at Tech Master Corp., also presently a color TV instructor at RCA Institute. Author of "Handbook of 630-type TV Receivers" and other books.



Watch for, and read, **ELECTRONIC DESIGN NEWS** . . . in every issue of **ELECTRONIC DESIGN**.

NEW PRODUCTS

Viscosity Modifier

For use with epoxy resins

This viscosity modifier, called Terpox, is a liquid oxy derivative of a terpene and is miscible with epoxy resins at room temperature. It promotes penetration and wetting in both amine and anhydride cured epoxy systems and permits increased filler loading of epoxies for potting, casting, laminating, coating, and adhesive formulations.

Heyden Newport Chemical Corp., Dept. ED, 342 Madison Ave., New York 17, N.Y.

CIRCLE 534 ON READER-SERVICE CARD

Digital Module

Transistorized

Model BD-101 transistorized digital module consists of four flip-flops. The required input is +20 v at 20 ma and -90 v at 1 ma; the maxi-

mum input rate is 100 kc. It can be externally connected as a binary counter, a binary coded decimal counter, or as a multi-stage counter requiring feedback.

Computer Control Co., Inc., Dept. ED, 983 Concord St., Framingham, Mass.

CIRCLE 535 ON READER-SERVICE CARD

Ball Drive

For dial or pointer

For dial or pointer, this planetary type ball drive unit fits directly to the condenser spindle or is used to give increased ratio to other mechanisms with 1/4 in. shafts. The following types are available: type 4511 without flange, 4511DA with two mounting lugs, and 4511DAF with flange and two mounting lugs. The ratio is 6:1. The unit measures 1-3/32 in. in diam and 11/16 in. long.

Jackson Bros., Dept. ED, 258 Broadway, New York 7, N.Y.

CIRCLE 536 ON READER-SERVICE CARD



FOR FASTER ASSEMBLY!

One way to speed up production is to use solder that's prefabricated to the job . . . the right size, shape, alloy and flux. **KESTER SOLDERFORMS** are doing a big job in reducing labor and material costs in electronic and other applications . . . will greatly speed up production for you.

KESTER SOLDERFORMS

WRITE TODAY for sample assortment and full details on **KESTER SOLDERFORMS**.

KESTER SOLDER COMPANY
4266 Wrightwood Ave., Chicago 39, Ill.
Newark 5, N. J. • Anaheim, Cal. • Brantford, Can.



OVER 60 YEARS' EXPERIENCE IN
SOLDER AND FLUX MANUFACTURING

CIRCLE 537 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Teleprinter Repeaters

Three models available



These teleprinter repeaters, designated Diamond-Trepac 560 series, have rechargeable standby batteries which allow continued operation three months after failure of the external power source. They have no electron tubes and the only moving part is a mercury relay. Each repeater is bi-directional and has pilot lamps to indicate the direction of transmission. They operate from 115 v 60 cps power or 12 to 14 v dc, and require 15 ma in the line closed condition. The models available include 561-A, a neutral single-line repeater; 562-A, a half-duplex neutral repeater; and 563-A, a half-duplex polar-neutral hybrid re-

peater.

Trepac Corp. of America, Dept. ED, 30 W. Hamilton Ave., Englewood, N.J.

CIRCLE 538 ON READER-SERVICE CARD

Gadolinium-Iron-Garnet Crystals

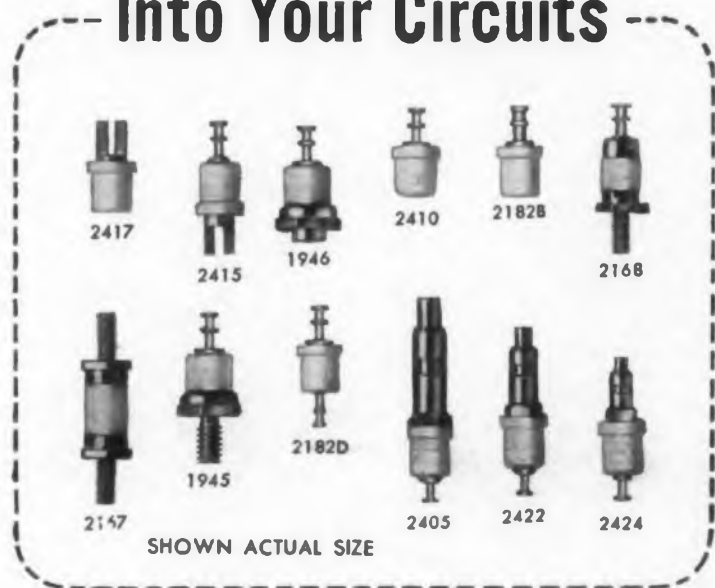
For microwave applications

Large single crystals of gadolinium-iron-garnet are available in weights of 4 g and over for use in hf and microwave equipment and magneto-optical devices. They have a density of 6.49 g per cc based on a lattice constant of $12.469 \text{ \AA} \pm 0.005$. Saturation magnetization is 50 gauss per cc at room temperature. The Curie temperature of these crystals is $296 \text{ C} \pm 1$. They may be made into lenses; an optical finish is obtainable.

Microwave Chemicals Lab., Inc., Dept. ED, 282 Seventh Ave., New York 1, N.Y.

CIRCLE 539 ON READER-SERVICE CARD

Build STAMINA Into Your Circuits



CAMBION® Teflon-insulated terminals and diode clips offer a wide choice of quality-guaranteed components designed to withstand the shock and vibration of today's toughest operating and service requirements. Uniquely fastened Teflon sections provide positive, press-type mountings as well as superior insulation. Spring-loaded diode clips for wire diameters up to .085" and ferrule contact types for pins up to .085" diameter assure tight, troublefree connections. Terminals and clips brass per QQ-B-626a 1/2 hard. Terminals silver plated, clips bright alloy plated unless otherwise specified. Get complete information. Write Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Massachusetts.

CIRCLE 540 ON READER-SERVICE CARD

WAVEGUIDE RF and PRESSURE SEALING PROBLEMS?



Let TECKNIT® help you solve them!

Yes—take your waveguide RF problems to Tecknit Design Service. Only Tecknit offers a complete RF gasketing engineering service using new design concepts that's yours for the asking.

No matter what your problem might be... TR and ATR Tubes ... Side Wall Hybrids... Top Wall Hybrids ... Duplexer Sections ... Choke Flanges... Rectangular Flanges... Combination RF and Pressure Sealing Gaskets for L, S, C, X and K Bands... Tecknit engineering will give you the answer.

Write today for a free Problem Outline Sheet that makes it easy to submit your specific problem to our engineers, or call and outline your problem by phone. In any case you'll get a prompt and complete recommendation . . . no charge or obligation of course!



**Technical
Wire Products, Inc.**

48 Brown Avenue
Springfield, N. J.
Phone: DRexel 6-3010
TWX: Millburn, N. J. 40

Technical Wire Products, Inc.

48 Brown Avenue, Springfield, N. J.
We've got a Waveguide RF Sealing Problem

Please send "Problem Outline Sheet"
 Please have an engineer call.

Name _____ Title _____

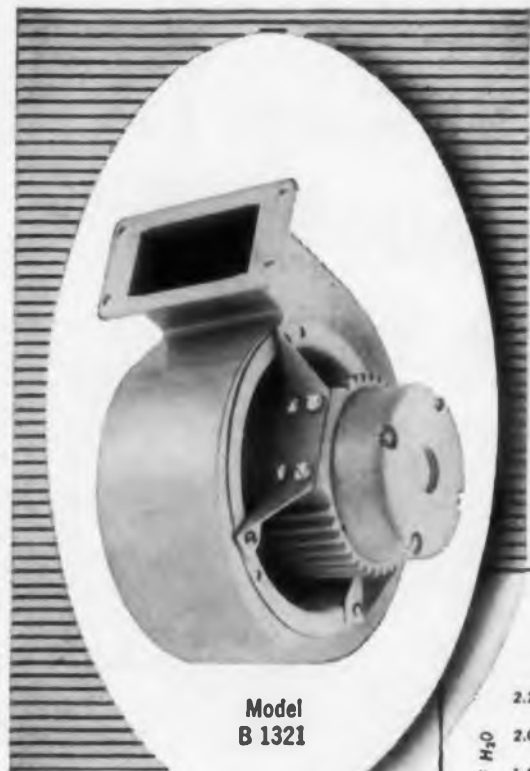
Department _____

Company _____

City _____ Zone _____ State _____

PS-678

CIRCLE 541 ON READER-SERVICE CARD

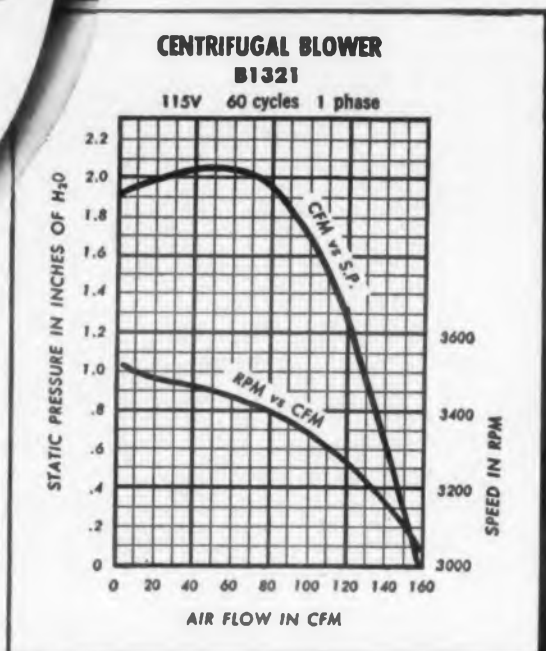


Model
B 1321

The AIR • MARINE inverted type centrifugal blower is especially designed for those applications where space is at a premium. By locating the motor inside the squirrel cage, space is saved and the motor is constantly cooled. Compliance with applicable MIL specifications make this blower ideally suited for critical applications.

Characteristics:
115 or 208 volts; 50/60 cycles;
158 CFM at 0" SP at 3000 RPM;
1 or 3 phase.

AIR • MARINE INVERTED TYPE BLOWERS DELIVER HIGH VOLUME AGAINST HIGH BACK PRESSURE



For further information on the complete line of Air-Marine motors, blowers, and fans, contact our sales dept. at either division.

air • marine
motors, inc.
Cooling Electronic "Hot Spots"

369 BAYVIEW AVENUE, AMITYVILLE, L. I., N. Y.
WESTERN DIVISION: 2221 BARRY AVENUE, LOS ANGELES, CALIFORNIA

CIRCLE 543 ON READER-SERVICE CARD

NEW PRODUCTS

Transistor

Has 0.3 v dc saturation voltage

Designed for application in single-ended class B drivers and output amplifiers, type 2N1176, series A and B transistor has a saturation voltage of 0.3 v dc. It can be supplied in 15, 40, and 60 v ratings with a 300 ma dc max collector current rating.

Bendix Aviation Corp., Red Bank Div., Dept. ED, Long Branch, N.J.

CIRCLE 544 ON READER-SERVICE CARD

Vibration Analyzer

Portable

Model PVA portable vibration analyzer measures the peak-to-peak displacement and frequency of mechanical vibrations. Four velocity-type seismic pickups and cables are furnished. The pickups have a flat frequency response from 20 to

2000 cps, are calibrated to 1% accuracy, and are designed for omnidirectional mounting. The power supply is a 12 v, nickel-cadmium battery with a self-contained charging system which may be plugged into a 115 v, 60 cps source.

Sun Electric Corp., Dept. ED, Harlem and Avondale, Chicago 31, Ill.

CIRCLE 545 ON READER-SERVICE CARD

Vinyl Sleaving

Flexible to -95 F

This vinyl insulation sleaving is flexible to -95 F, is resistant to fungus and corrosion, and is self-extinguishing in 1 to 5 sec. Called resinite EP-93C, it meets MIL-L-7444B. It is rated at 250 to 340 v per mil of wall thickness. The sleaving is colorless and transparent; it may also be produced in a variety of colors. Sizes range from No. 24 AWG up to 2-1/2 in. in diam.

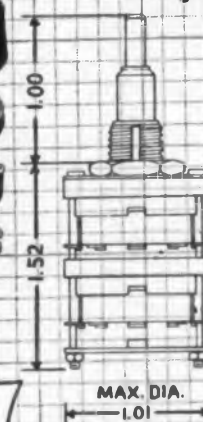
Borden Chemical Co., Dept. ED, 350 Madison Ave., New York 17, N.Y.

CIRCLE 546 ON READER-SERVICE CARD

NEW from the Grayhill Sketch Book

MINIATURE CONCENTRIC SHAFT SWITCH!

Grayhill Series 6



- New flexibility in a miniature rotary tap switch.
- Allows 2 switches to be mounted in the space normally occupied by one.
- Up to 3 decks controlled by each shaft.
- Two to 10 shunting or non-shunting positions per deck.
- Breaks 1 amp. 115 V. AC resistive, carries 5 amps.
- Available in over 6500 combinations of decks and positions.

Write for complete information

"Pioneers in
Miniaturization"

Grayhill
INC.

Phone: Fleetwood 4-1040

565 Hillgrove Ave., LaGrange, Illinois

CIRCLE 547 ON READER-SERVICE CARD

Power Supplies

Operate at -55 to +120 C

Designed to operate at temperatures of -55 to +120 C, these power supplies are silicon-transistor regulated with silicon rectifiers, tantalum capacitors, and a Zener diode reference. Ripple and output impedance are low.

Arnoux Corp., Dept. ED, 11924 W. Washington Blvd., Los Angeles 66, Calif.

CIRCLE 548 ON READER-SERVICE CARD

Circuit Cards

Two types available

Series C100 transistor digital circuit cards provide a set of 200 kc digital modules. This series includes flip-flop cards for logical and control functions, binary and decade counters, diode and transistor gates, amplifier units, and a delay multi-vibrator unit for signal delay and shaping purposes. They operate

from ± 6 and ± 18 v power and use signal levels of 0 and -6 v. The 1 mc series 1000 transistor digital circuits, a compatible extension of series 100, uses a supply voltage of ± 6 v and -18 v and signals of 0 and -6 v. Signal transition and circuit recovery times permit operation in excess of 1 mc. The ambient temperature range for both types is -10 to +55 C.

Epsco Inc., Dept. ED, 275 Massachusetts Ave., Cambridge, Mass.

CIRCLE 549 ON READER-SERVICE CARD

Induction Heater

Operates at 120 mc

This induction heater operates at 120 mc and, used in conjunction with an output fixture, heats highly resistive conductors such as silicon, boron, titanium boride, and yttrium-iron-garnet. Available in 1-kw and 5-kw sizes, this unit may also be used as a dielectric heater.

Radio Frequency Co., Inc., Dept. ED, 44-46 Park St., Medfield, Mass.

CIRCLE 550 ON READER-SERVICE CARD

NOW!

MINIATURE AGASTAT®

time/delay/relay

MEASURES ONLY 4" x 1½" x 1½"



The Miniature Agastat time delay relay is a space-saving answer to aircraft, missile and computer problems. You get all these valuable features in one small package:

- Easily adjusted timing ranges as short as .030 seconds.
- Repeat accuracy of $\pm 5\%$.
- Time delay on energizing or de-energizing.
- For DC or AC operation.
- Hermetically sealed or dust-proof housings.

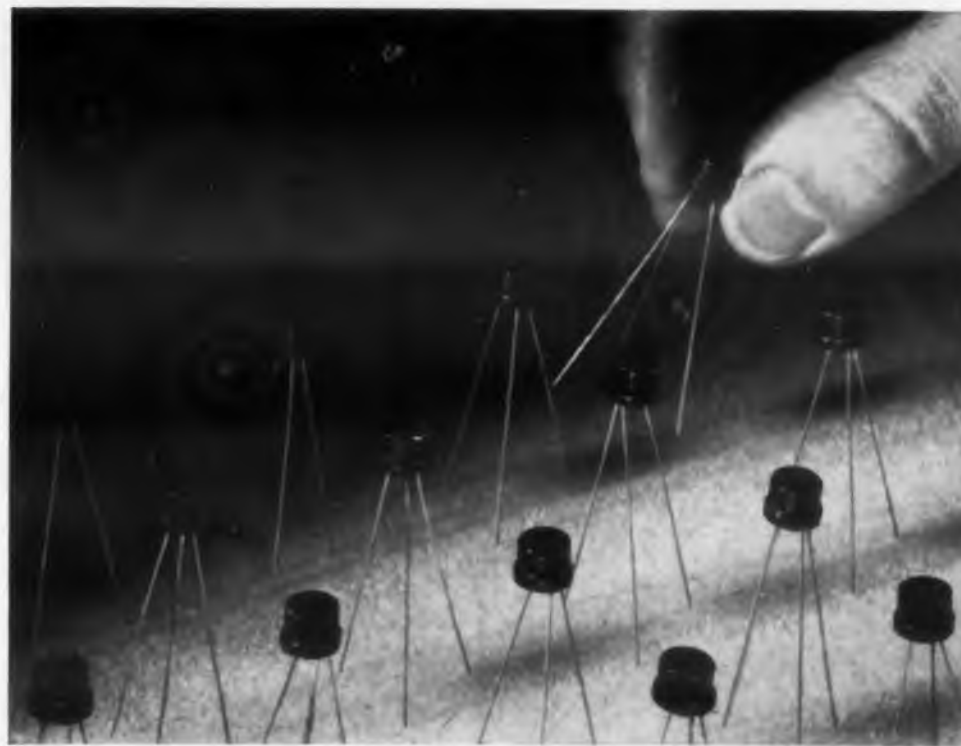
Write today for the full details on the new miniature Agastat. Dept. A36-1024,

AGA DIVISION ELASTIC STOP NUT CORPORATION OF AMERICA
1027 Newark Avenue, Elizabeth, N. J.

Gasaccumulator Co., (Canada) Ltd., 12 Gower Street, Toronto 16, Ontario

CIRCLE 551 ON READER-SERVICE CARD

NEW BENDIX DRIVER TRANSISTORS



AUDIO AMPLIFIER (CLASS A OR B) • AUDIO OSCILLATOR • POWER SWITCH
TRANSISTOR DRIVER • SERVO CONTROL • RELAY DRIVER • MOTOR CONTROL

Slated to be the "workhorse of the transistor industry", this new Bendix series consists of three models—each with a different voltage rating and each in high-volume production.

Contained in the JEDEC TO-9 package, this tiny transistor dissipates 400 mW of power at 25°C and 67 mW at 75°C. The higher voltage rating and high current gain are combined with more linear current gain characteristics to enable switching applications and lower distortion output. Featuring low saturation resistance, the typical values are 1 ohm measured at 100 MA. The 2N1008 series has a minimum current gain of 40 and a maximum of 150.

Eliminating the internal connection between transistor and case allows circuit isolation. Long life and stable operation are assured by welded construction and a vacuum-tight seal.

ABSOLUTE MAXIMUM RATINGS

	Vce Vdc	Ic mAdc	Pc mW	Ib mAdc	T Storage °C	Tj °C
2N1008	-20	300	400	30	-65 to +85	85
2N1008A	-40	300	400	30	-65 to +85	85
2N1008B	-60	300	400	30	-65 to +85	85

Write today for the new Bendix Semiconductor Catalog for more information on our complete line of power transistors, power rectifiers, and driver transistors. SEMICONDUCTOR PRODUCTS, BENDIX AVIATION CORPORATION, LONG BRANCH, N. J.

West Coast Sales Office: 117 E. Providencia Avenue, Burbank, California

Midwest Sales Office: 4104 N. Harlem Avenue, Chicago 34, Illinois

New England Sales Office: 4 Lloyd Road, Tewksbury, Massachusetts

Export Sales Office: Bendix International Division, 205 E. 42nd Street, New York 17, New York
Canadian Affiliate: Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ontario, Canada.

Red Bank Division



CIRCLE 552 ON READER-SERVICE CARD

HETHERINGTON

SWITCHES • INDICATOR LIGHTS • SPECIAL ASSEMBLIES

ENGINEERING NEWS



"RESISTORIZED" NEON INDICATOR

... to MIL-L-6723 (ASG)

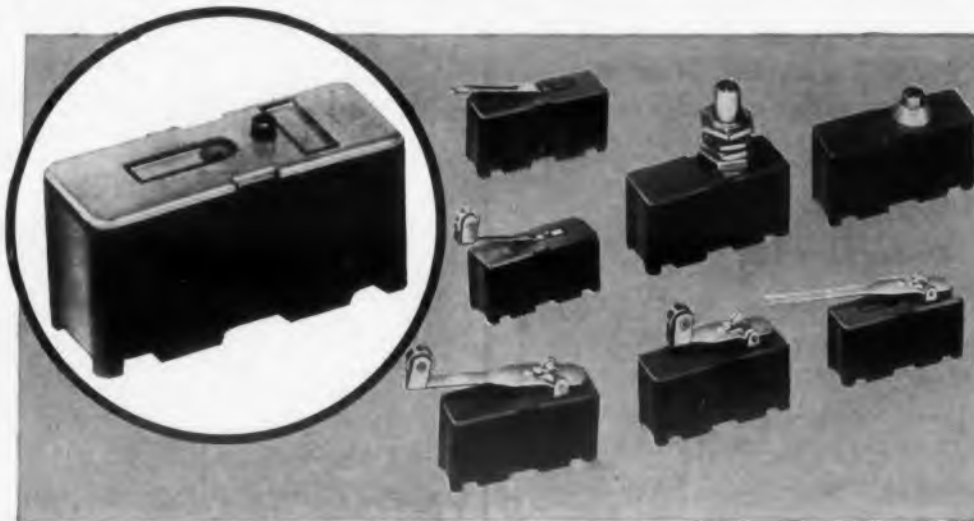
Keeping pace with the needs of miniaturized, ruggedized, transistorized equipment of minimized dimensions, Hetherington engineers have found space for an internal resistor in an indicator light that already is only $1\frac{3}{64}$ " long. It's known as the Hetherington L15,000 Series and it's designed to MIL-L-6723 (ASG), Drawing MS25257. With the built-in resistor, the unit operates on 115 volts using MS25252-NE2D neon lamps.

If low-voltage incandescent lamps are preferred, $1\frac{1}{32}$ " in length can be saved by specifying the still smaller L14,000 Series, designed to MS25256.

Both types have corrosion-resistant anodized aluminum sockets with integral mounting flanges, panel indexing tabs, and two solder-lug terminals. Lamps replace from the front by unscrewing the wide-visibility lenses. Center contacts are large silver-plated buttons, internally spring-loaded to resist vibration.

Complete specifications on both MIL-L-6723 (ASG) lights are shown in Data Sheet L-5a.

CIRCLE 716 ON READER-SERVICE CARD



New 20-AMP PRECISION SWITCHES braced for toughest service!

Rigidly-braced phenolic cases of Hetherington Series S2A "HiPAC" Switches pave the way toward greater dependability and unsurpassed repeatability in critical control and positioning circuits. Molded-in safety limits prevent over-travel damage to the blade-type movable contacts. Extra bracing around mounting holes prevents case distortion from excessive mounting pressures. On the bottom, molded-in barriers and cup washers provide long creepage paths and positive

separation between terminals and leads.

U. L. rated "HiPAC" Switches are presently available with any of eight actuators. All are interchangeable with other precision switches of equivalent ratings. Quantities for samples or small production runs are stocked for immediate delivery by over 50 leading electronic parts distributors throughout the country.

For detailed specifications on the "HiPAC" line, write for Hetherington Bulletin S-9.

CIRCLE 717 ON READER-SERVICE CARD



TINY LIGHT with a BRIGHT FUTURE

One of the smallest indicator lights ever developed, the Hetherington L10,000 Series measures only $1\frac{5}{64}$ " in diameter by $3\frac{3}{64}$ " long. It's equipped with wire leads and a threaded aluminum bushing that mounts in a clearance hole for a #10 screw. Secret of the L10,000's midget size is a fully moistureproof lamp/lens assembly

that is molded to the mounting stem.

Designed for electronic equipment requiring components of minimum size and weight, the L10,000 gives bright, wide visibility for 60,000 hours at 5 volts dc. Many translucent colors are available.

Dimensions of the L10,000 are available on request.

CIRCLE 718 ON READER-SERVICE CARD

HETHERINGTON INC. DELMAR DRIVE, FOLCROFT, PA. • 139 Illinois St., El Segundo, Calif.

A Controls Company of America Subsidiary

CIRCLE 716, 717, 718 ON READER-SERVICE CARD

SERVICES FOR DESIGNERS

Composite Laminates

Recent technical advances in the bonding of various metallic and non-metallic materials to laminated plastics have opened up new design opportunities using combination laminates, reports Taylor Fibre Co., Norristown, Pa., manufacturers of laminated plastics and vulcanized fibre.

It is now possible, the company says, to bond virtually any compatible material with a laminate to form a composite which combines the advantages of both.

One of the first combination materials was copper-clad laminates used for etched printed circuits. With the rapidly increasing use of printed circuits, copper-clad laminate has become a standard engineering material in the electronic industry.

More recent composite laminates are usually manufactured to customer specifications, Taylor Fibre states. Among those which it has produced are:

- Vulcanized fibre-clad laminates. These combine the high strength of laminated plastics with the superior hot arc resistance of vulcanized fibre. They have been used in switch gear for both low and high voltage applications. Other applications are suggested where the high impact strength of vulcanized fibre may prove advantageous.

- Rubber-clad laminates. Almost any type of natural or synthetic rubber, including Buna and Buna S, may be used as the cladding material. The composite laminates are widely used for condenser tops in wet condensers to protect the laminate against highly alkaline electrolyte. They have application in any part where sealing or chemical resistance is needed (as in battery tops) and for isolating vibration (as in shock absorbers).

- Asbestos-clad laminates. Laminated plastic clad with untreated asbestos paper has high heat resistance and arc resistance.

- Laminate-clad lead. Lead sheets bonded between Grade XX paper-base laminates have been used for X-ray shields. The laminate provides strength and also contributes to the high shielding properties of the lead.

- Aluminum-clad laminate. Laminated plastic with aluminum cladding have been used extensively for engraving stock. The laminate base is black in color, providing a good contrast with the aluminum when the design is etched away. Aluminum-clad laminates also offer possibilities as a printed circuit material, but soldering problems remain to be solved. Another application

EFIS for plate holders for X-ray machines where the aluminum not only acts as a shield but also resists abrasion.

■ Beryllium copper-clad laminates. Beryllium copper is non-magnetic and a good conductor. The composite material has possibilities for printed circuit applications.

■ Stainless steel-clad laminates. This material also has application where non-magnetic properties are required. Other applications are in certain corrosive environments where stainless steel's resistance to attack is an asset.

■ Magnesium-clad laminates. Taylor Fibre has supplied 108-inch long sheets of this material for use as a screen for X-ray operators. The lightness of the magnesium greatly reduces the weight of this large-size piece.

■ Silver- and gold-faced laminates. The extremely high electrical conductivity of silver and gold indicates possible use of the composite materials for electrical contacts. The laminate provides strength and insulation properties.

Taylor Fibre Co., Dept. ED, Morristown, Pa.

CIRCLE 557 ON READER-SERVICE CARD

PW Assemblies to Order

A printed circuitry division is announced by the Harris Manufacturing Co., Inc., St. Louis, makers of electro-mechanical components for aircraft. The company now has complete precision printed circuit board production facilities including tool and die fabricating equipment.

Harris is also staffed and equipped to install components on printed circuit boards to provide functioning electronic assemblies. Design and development of electronic components, utilizing printed circuits is performed by Harris' engineering department.

Inquiries should be addressed to Mr. Paul Guth, Manager, Printed Circuit Div., Harris Manufacturing Co., Inc., Dept. ED, 8031 Litzinger, St. Louis 17, Mo.

CIRCLE 558 ON READER-SERVICE CARD

Hermetic Sealing of Components

Expansion of facilities for the sealing of electronic parts has been completed by Electrical Industries. The company handles a wide range of components from simple shapes and sizes to complex multi-head assemblies. Manufacturers can ship their components to Electrical Industries where they are sealed to meet required specifications and returned quickly.

This custom-sealing service supplements the company's standard line of glass-to-metal seals for all applications, commercial and military.

Electrical Industries, Dept. ED, 691 Central Ave., Murray Hill, N.J.

CIRCLE 559 ON READER-SERVICE CARD



**ROEBLING
MAGNET
WIRE**

*Compliments
of a friend...
send for it!*

Electrical Wire Division
John A. Roebling's Sons Corp.
Trenton 2, New Jersey

Please send my free copy of Roebling's new
Magnet Wire Fact Book.

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 This illustrated book covers every type of
Roebling Magnet Wire—how it's made, tested,
packaged. Complete tables of sizes, weights, shipping
information—plus interesting temperature, specification
and test data. You shouldn't be without these facts if
magnet wire of any description fits into your manu-
facturing picture!

Your free copy is waiting for you. Just write—today—
to Electrical Wire Division, John A. Roebling's Sons
Corporation, Trenton 2, New Jersey.

CIRCLE 560 ON READER-SERVICE CARD

FREQUENCY STANDARDS

PRECISION FORK UNIT TYPE 50



Size 1" dia. x 3 3/4" H.* Wght., 4 oz.
Frequencies: 240 to 1000 cycles
Accuracies:—
Type 50 ($\pm .02\%$ at -65° to 85°C)
Type R50 ($\pm .002\%$ at 15° to 35°C)
Double triode and 5 pigtail parts required
Input, Tube heater voltage and B voltage
Output, approx. 5V into 200,000 ohms

*3 1/2" high
400 - 1000 cy.

FREQUENCY STANDARD TYPE 50L



Size 3 3/4" x 4 1/2" x 5 1/2" High
Weight, 2 lbs.
Frequencies: 50, 60, 75 or 100 cycles
Accuracies:—
Type 50L ($\pm .02\%$ at -65° to 85°C)
Type R50L ($\pm .002\%$ at 15° to 35°C)
Output, 3V into 200,000 ohms
Input, 150 to 300V, B (6V at .6 amps.)

PRECISION FORK UNIT TYPE 2003



Size 1 1/2" dia. x 4 1/2" H.* Wght. 8 oz.
Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 ($\pm .02\%$ at -65° to 85°C)
Type R2003 ($\pm .002\%$ at 15° to 35°C)
Type W2003 ($\pm .005\%$ at -65° to 85°C)
Double triode and 5 pigtail parts required
Input and output same as Type 50, above

*3 1/2" high
400 to 500 cy.
optional

FREQUENCY STANDARD TYPE 2005



Size, 8" x 8" x 7 1/4" High
Weight, 14 lbs.
Frequencies: 50 to 400 cycles
(Specify)
Accuracy: $\pm .001\%$ from 20° to 30°C
Output, 10 Watts at 115 Volts
Input, 115V. (50 to 400 cycles)

FREQUENCY STANDARD TYPE 2007-6



TRANSISTORIZED, Silicon Type
Size 1 1/2" dia. x 3 1/2" H. Wght. 7 ozs.
Frequencies: 400 — 500 or 1000 cycles
Accuracies:
2007-6 ($\pm .02\%$ at -50° to $+85^{\circ}\text{C}$)
R2007-6 ($\pm .002\%$ at $+15^{\circ}$ to $+35^{\circ}\text{C}$)
W2007-6 ($\pm .005\%$ at -65° to $+125^{\circ}\text{C}$)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

FREQUENCY STANDARD TYPE 2121A



Size
8 3/4" x 19" panel
Weight, 25 lbs.
Output: 115V
60 cycles, 10 Watt
Accuracy:
 $\pm .001\%$ from 20° to 30°C
Input, 115V (50 to 400 cycles)

FREQUENCY STANDARD TYPE 2001-2



Size 3 3/4" x 4 1/2" x 6" H., Wght. 26 oz.
Frequencies: 200 to 3000 cycles
Accuracy: $\pm .001\%$ at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
B voltage, 100 to 300 V., at 5 to 10 ma.

FREQUENCY STANDARD TYPE 2111C



Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8 3/4" H.
Weight, 25 lbs.
Frequencies: 50 to 1000 cycles
Accuracy: ($\pm .002\%$ at 15° to 35°C)
Output: 115V, 75W. Input: 115V, 50 to 75 cycles.

ACCESSORY UNITS for TYPE 2001-2



L—For low frequencies
multi-vibrator type, 40-200 cy.
D—For low frequencies
counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

*This organization makes frequency standards
within a range of 30 to 30,000 cycles. They are
used extensively by aviation, industry, govern-
ment departments, armed forces—where maxi-
mum accuracy and durability are required.*

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

American Time Products, Inc.

Watch Master
Timing Systems

Telephone: PLaza 7-1430

580 Fifth Ave., New York 36, N. Y.

CIRCLE 561 ON READER-SERVICE CARD

SERVICES FOR DESIGNERS Silicon Single Crystal

Tang Industries, Inc. is now offering a complete service to Silicon diode and transistor manufacturers. Silicon, either "N" or "P" type single crystals, wafers and dices ranging from 0.5 ohm-cm to 500 ohm-cm in resistivity are available. Diameter and length of silicon crystals are up to 1 1/4 in. and 9 1/4 in. respectively. The service combines exacting control and the improved techniques of the Czochralski method of crystal growing. Tang makes available guaranteed uniformity of silicon single crystal quality in production quantity. Minimum dislocation density and low oxygen content are achieved.

Sliced wafers are furnished to tight dimensional tolerances with or without "damaged" surfaces. Dices are supplied in round, square, or rectangular shapes.

Tang Industries, Inc., Dept. ED, 49 Jones Rd., Waltham, Mass.

CIRCLE 562 ON READER-SERVICE CARD

Custom-Made Coils

Expansion of aluminum strip conductor coil winding facilities, to meet the electrical industry's increasing need for prototype and quantity-production coils, was announced by Reynolds Metal Co.

Harold W. Adams, Reynolds director of electrical conductor products, said the company is adding new equipment and consolidating at its Richmond North Plant its coil winding facilities for foil gauge and sheet gauge strip conductor. Previously the two types of facilities were at separate Richmond locations.

Reynolds Metals Co., Dept. ED, Richmond, Va.

CIRCLE 563 ON READER-SERVICE CARD

Structural Testing Facility

Treating the subject of its increased capabilities for the development, design, and evaluation testing of missile and aircraft structures and components, a new booklet has been issued by the Missile and Space Vehicle Dept. of the General Electric Co.

The booklet describes elaborate and often unique laboratory facilities, for test programs in the areas of vibration, shock, acceleration, static, hydraulics, electrical, thermal, and acoustic testing and evaluation; as well as for conducting experimental stress analysis. The booklet is entitled "Advanced Facilities for Structural Testing."

General Electric Co., Missile and Space Vehicle Dept., Dept. ED, Room 4B, 3198 Chestnut St., Philadelphia 4, Pa.

CIRCLE 564 ON READER-SERVICE CARD

Precious Metal Components

New developments, announced by the Wilkinson Company, include the availability of doped gold discs which provide ohmic contact for silicon diodes, gold and platinum ribbon for diode whiskers, high purity aluminum wire, segments and foil, and a wide variety of precious metal, rare metal and metal alloy items.

Available upon request is a twelve page two color Brochure which illustrates and describes processing and high precision fabrication facilities.

Wilkinson Co., Dept. ED, 1660 Ninth St., Santa Monica, Calif.

CIRCLE 567 ON READER-SERVICE CARD

Customer Service Program

A new program to provide users of Elgin-Advance relays with high quality and the best service available in the relay industry has been announced.

To insure high quality, the Electronics Div. of the Elgin National Watch Co. has equipped its Burbank, Calif., plant to keep temperature, humidity, and dust conditions under rigid control. The entire plant is under "white coat" operating conditions, and the most modern equipment is being used in laboratory, production, and quality control operations, and in the complete Reliability Test Center. During the past six months, over \$100,000 has been expended for a Radiflo nuclear leak tester, MB and Calidyne vibration machines and other reliable test equipment.

Two field applications engineers have been appointed for the purpose of providing technical assistance to customers, and helping to establish closer customer-factory contacts in solving relay requirement problems. Supplementing the other phases of the program, new staff members have been added to the Burbank facilities.

Elgin National Watch Co., Dept. ED, Burbank, Cal.

CIRCLE 568 ON READER-SERVICE CARD

Antenna Field Service

New 4-page bulletin describing field service facilities for the antenna industry has been released by D. S. Kennedy Co., Cohasset, Mass. Antenna installation and maintenance through specialized field service departments has become an important facet in today's huge, complex electronic equipments. The bulletin delineates the various types of field engineering service available, such as site selection, construction, supervision, antenna erection, maintenance and training.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

CIRCLE 569 ON READER-SERVICE CARD

WHEN YOU WANT TO TOUCH THE UNTOUCHABLE

You may design manipulators for radioactive materials . . . control devices for corrosive chemicals . . . laboratory equipment for research on deadly viruses. *Whatever* you design, if it calls for precision instrument ball bearings, Fafnir can help you. Low torque, for example, is insured through Fafnir's balanced bearing and retainer design, extreme accuracy in geometry of parts, superior finishes, and "clean room" assembly. Let Fafnir's uniformly high standards of quality plus diversity of types, sizes, and materials help *you* "touch the untouchable" in meeting exacting requirements. The Fafnir Bearing Company, New Britain, Connecticut.



Fafnir precision instrument ball bearings are available in four tolerance classes—ABEC 1, 3, 7, and Modified 7—to meet specific needs.



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TORONTO, ONT. (George Kelk Ltd.), MITCHAM, SURREY, ENGLAND (Bryans Aeroequipment Ltd.)

CIRCLE 573 ON READER-SERVICE CARD

NEW LITERATURE

Pulse Generators

574

Complete technical data on a broad range of pulse instrumentation, including pulse generators, word generators, time delay generators, and electronic counters, are given in "1959-1960 General Catalog." Electrical, physical, and mechanical specifications and illustrations are also provided in this 48-page catalog. Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.

Lead Wire Insulation

575

Four-page bulletin CDS-179 illustrates the use of silicone rubber for lead wire insulation. Included is a comparison between silicone rubber, polyvinyl chloride, neoprene and natural rubber as insulating materials. Electrical, physical, and chemical properties are given. General Electric Co., Silicone Products Dept., Waterford, N.Y.

Circuit Breakers

576

Bulletin B-07 describes miniature, hermetically sealed, inverse time delay, magnetic circuit breakers. Illustrations, dimensional diagrams, and electrical specifications are given in this four-page brochure. Airpax Electronics, Cambridge, Md.

Transistor Chopper

577

Two-page bulletin C-98 illustrates and describes a transistor chopper which has a power requirement of less than 20 mw. Electrical, mechanical and environmental characteristics and performance specifications are given. Airpax Electronics Inc., Cambridge, Md.

Flight Controls

578

Eight-page illustrated bulletin GEA-59APJ-67 describes a complete line of flight controls. Application information is



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Micron range tolerances are standard practice with B.M.C. photomechanical techniques. Storage tube, mesh, transistor evaporation masks, intricate metal parts, mechanical filter screens, etched shaver combs, etched orifice plates, all are produced more perfectly by electroforming or mechanical etching.

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Etching on metal and glass, electroforming, manufacturers of fine mesh for storage and image tubes, micron sieves, shadow masks for color T.V., evaporation masks for transistors.

CIRCLE 579 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

given on self-adaptive flight control, all-transistor control amplifier, inertial guidance platform, gyros, accelerometers and automatic ground support test equipment. General Electric Co., Light Military Electronics Dept., 600 Main St., Johnson City, N.Y.

Input Scanner 583

Data sheet 19-46 illustrates and describes a multiple-point input scanner. Information on operation, application and available accessories for model 453M are given. Kin Tel, Div. of Cohu Electronics, Inc., 5725 Kearny Villa Rd., San Diego 12, Calif.

Molded Sheets, Rods and Tubes 584

Four-page brochure No. 3 describes a line of molded Teflon sheets, rods and tubes. Available sizes, physical properties, and typical uses are given. Chemplast, Inc., 3 Central Ave., E. Newark, N.J.

Switches 585

Catalog 63, "Small Basic Switches," describes miniature and subminiature basic switches. Electrical, mechanical, and dimensional data are given, as well as illustrations of the switches. Typical auxiliary actuators and assemblies are shown. Micro Switch, Freeport, Ill.

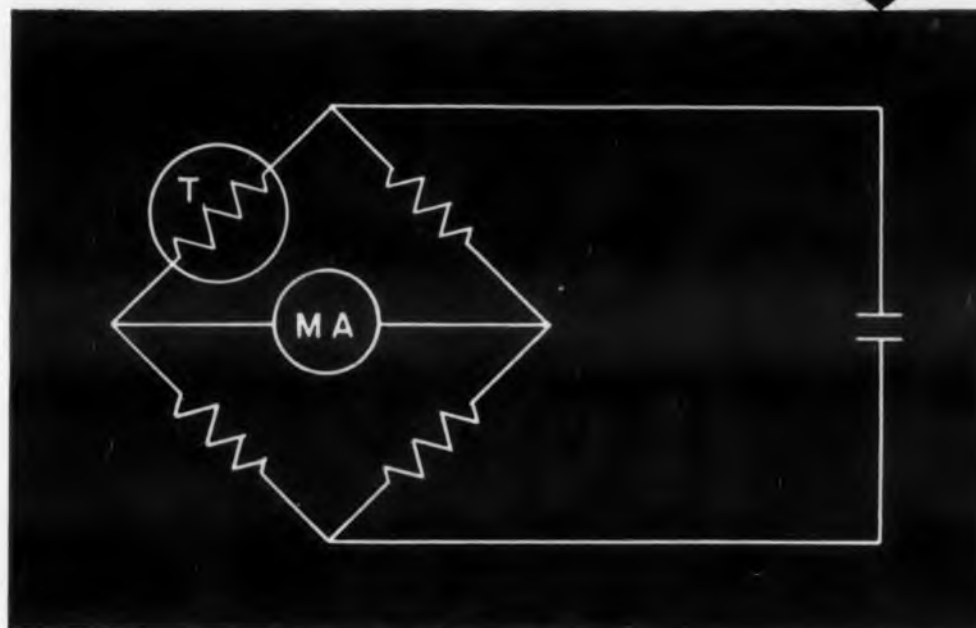
Electronic Generator 586

A 250 va electronic generator is described in this data sheet. Electrical, physical, and dimensional data are included. Industrial Test Equipment Co., 55 E. 11 St., New York 3, N.Y.

Optical Data 587

"Basic Optical Data for Electronics Engineers," a three-page reprint, is a summary of useful optical formulae and basic optical systems. Included are illustrations of basic lens arrangements, a table of definitions of symbols and sign convention, and a listing of common design terms. Leo Levi, 80 Bennett Ave., New York 33, N.Y.

GLENNITE® THERMISTOR DESIGN IDEAS NO. 9



THERMOMETRY...electronically ...with instantaneous response

Glennite thermistors have been utilized for temperature detection from ocean floor to outer space. Temperatures of the earth directly below the ocean bed have been measured within $.01^{\circ}\text{C}$ to determine the nature of radiant heat at the ocean floor. Glennite thermistors have also been used to determine functional characteristics of missiles in outer space.

Thermistors are temperature sensitive resistors with high coefficients of resistance. Incorporated in properly calibrated electronic meters, they will give *instantaneous readings* with a high degree of accuracy—a response impossible to achieve by other thermometric means.

Mounted to specification, thermistors form one arm of a standard bridge circuit. A slight change in environmental temperature will cause a relatively large change in thermistor resistance. This in turn affects the current in the meter branch of the bridge. The meter or recorder can be calibrated to read temperature directly.

Thermometry is only one of many interesting applications for Glennite Thermistors. Other uses include time delay, fire control, voltage control, liquid measurement, etc.

Glennite wafer, bead and rod thermistors are available in a variety of resistance values, temperature coefficients and sizes to help you evaluate circuit problems. They may be obtained from your local distributor, or from Gulton Industries in bulk quantities.



Test Your Ideas With A Glennite Experimenter's Thermistor Kit

An inquiry on your company letterhead will make available to you a Glennite Experimenter's Kit for \$14.95. For those engineers who have had some experience with thermistors, comprehensive kits are available for \$49.95. For complete information, write directly to Gulton Industries, Inc.

Custom Made Thermistors To Your Specifications

Gulton will supply thermistors to your specifications with resistance values from 1 ohm to 10 megohms and temperature coefficients of resistance to -6.8% per degree C. Temperature range: -60° to $+500^{\circ}\text{C}$.

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Gulton Industries, Inc.

In Canada: Titanla Electric Corp. of Canada Ltd., Gananoque, Ont.



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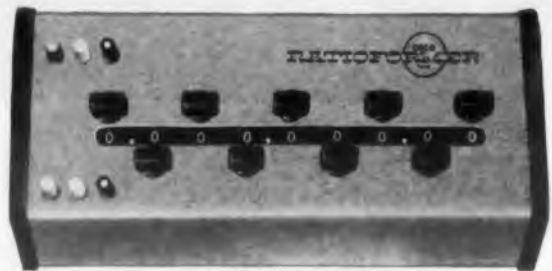
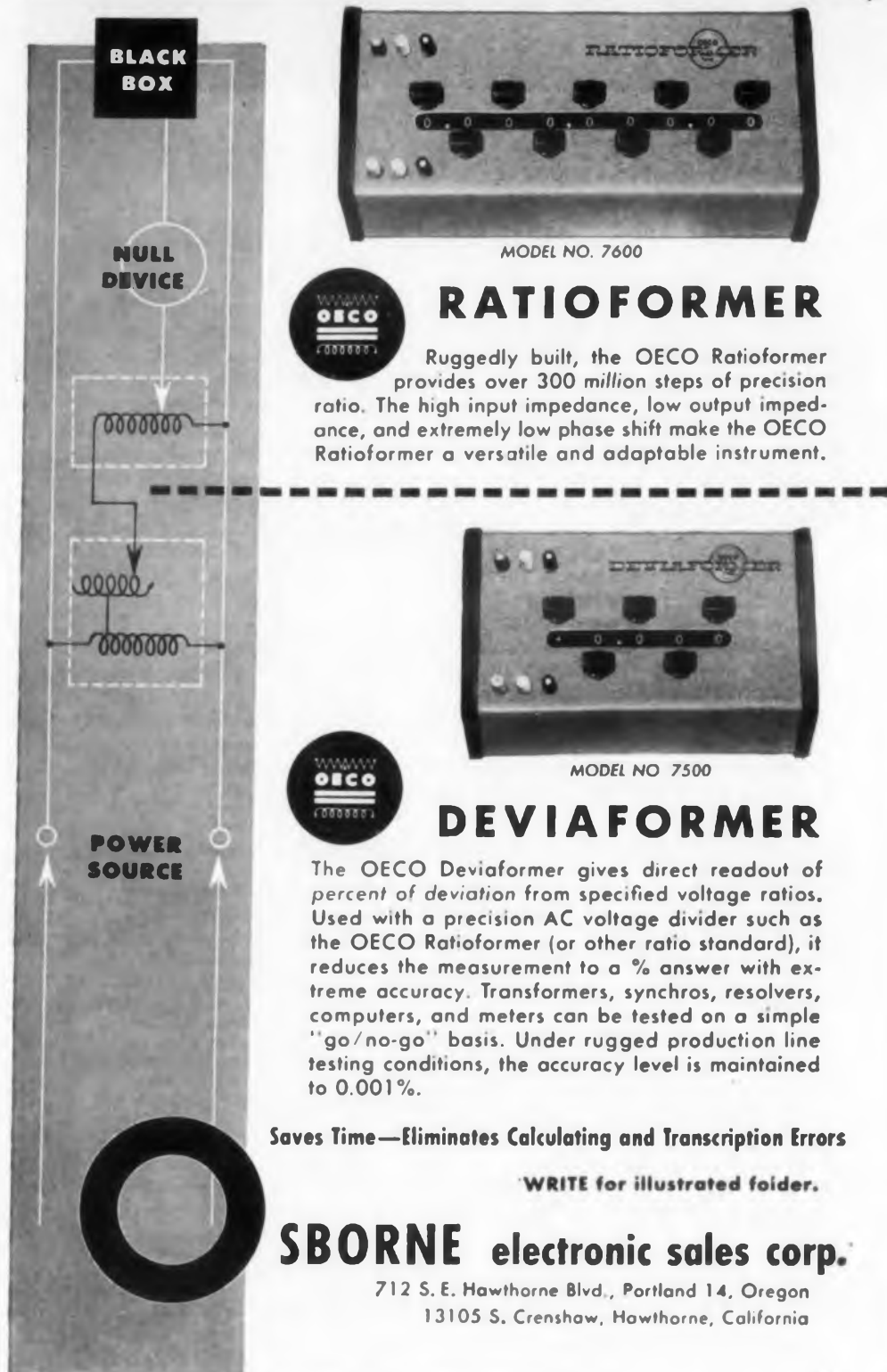


CIRCLE 588 ON READER-SERVICE CARD

CIRCLE 589 ON READER-SERVICE CARD

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Provides ratios of 3-to-1 step up to 10^7 step down.
0.001% Ratio Accuracy at a 1000:1 step down;
this is terminal linearity of 1 part in 10,000,000.
Easy-to-read, in-line numbers on sloping panel.
Adaptable to a wide range of test set-ups.



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The OEKO Deviaformer gives direct readout of percent of deviation from specified voltage ratios. Used with a precision AC voltage divider such as the OEKO Ratioformer (or other ratio standard), it reduces the measurement to a % answer with extreme accuracy. Transformers, synchros, resolvers, computers, and meters can be tested on a simple "go/no-go" basis. Under rugged production line testing conditions, the accuracy level is maintained to 0.001%.

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CIRCLE 593 ON READER-SERVICE CARD

NEW LITERATURE

Memory Core Tester 594

A high-speed magnetic memory core analyzer is described in four-page bulletin 59-A. Included are illustrations of the modular test system design approach, basic core test program, pulse programming, and complete system operation. Also given are a block diagram of the tester, complete specifications and illustrations of components. Rose Engineering, Inc., 731 Arch St., Philadelphia 6, Pa.

Contact Modulator 595

This 29-page booklet is the fourth in the Contact Modulator series. Called "Part 4: Application and Performance," it discusses input circuits, phase relationship, and ambient changes in contact modulators. Circuit diagrams, wave traces, tables, and graphs are included. Airpax Electronics, Inc., P.O. Box 8488, Fort Lauderdale, Fla.

Film Capacitors 596

Bulletin 2510A, 11 pages, provides electrical and dimensional data on a series of film capacitors which are hermetically sealed in metal cases. Application notes, electrical vs. temperature characteristic curves, and performance characteristics are given. Sprague Electric Co., N. Adams, Mass.

Microwave Stability Tester 597

Applications, specifications and features of the firm's microwave stability tester appear in this four-page bulletin. Tunable stalos are also illustrated and described. Pitometer Log Corp., 237 Lafayette St., New York 12, N.Y.

Precision Resistors 598

This two-page table provides electrical and physical specifications on a series of precision carbon film resistors. Included are illustrations, weights, dimensions, and MIL designations. Also provided is a table

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KAY

Therma-Node

**New Noise Generation Technique
Covers 0.5 to 1100 mc—Accurate
To ± 0.1 db—No Gas Discharge
Tubes, Diodes or External Cables**



Kay Therma-Node (Cat. No. 770; left) Shown operating in conjunction with Kay Direct Reading Digital Attenuator Model 40-0

The new Kay Therma-Node is a highly accurate commercial noise generator based on the measurement of the noise temperature of a heated resistive element. It covers an extremely wide frequency range of 0.5 to 1100 mc, either fixed or tuned, is accurate to ± 0.1 db, and provides noise temperatures ranging from 2000° K to 2400° K readable to $\pm 2\%$ —sufficient to accommodate noise figure measurements up to 10 db. Lower noise temperatures (down to room temperatures) and various impedances are attainable with suitable matching networks and attenuators. No gas discharge tubes, diodes, or external cables are required. The resistive element that generates the noise has a life expectancy of more than 10,000 hours of continuous or intermittent use; the few

active devices used in the Therma-Node are of solid state, reducing maintenance to a minimum. The unit can be operated on 117 V., 60 cps or 24 volt battery.

SPECIFICATIONS

FIXED TUNING RANGE: 1-500 mc.
Output Impedance: 50 ohms.
Maximum VSWR: 1.2 VSWR from 4 mc to 200 mc; 1.4 VSWR from 2 mc to 400 mc; 2.0 VSWR from 1 mc to 500 mc.
Noise Temperature: 2000°-2400° K, measured within 2%.

VARIABLE TUNING RANGE: 5-1050 mc.
Output Impedance: 50 ohms.
Maximum VSWR: 1.1 at center frequency.
Minimum Bandwidth for Average VSWR of 1.4: From 200 to 1050 mc—200 mc; below 200 mc the unit is broadband down to 1 mc.
Noise Temperature: 2000°-2400° K, measured within 2%.
Dimensions: 10 1/2" x 7" x 4".
Weight: 8 lbs.
Price: \$495.00, f.o.b. factory.

Write for Kay Catalog 1959-A

KAY ELECTRIC COMPANY

Dept. ED10
Maple Avenue, Pine Brook, N. J.
CApital 6-4000

CIRCLE 599 ON READER-SERVICE CARD

of standard precision resistance values. Texas Instruments Inc., Semiconductor Components Div., P.O. Box 312, 13500 N. Central Expressway, Dallas, Tex.

Fasteners 604

This 179-page brochure is a combination price handbook and catalog of stainless steel and nylon fasteners. Included are AN and MS designations, technical data on nylon, product descriptions and applications, and a discussion of stainless steel. Anti-Corrosive Metal Products Co., Inc., P.O. Box 1894, Albany, N.Y.

Entertainment Transistors 605

"Entertainment Transistors for Every Design Approach" contains maximum ratings and electrical characteristics for a variety of npn, pnp, and drift transistors. Also included in this 32-page booklet are diagrams illustrating the mechanical specifications and connections of all types in the firm's transistor line. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N.Y.

Protective Coatings 606

Suggestions for proper use of Humi-Seal insulating and protective coatings in electronic applications are given in 14-page bulletin 79. Also included are examples of coating procedures. Columbia Technical Corp., 61-02 31 Ave., Woodside 77, N.Y.

Complex Film Capacitors 607

Bulletin 2073A, four pages, illustrates and describes a series of complex film capacitors. Electrical and dimensional specifications, as well as electrical vs. temperature characteristic curves, are given. Sprague Electric Co., N. Adams, Mass.

Voltage Monitors 608

Bulletin 146, two pages, describes and illustrates solid state voltage monitors which have a range of 5 to 40 v dc. Specifications and application data are given for three models: single trip, dual trip, and double dual trip. Alto Scientific Co., 855 Commercial St., Palo Alto, Calif.



Attach Leads to Ultra-Fine Magnet Wire? Sure!! ...and Economically

Send for samples illustrating how Deluxe Coils' advanced engineering and manufacturing know-how can supply miniaturized coils (48-56 gauge wire) with leads. Cut your scrap and termination problems.

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For high resolution and accuracy application where readability and dynamic response are important.



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CIRCLE 610 ON READER-SERVICE CARD

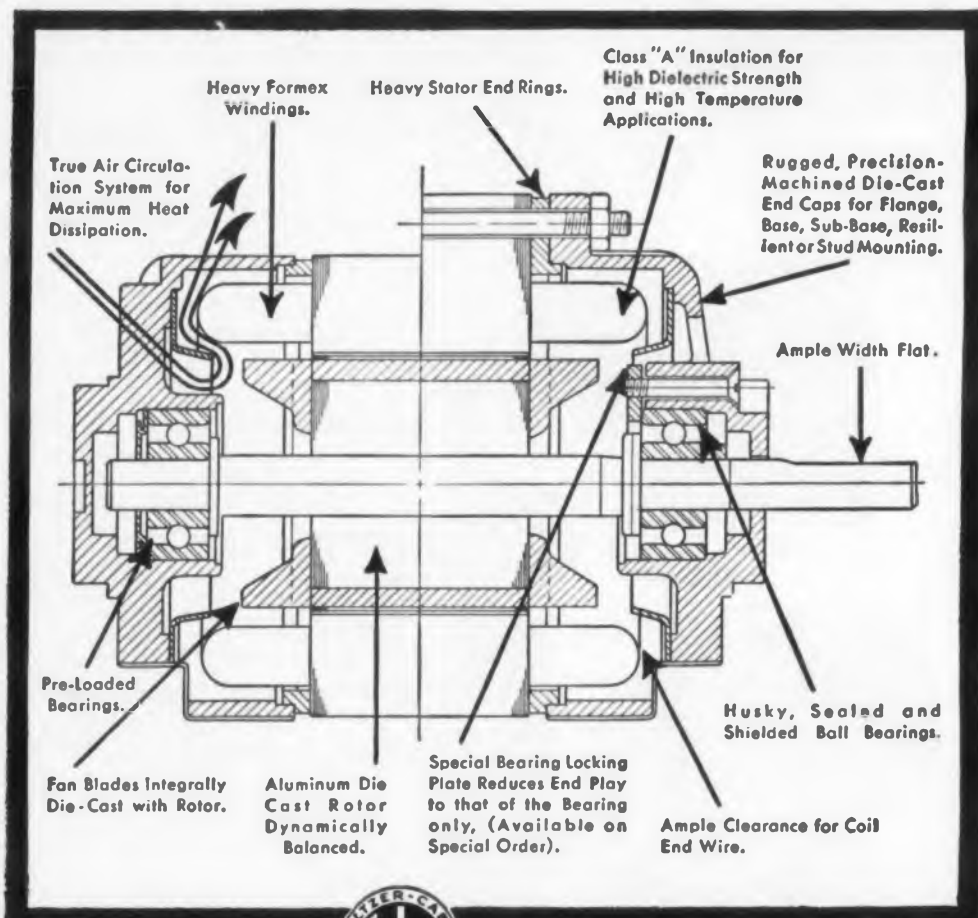
Instrumentation Motors from **HOLTZER-CABOT**

TYPE R-29 MOTOR 2 1/8" Diameter



Many Standard Mountings Available

This motor is an ideal power source for recording instruments, timers, medical instruments, office equipment, blowers, tape recorders, communications equipment, etc. It is available in both 2-pole and 4-pole design, each in three stacking lengths. Type R-29 is a permanent split capacitor type available as an induction or synchronous motor. H.P. of various models ranges from 1/75 to 1/30. Construction features are indicated below.



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CIRCLE 614 ON READER-SERVICE CARD

NEW LITERATURE

Frequency Detector 615

Schematics, graphs and waveforms describe typical operations of the firm's frequency detector in bulletin F-25, four pages. Circuit diagrams indicate use with tube or transistor drive for low-level input signals. Electrical and mechanical characteristics are also discussed. Airpax Electronics, Inc., Fort Lauderdale, Florida.

Rectifiers 616

Bulletin 100, 16, pages, describes various types of selenium, germanium and silicon rectifiers for electroplating and other applications. Specifications and illustrations of laboratory type dc power supplies are included. Djordjevic Engineering & Consulting Co., 1933 N. Damen, Chicago 47, Ill.

Capacitors, Switches 617

Variable capacitors, rotary switches, and tuners are listed and illustrated in this

two-page bulletin. These components are made by the Kataoka Electric Co. Ltd., Japan. Kanematsu New York, Inc., 150 Broadway, New York 38, N.Y.

Hermetic Connectors 618

Technical Notes P & PM 60-2 gives instructions on the installation of hermetic connectors. Included is a step-by-step procedure for fusing hermetic connectors to plates, boxes or cans. Details are given on the protection of the connector during the fusing process. Deutsch Co., Electronic Components Div., Municipal Airport, Banning, Calif.

Servomotors 619

Size 15 servomotors are described in this 16-page catalog. Electrical and mechanical specifications, dimensional drawings, schematics, and torque-speed curves are presented for servomotors, servomotor-rate generators, inertia-damp and adjustable velocity-damp servomotors. Beckman Instruments, Helipot Div., Technical Information Service, Fullerton, Calif.

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CIRCLE 620 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Analog Computer 624

A universal linear operator is described in four-page bulletin K5-U. General specifications and application notes on this building-block of analog computing systems are given. George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass.

Magnetic Amplifiers 625

Magnetic Amplifiers for servo applications are described in this four-page brochure. Electrical, environmental, and performance characteristics are given for two models. Typical performance curves are provided for low-level, switching, and integrating servo amplifiers. Milwaukee Transformer Co., 5231 N. Hopkins St., Milwaukee 9, Wis.

Wattmeters 626

Four two-page data sheets illustrate and describe directional wattmeters and

water- and air-cooled rf load wattmeters. Electrical, physical and dimensional specifications are given in bulletins TW 676, TW 606, No. 406, and W-436. Bird Electronics Corp., 1800 E. 38 St., Cleveland 14, Ohio.

Capacitors 627

Capacitors for TV and radio, and general purpose ac capacitors made by Kansainii Works Co. Ltd., Japan are described in these two brochures, six and seven pages. Illustrations and electrical and physical specifications are provided. Itoh and Co., 425 Park Ave., New York 22, N.Y.

Electrolytic Capacitors 628

Electrolytic and oil tubular capacitors manufactured by Nippon Chemical Condenser Co. Ltd. are described in this two-page bulletin. Electrical and dimensional specifications are given on tubular, lug terminal, prong base, and block types. Kanematsu New York, Inc., 150 Broadway, New York 38, N.Y.



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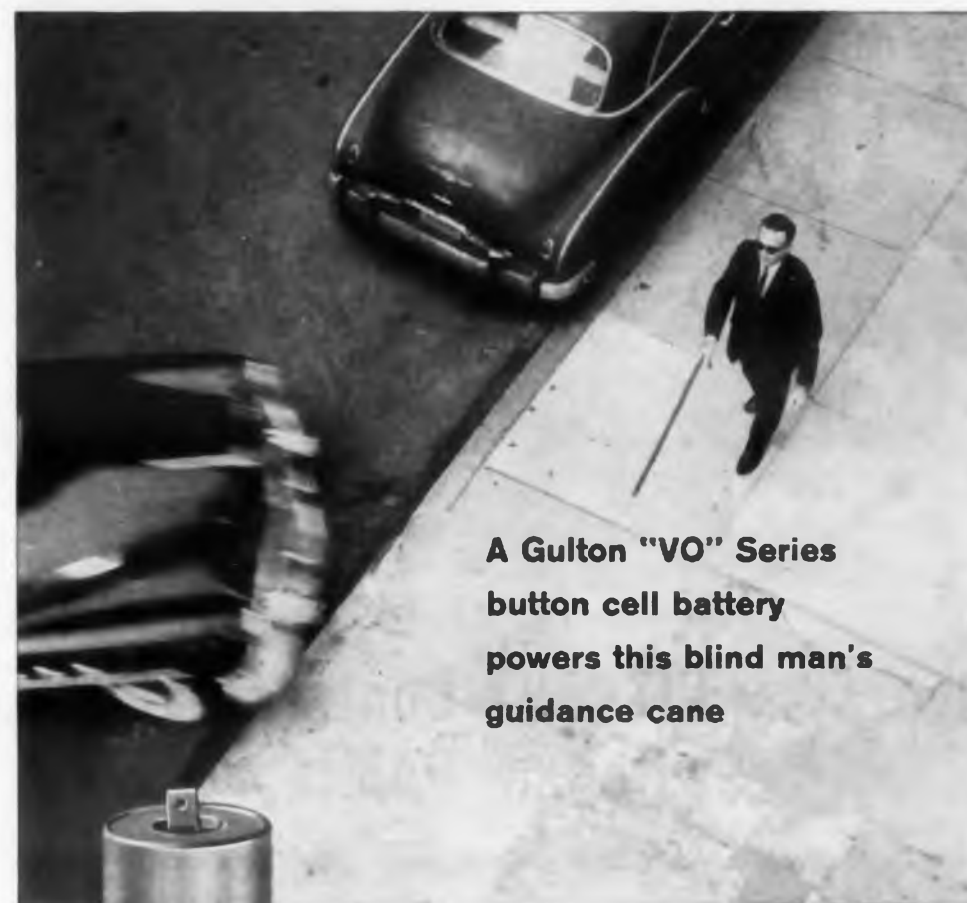


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button cell battery
powers this blind man's
guidance cane



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Requirements called for the power supply to be small enough to fit in the handle of the cane, rugged enough to perform well under abuse, and... to be rechargeable.

After extensive testing, designers chose the Gulton "VO" sealed nickel cadmium button cell battery to do the job.

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"VO" cells are available in capacities of 100, 180, 250, 500 and 1750 mah; have a nominal 1.2 voltage; can be packaged in any combination to meet your voltage specs. Patented sintered plate construction provides exceptional cycling characteristics; highest capacity per unit size. Like more information? Write us for Bulletin No. VO-103.



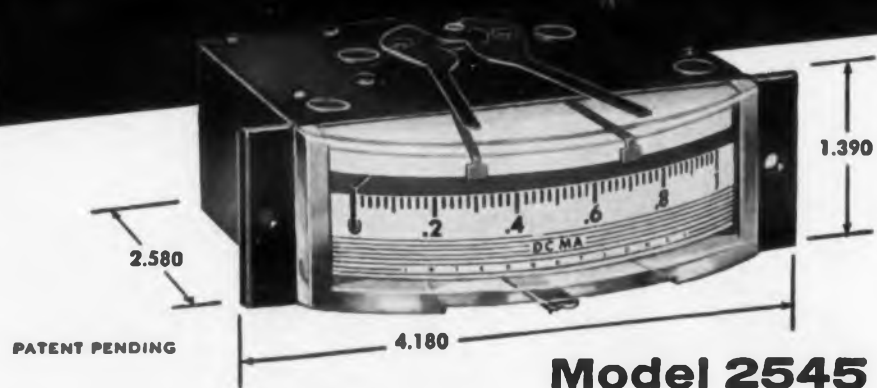
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Alkaline Battery Division, Metuchen, New Jersey,

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Model 2545

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Offering You these Important Advantages:-

- **ONLY MINIATURIZED CONTROL METER . . .** now available without contacts.
- **MORE RELIABLE SWITCHING . . .** with elimination of contact resistance, arcing and corrosion. Signal does not depend on pointer contact.
- **FULL-SCALE USE . . .** of indicating meter always available, regardless of control point settings.
- **MORE ACCURATE READINGS . . .** with indicating circuit completely isolated from the switching circuit.
- **SIMPLEST SYSTEM . . .** with no need for pull-in or locking coils and no re-set mechanism.
- **EXTERNAL ZERO ADJUSTER**

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- Automatic Process Control
- Missile Check-out
- Nuclear Instrumentation
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Switching is accomplished by a metal shield attached to the pointer passing between 2 mutually coupled coils of a self-contained, transistorized oscillator-detector-amplifier. Positions of the 2 control points are manually set by means of external arms. Provides the same scale length as conventional 4½" meters. Accuracy held to ±2% of full-scale for dc and ±5% for ac.

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CIRCLE 634 ON READER-SERVICE CARD

NEW LITERATURE

Electrolytic Capacitors 635

This two-page bulletin describes a series of electrolytic capacitors manufactured by the Toky Denki Co. Ltd., of Japan. Electrical and physical specifications are given for tubular, prong base, lug terminal, and miniature types. Kinsho Trading Co., 10 E. 40 St., New York 16, N.Y.

Semiconductor Directory 636

This "Semiconductor Directory" is a comprehensive listing of the latest in germanium transistors, silicon transistors, diodes, and rectifiers. All major manufacturers and types are numerically listed complete with descriptions and applications. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y.

Parts Catalog

"1960 Guide to Electronic Buying" lists 40,000 items of electronic merchandise

with illustrations. It includes 200 pages of industrial and service items and over 100 pages of hi-fi products. Write on company letterhead to Radio Shack Corp., Dept. ED, 730 Commonwealth Ave., Boston, Mass.

Transformers 637

The firm's complete industrial transformer line is listed in 31-page catalog TR-60. It contains over 1000 items, including several new lines, such as micro-miniature transformers and transformers for transistor applications. Also given are electrical, physical, and dimensional specifications and illustrations. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Potentiometer Field Tapping 638

This four-page illustrated brochure describes the use of a potentiometer field tapping kit. Installation of adjustable shorted areas are also described. DeJur-Amsco Corp., Electronic Sales Div., 45-01 Northern Boulevard, Long Island City 1, N.Y.

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Direct New York phone: Wlconsin 7-6310

Direct Philadelphia phone: WALnut 5-3660

CIRCLE 639 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 14, 1959

Instrument Enclosure Systems 644

This six-page bulletin illustrates and describes a line of semi-custom modular instrument enclosure systems. Included are 16 pages of dimensional drawings of the various models. Amco Engineering Co., 7333 W. Ainslie St., Chicago 31, Ill.

RF Filters 645

This four-page bulletin illustrates and describes multiplexers, harmonic filters, and bandpass filters for communications and space systems. These rf filters use resonator techniques in the frequency range of 25 to 1000 mc to meet unusually low loss or difficult discrimination requirements. The brochure gives electrical and physical specifications as well as graphs and schematics. C. A. Rypinski Co., 2005 N. Fair Oaks Ave., Pasadena, Calif.

Data Control Chassis 646

Bulletin 111, two pages, describes the model K-111 control chassis. Included is a

summary of the operational principles, a description of the chassis circuitry and the storage circuit. Also given are electrical and physical specifications, dimensional drawings and a block diagram. Datex Corp., 307 S. Myrtle Ave., Monrovia, Calif.

Trouble Spotter 647

Two-page bulletin illustrates and describes an electronic trouble spotter for production testing. The unit locates vibration sources and diagnoses air-borne sounds. Electrical and physical data is provided. Erwood, Inc., 1770 Berteau St., Chicago 13, Ill.

Reflector Antennas 648

Reflector antennas especially designed for celestial study, missile and satellite tracking, and radar control, are described in 12-page booklet No. 2556. It illustrates equatorially-mounted, azimuth elevation, and stationary type antennas, and outlines specifications for some of these units. Blaw-Knox Co., Blaw-Knox Equipment Div., P.O. Box 1198, Pittsburgh 30, Pa.



NULL METER

A PHASE SENSITIVE NULL METER WHEREIN NOISE AND HARMONIC VOLTAGES ARE EFFECTIVELY ELIMINATED



MODEL 100A

- Allows separate balance of in-phase or quadrature in null circuits.
- Eliminates the necessity for filters.
- High sensitivity.
- Direction of null clearly shown on zero centered meter.
- Synchro zeroing without recourse to coarse and fine switching.

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OEM

APPLICATION-ENGINEERED BY REFLECTONE

You *could* shop among the more than 400 power-supply manufacturers to find just the right supply for each of your design, test or production problems as it arises. But why not check first with a manufacturer experienced in using and producing power supplies for *all* types of applications.

Take advantage of Reflectone's *comprehensive* experience and diversity of engineering approaches. Select from Reflectone's ever-expanding line of Application-Engineered designs.

With nearly two decades of experience in advanced systems design and development, Reflectone offers you the engineering know-how and manufacturing skills which guarantee you reliable performance in *your* application.

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CIRCLE 650 ON READER-SERVICE CARD

Raytheon relies on

COUCH RELAYS*

for the

HAWK...



IMPORTANT SPECIFICATIONS

Contacts: 4PDT - Dry circuit to 3 amperes

Size: 1 1/2" D x 1 1/2"

Weight: 3.2 oz.

Pull-in power: 1/2 watt

Ambient Temperature: -65°C to +125°C

Vibration Resistance: 20G, 5 to 2000 cps

Shock Resistance: 75G operating 200G non-operating

Couch Relays are used in the successful Hawk missile now being produced by Raytheon Company for the U.S. Army. Designed primarily to attack low flying aircraft from mobile launchers at a battle front, or from fixed installations in populated areas of the United States, the Hawk's mission leaves no room for error or unreliability of its systems. The production quantities of Couch Relays used in these systems measure up to this required reliability.

Write for our new catalog on the full Couch line of rugged rotary relays.

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ORDNANCE INC.

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CIRCLE 654 ON READER-SERVICE CARD

NEW LITERATURE

Lamps

655

Electrical and physical characteristics for 284 miniature and sealed beam lamps together with technical information on the relationship of applied voltage to life, current and light-output, appear in catalog A-21. A set of line drawings provides external dimensions and appearance, basing information and filament designs. Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N.J.

Digital Voltmeter

656

Four-page illustrated bulletin 309 describes a series of digital voltmeters and multimeters for use in automatic data systems and for precision laboratory use. Electrical and mechanical specifications are given, as well as a comparison of obtainable precision vs. input resistance. Conversion time and overall speed are also defined. Franklin Electronics Inc., Bridgeport, Pa.

Gyros

656

Two four-page illustrated brochures describe floated free gyros and rate gyros. Major design features and applications are given. Specifications are provided for two series of free gyros, FC35 and FC45, and one for series of rate gyros, R151. Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.

Micro-Miniature Connector

667

Four-page bulletin 114 describes the 8100 series of microminiature varicon connectors. Complete electrical, physical, and dimensional specifications are given, as well as photographs. These connectors are used where high contact density is a necessity. Elco Corp., M St. below Erie Ave., Philadelphia 24, Pa.

BETTER PRINTED CIRCUIT Protection



PRE-SOLDERING PROTECTIVE COATING

... Gives
3 Advantages Over
Other Water-Dip
Lacquers

1. Longer protection against oxides, carbonates and hydrates.
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Lonco Sealbrite 230-10 gives approximate coverage of 7,000 sq. feet per gallon... dries quickly to a permanently invisible tack-free film... keeps soldering surfaces clean and acts as a soldering aid. It can be used as received or thinned to any working viscosity.

Get Sealbrite 230-10 protection for your printed circuits. Immediate delivery in 1-gallon bottles, 5-gallon cans or 55-gallon drums. Request literature for full information.



LONDON CHEMICAL CO., INC.

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Member of Institute of Printed Circuits

Other Lonco Products: Solder • Fluxes

Chemical Solder Masks • Flux Removers • Chemical Wire Strippers

CIRCLE 660 ON READER-SERVICE CARD

Semiconductors

657

Catalog TE-1340A lists and describes all of the firm's basic silicon and germanium products. Included are illustrations and data charts giving the range of performance of each device. Transatron Electronic Corp., 168-182 Albion St., Wakefield, Mass.

Indicator Lights

658

Miniature indicator lights for use in data processing equipment, computers, and automation applications are described in eight-page brochure L-160A. Complete lamp data, illustrations, electrical specifications, and schematics are included. Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y.

Battery Index

659

This index is a cross reference and interchangeable numbers compilation of all of the batteries available to industry. Included are A, B, industrial, transistor,

and special purpose batteries. National Electronic Distributors Association, Inc., 343 S. Dearborn St., Chicago 4, Ill.

Magnetic Tape Transport

664

Bulletin 3215, four pages, describes model 546 magnetic tape transport. This unit is used with digital computer and control systems. Electrical and physical specifications, as well as typical performance characteristics, are included in this illustrated bulletin. Burroughs Corp., ElectroData Div., 460 Sierra Madre Villa, Pasadena, Calif.

Time Indicator

665

The physical and electrical characteristics of model WT-1 subminiature elapsed time indicator are given in bulletin 5001, two pages. Dimension drawings and an actual size template for panel layout also appear. Waltham Precision Instrument Co., 221 Crescent St., Waltham 54, Mass.

PLANNING FUNNEL TYPE EYELETS FOR PRINTED CIRCUIT BOARDS?

this Edward Segal
automatic machine
feeds, inserts and
flares with utmost
reliability!



Part of the secret's in Segal's unique anvil tool holder and spring loaded work table (shown at left) which allow the eyelet to pass through the assembly before staking or flaring. Avoids loose settings, compensates for material variations, too.

There's a Segal machine for every eyeletting application. Tell us about yours and we'll gladly look into it without obligation. And write today for new bulletin ED-10



Manufacturers of eyeletting machinery,
special hoppers and feeding devices
132 LAFAYETTE STREET, NEW YORK 13, N. Y.

CIRCLE 668 ON READER-SERVICE CARD

another first from **ELECTRO TEC**

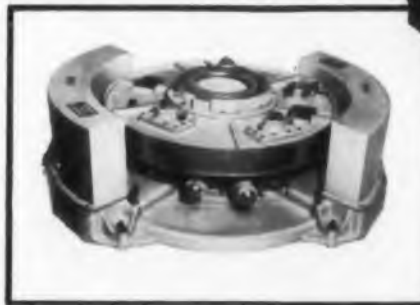
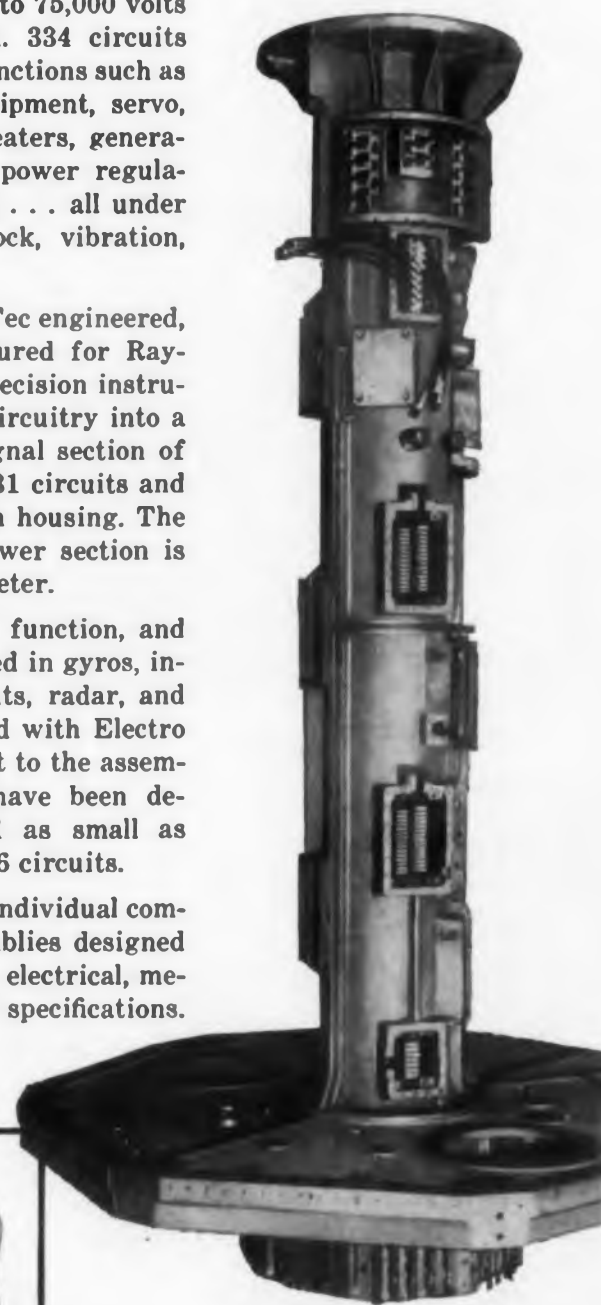
critical slip ring assembly for **TARTAR MISSILE RADAR TRACKING UNIT**

THE PROBLEM — Means was required for the uninterrupted transmission of power and signals through a rotating joint to a revolving antenna. Power requirements were extremely high—up to 75,000 volts—and space was limited. 334 circuits were involved in diverse functions such as operating TV camera equipment, servo, and synchro equipment, heaters, generators, de-icing equipment, power regulators, and hydraulic pumps . . . all under extreme conditions of shock, vibration, and humidity.

THE SOLUTION — Electro Tec engineered, prototyped, and manufactured for Raytheon a highly sensitive precision instrument that packs a lot of circuitry into a small unit volume. The signal section of the slip ring consists of 331 circuits and is 6 feet tall complete with housing. The base which houses the power section is 3 feet tall and 52" in diameter.

Many other unique space, function, and reliability problems involved in gyros, inertial guidance, instruments, radar, and switching have been solved with Electro Tec slip rings.* In contrast to the assembly for Raytheon, units have been designed and manufactured as small as .039" diameter containing 6 circuits.

Write for information on individual components or complete assemblies designed to meet the most stringent electrical, mechanical and environmental specifications.



*Patent No. 2,696,570
and other patents pending.

Write Electro Tec Corporation on all your slip ring requirements.

ELECTRO TEC CORP. Products of Precision
Craftsmanship 

P. O. BOX 37B, SOUTH HACKENSACK, N. J. • BLACKSBURG, VA., ORMOND BEACH, FLA.

CIRCLE 669 ON READER-SERVICE CARD

Inside-Out Twin-T

Varies Rejection Frequency

THE RC TWIN-T network is a three terminal device commonly used to reject a certain spot frequency in the lower frequency regions up to, say, 100 kc. By varying the components in the filter, it can be used as a passive modulator, oscillator, or frequency acceptance circuit when in an amplifier feedback circuit.

These uses have been well treated in the literature. But, what apparently has not been covered is a means to vary the rejection frequency over a wide range by means of a single potentiometer, independent of the output impedance.

Essentially the scheme consists of unraveling the twin-T and putting the input voltage E on one end and a variable resistive fraction xE on the other. The output is then taken from the center as the sequence of figures shows.

Fig. 2 consists of two T sections and these reduce to impedances of the form shown in Fig. 3. From Fig. 3 it is evident that if the voltage drop across E and Z_1 equals the drop across xE and Z_2 , there will be no output e . This condition amounts to

$$XZ_1 + Z_2 = 0$$

However, Z_1 and Z_2 are complex, and when evaluated and substituted in the above relation, yield two necessary and sufficient conditions for frequency cutoff, namely:

$$(r\omega_c)^2 = \frac{n}{ax(m+1)}$$

$$(r\omega_c)^2 = \frac{b(n+1)}{xm}$$

Consequently, the frequency at extinction is proportional to the inverse root of x .

However, to show that x does not affect the network components relationship, it is only necessary to eliminate $r\omega_c$ from the above equations to obtain a necessary ratio condition:

$$mn = ab(m+1)(n+1)$$

This is the condition that the filter have zero output at some frequency ω . It is possible also to show that the circuit Q is the same as in the straight twin-T case, namely:

$$Q = \frac{b}{b(m+1) + m\left(1 + \frac{r}{R}\right)} \cdot \left[\frac{a\left[1 + (m+1)\frac{r}{R}\right]}{n} \right]$$

where R is the resistive output load. Q , for RC components never exceeds more than about 1.3 in this case, but is independent of x .

The final circuit showing the potentiometer frequency cutoff control reduces to that shown in Fig. 4.

In practice, this circuit, when turned to 10 cps, gave a 100:1 frequency range to 1 kc.

Patrick F. Howden, Consolidated Systems Corp., Monrovia, Calif.

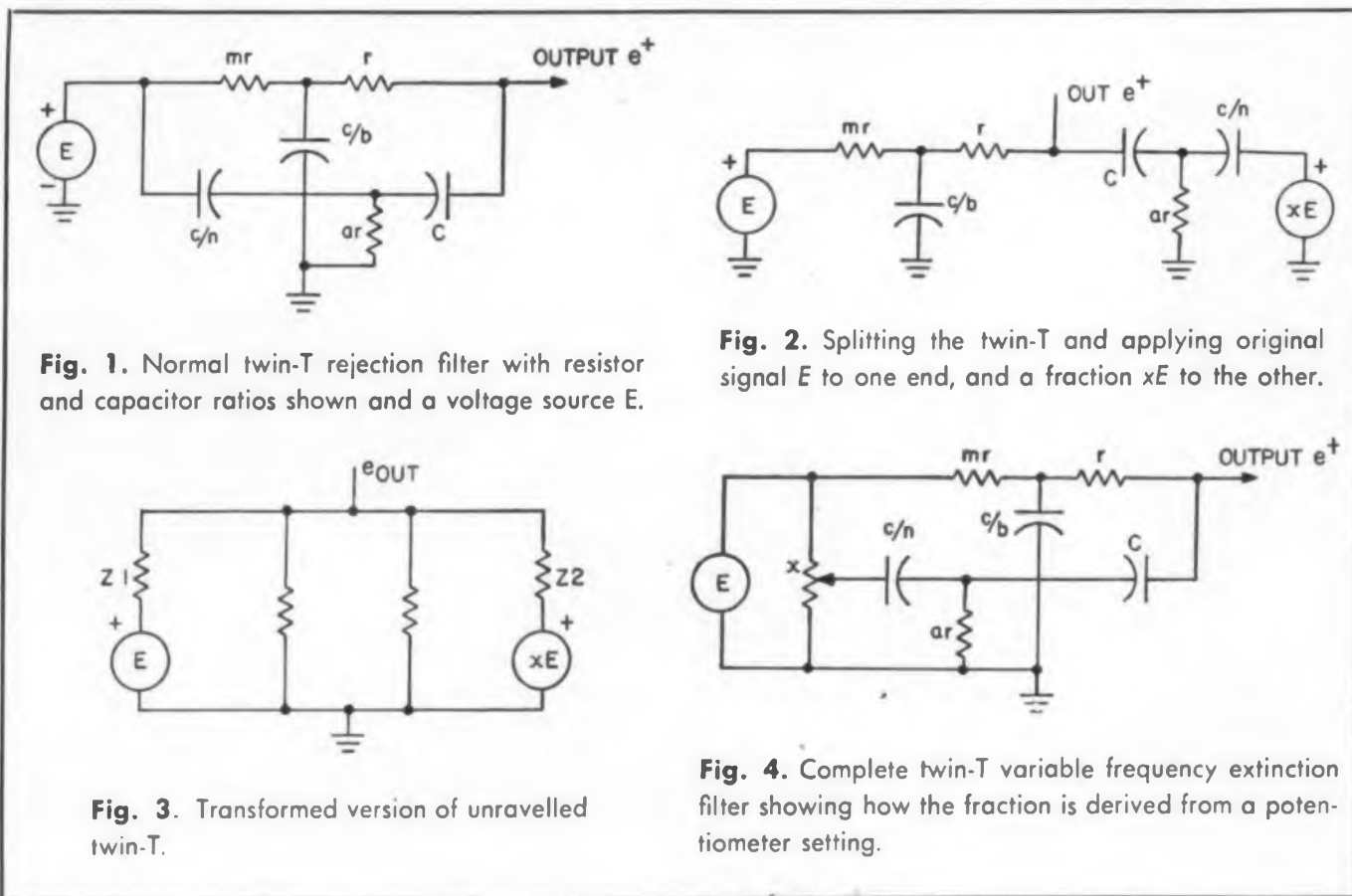


Fig. 1. Normal twin-T rejection filter with resistor and capacitor ratios shown and a voltage source E .

Fig. 2. Splitting the twin-T and applying original signal E to one end, and a fraction xE to the other.

Fig. 3. Transformed version of unravelled twin-T.

Fig. 4. Complete twin-T variable frequency extinction filter showing how the fraction is derived from a potentiometer setting.

for reliability in heavy-duty
power control... specify new

LEACH POWER CONTACTORS

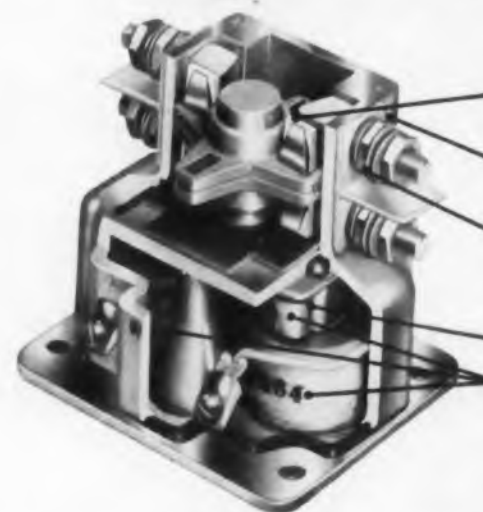


Your airborne and electronic high performance requirements dictated the design and construction of Leach Rotary Contactors—the new power control devices that operate with unequaled reliability under extremes of high temperature, altitude, shock and vibration.

These bi-polar, rotary mechanisms incorporate the balanced armature principle to help solve application problems of inverter control, motor control, motor reversal, and power transfer. Compact design achieves the advantages of small size and light weight to meet the needs of the aircraft, missile and electronic industries.

Leach Rotary Contactors meet and, in many cases, surpass the stringent requirements of MIL-R-6106.

Write today for specifications and a complete description of operating characteristics. Ask for the new Leach Power Contactors Brochure.



- Double-break contacts guarantee maximum circuit-breaking capacity.
- Lightweight, high dielectric strength materials are used throughout.
- Positive lock terminals guard against faulty operation caused by movement of terminals.
- Bi-polar rotary design.
- Balanced armature construction and dual coil design provide the most efficient magnetic circuit for maximum resistance to shock and vibration.

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CIRCLE 674 ON READER-SERVICE CARD

This Power Supply Provides Dependable Performance to the Magnetic Tape Units of the IBM SAGE COMPUTER.

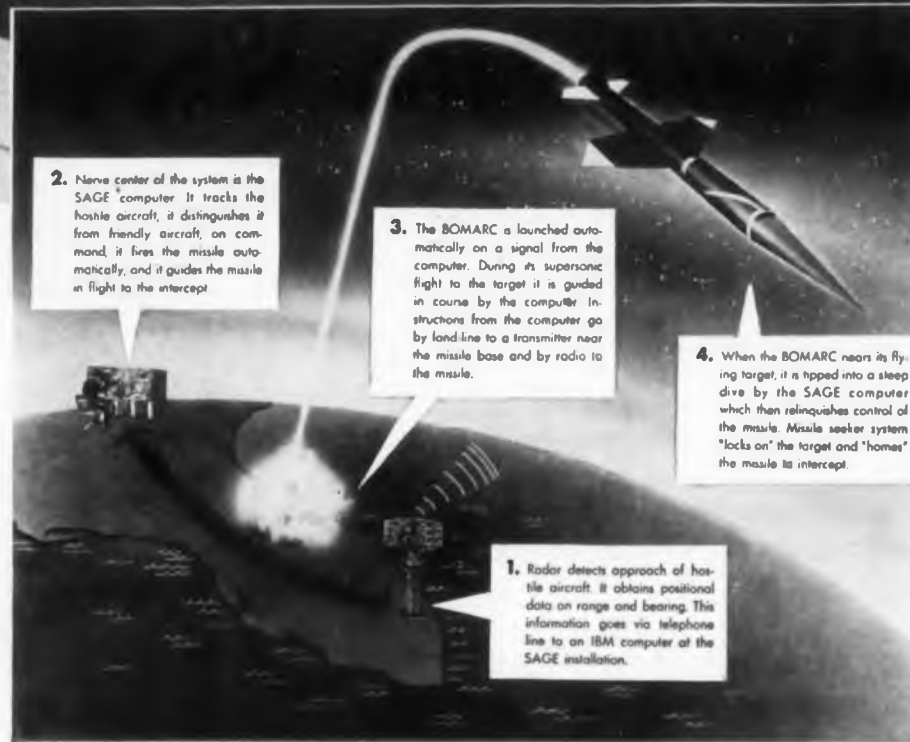


Computer Operating and Programming Room at one of the U. S. Air Force's SAGE Installations



Power Supply Unit supplied by Acme Electric

Acme Electric



Reliability is the keynote of IBM Computer Systems, doubly emphasized in such military systems as semi-automatic ground environment operation. Behind the smart, uncluttered cabinet of this Power Supply Unit, is an example of engineering achievement through cooperation between IBM and Acme Electric engineers.

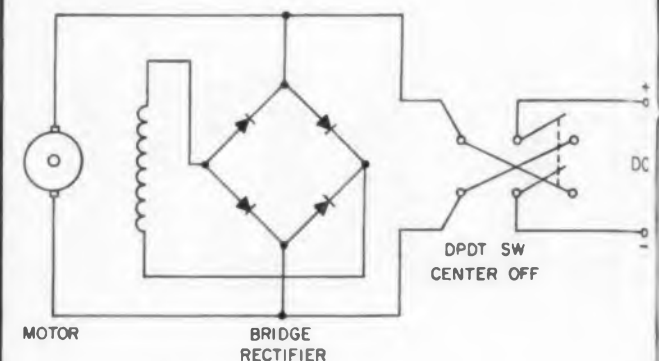
ACME ELECTRIC CORPORATION
9010 Water St., Cuba, N. Y. • 12822 Yukon Ave., Hawthorne, Calif.

CIRCLE 675 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Motor Rotation Determined Via Two Wires

It is often necessary to control the direction of rotation of a dc motor via a two wire line without the use of relays.



Bridge rectifier allows polarity change across armature, not across field, so motor rotation can be controlled via two wires.

The circuit shown solves the problem neatly. Reversal of the line polarity reverses the armature voltage but not the field voltage.

K. C. Herrick, Staff Engineer, The Reflectone Corp., Stamford, Conn.

Simpler, Better Brake for Capacitor Motors

The circuit of Richard Ceier, which appeared in the Ideas for Design section of July 22, can be improved and simplified. The arrangement he gives results in considerable "jitter" of the motor rotor as is evidenced in low ratio reduction motors or in ungeared motors.

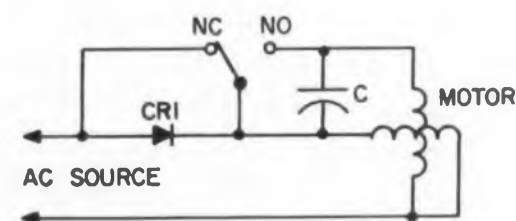


Fig. 1. Simple one-way brake.

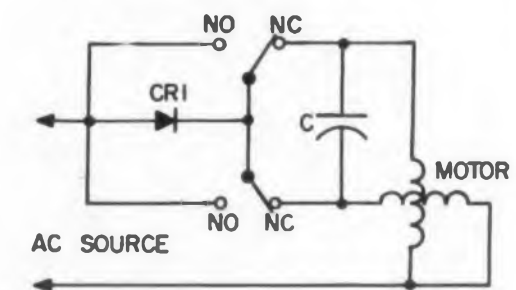


Fig. 2. Simple reversible brake.

We have built many laboratory devices using the circuit shown in Fig. 1 to obtain a fast brake. The circuit shown in Fig. 2 is our arrangement for push-button reversing of capacitor motors with electrical braking.

For reduction motors with high-gear ratios, effective braking can sometimes be accomplished by simply shorting the capacitor so that both windings have the same voltage applied to them without phase displacement.

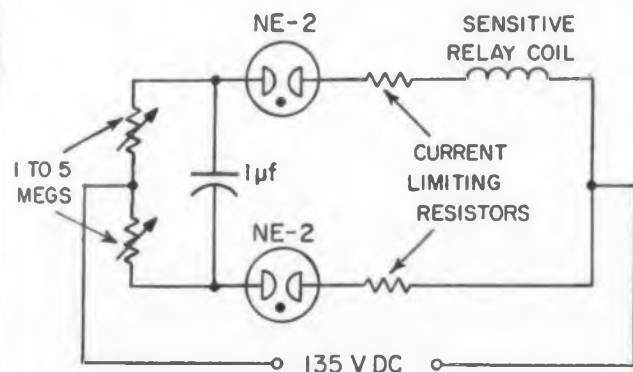
Louis E. Owen, Supervisor, Spectrochemistry Dept., Goodyear Atomic Corp., Portsmouth, Ohio.

Switching Circuit Works, But How?

While designing a switching unit using neon glow lamps and "standard" charging circuits, I tried the accompanying circuit. To my amazement, one glow lamp fired for a definite period, extinguished itself, and then the other glow lamp fired.

The cycle repeated itself, the respective periods depending on the values of the resistors, the capacitor, and the applied voltage. Periods less than a second and up to about five seconds were achieved.

A pot may be substituted for fixed resistors for



Switching circuit should not work—but it does. There is certainly no clearly defined charge and discharge path for the capacitor.

continuous control. In that event current limiting resistors are necessary, as shown in the schematic.

The circuit was tested by connecting the coil of a Weston Model 534 current relay, as shown. Other sensitive relays work equally well. Latching, polarized relays, such as Sigma 72 series (two amperes contact rating) may prove to be more useful.

Glow lamps used were 1/4-w NE-2's or 1/25-w NE-51's.

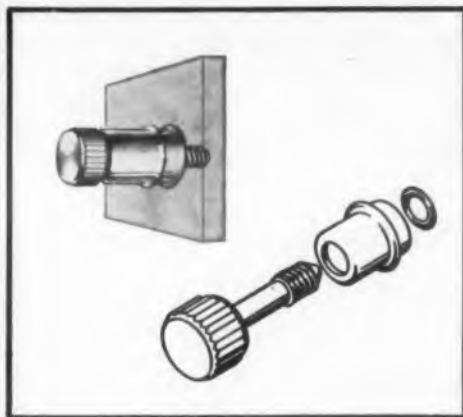
To my knowledge, this circuit is the simplest. However, I am unable to explain why it functions as it does. Can readers of ELECTRONIC DESIGN shed some light on this?

Mark D. Bedrossyan, Atlantic Electronics Labs., Asbury Park, N.J.

Compact Captive Panel Screws:

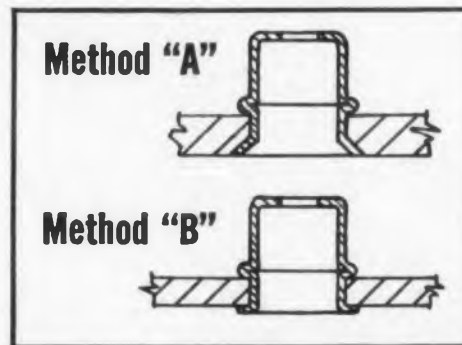
Standard Design Lowers Installed Costs

No longer is it necessary to resort to a costly fastening device of special design to provide quick attachment and release of electronic components. Standard Southco Retractable Screw Fasteners (stand-off thumb screws), available from stock, are both fast to install and economical. The five sizes,

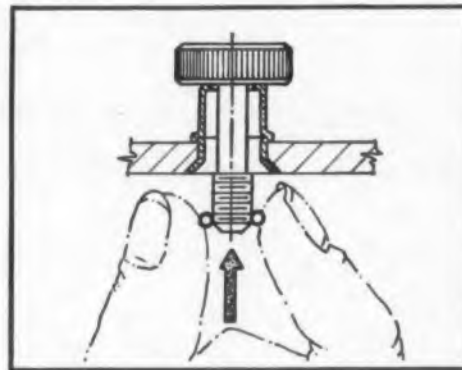


shown below, meet a very wide variety of requirements.

Check these advantages of simplified Southco Captive Panel Screws. Even when many screws are in one panel, misalignment is easily handled because the screw floats in a large hole in the stand-off, allowing ample play for "lining up." No special tools are



needed for installation, thus production is not subject to tool failure, nor limited by either the number of special tools available or the number of personnel trained in their use.



The Southco No. 58 Retractable Screw Fastener consists of three parts: thumb screw, stand-off, and retaining

ring. The bright nickel-plated brass stand-off is inserted in either a drilled and countersunk hole (Method A), or a drilled hole (Method B), and flared. The polished, chrome-finished brass screw is passed through the hole in the stand-off and made captive by a retaining ring. Engaging in a tapped hole in the frame, the screw may be fully withdrawn without moving the panel, yet always is retained.

The unslotted screw is standard in 3/4", 9/16", and 7/16" head diameters and three thread sizes. Slotted head screws are also available in all sizes. The stand-off is standard in sizes to fit panel thicknesses from a minimum of 1/16" to a maximum of 1 7/64". Screw and stand-off are also obtainable in stainless steel.

MINIATURE TO LARGE SIZE HEADS IN FIVE TYPES

HEAD DIAMETER	3/4"	9/16"	9/16"	7/16"	7/16"
THREAD SIZE	1/4-20	1/4-20	12-24	10-24	10-32



BLIND RIVETS | 1/4 TURN FASTENERS | ADJ. PAWL FASTENERS | DOOR LATCHES | RETAINING SPRINGS | ANCHOR NUTS

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Send for your complete Southco Fastener Handbook, just printed. Write to Southco Division, South Chester Corporation, 235 Industrial Highway, Lester, Pa.



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CIRCLE 676 ON READER-SERVICE CARD

*dial any output
from 0-1000V within 1%*



**KEITHLEY Model 240 High-voltage Supply
combines convenience, accuracy, wide range**

This convenient supply brings new speed, ease and accuracy to laboratory tests. Typical applications include calibration of meters and dc amplifiers, supplying potentials for photo-multiplier tubes and ionization chambers. Other uses include furnishing potentials for high resistance measurements, and for diode and capacitor leakage resistance tests.

The Model 240 output delivers 0 to 1000 volts at up to 10 milliamperes. Three calibrated dials on the front panel select the desired output voltage in one volt steps, with accuracy of 1% or 100 millivolts. Greater accuracy may be obtained with a potentiometer provided for setting the output with an accurate voltmeter.

Polarity is selectable. The switch includes an "OFF" position, facilitating timed measurements. An overload relay cuts off the output at 12 milliamperes within 50 milliseconds. Connectors are provided on front and rear panels.

SPECIFICATIONS

DC OUTPUT VOLTAGE: Positive or negative, 0 to 1000 volts, in one volt steps.

OUTPUT CURRENT: 0 to 10 milliamperes.

ACCURACY: Within 1% above 10 volts, within 100 millivolts below 10 volts.

LOAD REGULATION: 0.02% for 0 to 10 ma.

RIPPLE: Less than 3 mv RMS above 5 cps.

OUTPUT IMPEDANCE: Less than 15 ohms.

STABILITY: After a 20-minute warmup, within 0.02 volts \pm 0.02% the first hour, or in any subsequent 8-hour period, with line voltage changes within \pm 10%.

LINE REGULATION: Output change is less than 0.02 volts + 0.02% for a 10% change in line voltage.

RACK mounting, shown above with accessory end frames, bench mounting.

PRICE \$325.00

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IDEAS FOR DESIGN

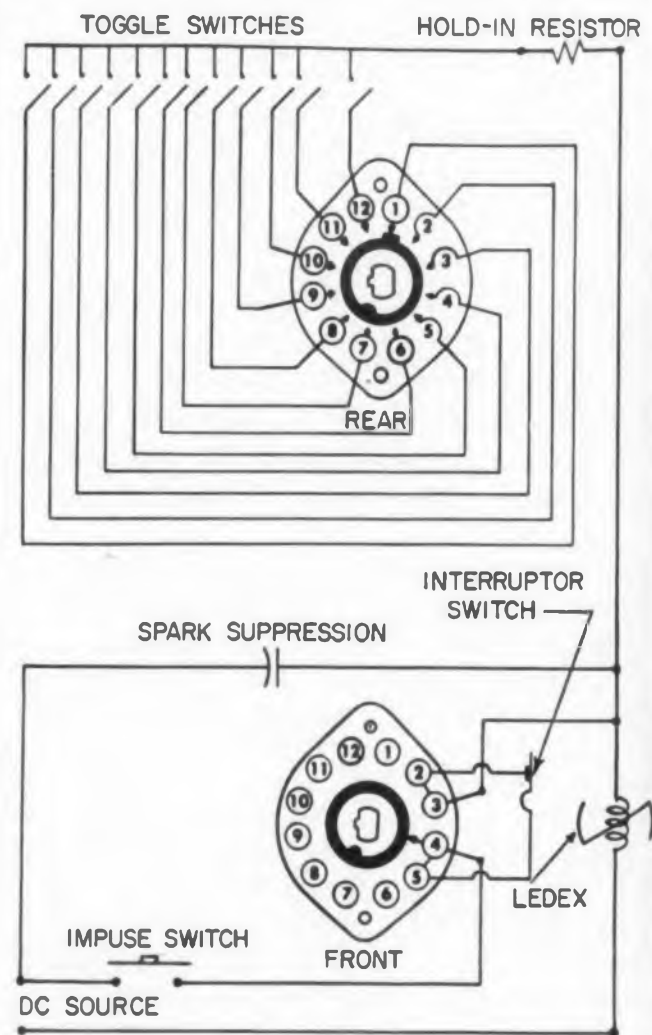
**Rotary Selector
Controls Function Sequence**

An extremely simple and versatile programming circuit uses a Ledex Rotary Selector to control a sequence of functions in automatic equipment. With this circuit, a specific sequence of operations can be set up to perform one job; then the sequence can be altered to perform another job.

The selector, which is normally impulsed from one position to the next position on a control wafer, can be made to skip unwanted positions by the flick of a switch.

The stepping sequence of the selector is varied by a toggle switch between each homing contact and a hold-in resistor. The solenoid drives the programming selector through a ratchet.

Five degrees before the end of each stroke a Bakelite cam opens the interrupter switch. With a toggle switch closed, the resistor is placed in parallel with the interrupter. When the interrupter is opened, the solenoid is still energized through this resistor. The selector will remain at this position until the impulse switch is released and another impulse is received.



A flick of a switch can change the sequence of functions in automatic equipment.

An open toggle switch allows the selector to step past that position automatically when the impulse switch is closed. This takes place because the rotary solenoid is now energized only through the interrupter switch. When the interrupter switch is opened, the solenoid drops back. It is re-energized as the interrupter switch closes, picks up the ratchet, and advances the selector. This automatic advance continues until the selector reaches a position where the toggle switch is closed.

The Ledex selector, manufactured by G. H. Leland, Inc., Dayton, Ohio, can be wired for any voltage from six to 350 vdc. As many as ten additional decks can be stacked on the shaft with the control wafer.

Block Diagram Travels With Portable Equipment

Instruction pamphlets for portable test equipment have two big failings—they are often too wordy, and they are much too easily mislaid. Here is one sure cure for both ills.

Block diagram and simple operating instructions for all new Southwestern Industrial Electronics Co., Houston, Tex., "Advanced Design Instruments" are mounted under a plastic sheet retained by the legs of the instrument as shown. In battery powered models, battery connections are also indicated. All needed information has been distilled onto this one card.



Operating data travels along with this portable test instrument—can't possibly be mislaid.

Outstanding New Performance... Flexibility

in automatic
noise figure
measurement



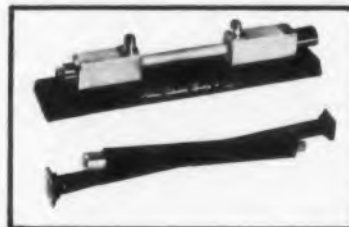
Only THE NEW TYPE 74 Offers These Advantages

- **Noise Figure Range, RF or IF** ... High Scale—23 to 36 db with extension to infinity
Low Scale—0 to 25 db
- **Accuracy** Automatic: Low Scale— $\pm 1/2$ db
High Scale— ± 1 db
Manual: ± 0.1 db with AIL
Type 30 Attenuator
- **Automatic Operation** AGC range—65 db minimum
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Other frequencies available
- **Sensitivity** 50 microvolts at 30 MC
100 microvolts at 60 MC
- **Bandwidth** 6.0 MC minimum
- **Recorder Outputs** Noise figure and AGC

All these features at a new, low price **\$765.00**

The AIL Type 74 provides continuous, automatic noise figure measurements. Its design permits the adjustment of receiver parameters

to minimize noise figure. No special training is required for use on the production line, in the laboratory, or in the field.



Ten All Type 70 Noise Generators provide continuous coverage from 30 MC to 40,000 MC . . . most complete line of noise generators available for automatic noise figure measurements.



AIRBORNE INSTRUMENTS LABORATORY

1345 NEW YORK AVENUE, HUNTINGTON STATION, L. I., NEW YORK

A DIVISION OF CUTLER-HAMMER, INC.

CIRCLE 678 ON READER-SERVICE CARD

NEW
FROM
NARDA

THE INDUSTRY'S FLATTEST COAX COUPLER!

*Only 0.2 db variation
over full octave!*



Frequency (mc)	Nominal Coupling	NARDA Model	VSWR Primary, VSWR Secondary	Minimum Directivity (db)	FORWARD (watts)	Power Rating REV. (watts)	PK. (kw)	Price
240-500	20	3040-20	1.1/1.2	20	1000	100	10	\$200
500-1000	20	3041-20	1.1/1.2	20	1000	100	10	
950-2000	20	3042-20	1.1/1.2	20	1000	100	10	
2000-4000	20	3043-20	1.15/1.2	20	1000	200	10	
4000-8000	20	3044-20	1.2/1.25	17	1000	200	10	
7000-11,000	20	3045-20	1.25/1.3	15	1000	200	10	

What more is there to say?
The new series of
Narda Coaxial Couplers
is absolutely the flattest
on the market; the specs
are here; the prices
are here. And you know
Narda's reputation
for quality! If you need
a really flat coupler,
contact your
Narda representative, or
write to us directly.

Coupling Characteristics

Frequency Response ± 0.2 db

Deviation of Mean Value
from Nominal ± 0.3 db

Calibration Accuracy ± 0.1 db

Calibration points at 5 frequencies

Connectors: Series N female;
others on special order.

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1959 CATALOG

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IDEAS FOR DESIGN

Back-to-Back VR's Calibrate Scope

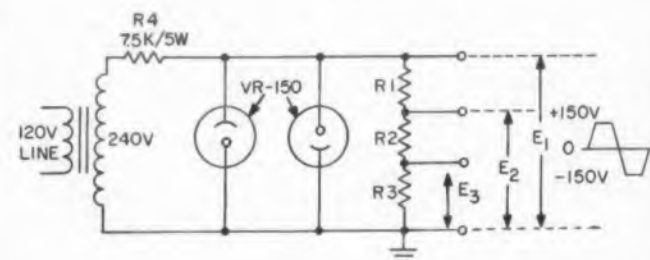
The circuit shown delivers a reasonably accurate, stable, temperature-insensitive calibrating signal for a scope.

Two VR tubes are connected back-to-back so as to fire on alternate half cycles. Resistor R_4 limits the tube current to a nominal value at which satisfactory regulation results.

The VR tubes clip the transformer secondary voltage at plus and minus 150 v, yielding a 300 v peak to peak trapezoid. The output voltage varies less than 1.5 per cent for line variations from 108 to 130 v.

Resistors R_1 , R_2 , and R_3 are chosen to provide required calibrating levels.

P. Cutler, Project Engineer, Universal Electronic Controls, Garden Grove, Calif.



Inexpensive scope calibrator uses back-to-back VR's.

Socketless Tubes Make Compact Circuits

The virtues of stacked-ceramic tubes are by now, pretty well known, particularly with regard to their ruggedness and high temperature performance. Less well known are their advantages in compact, high frequency circuitry.

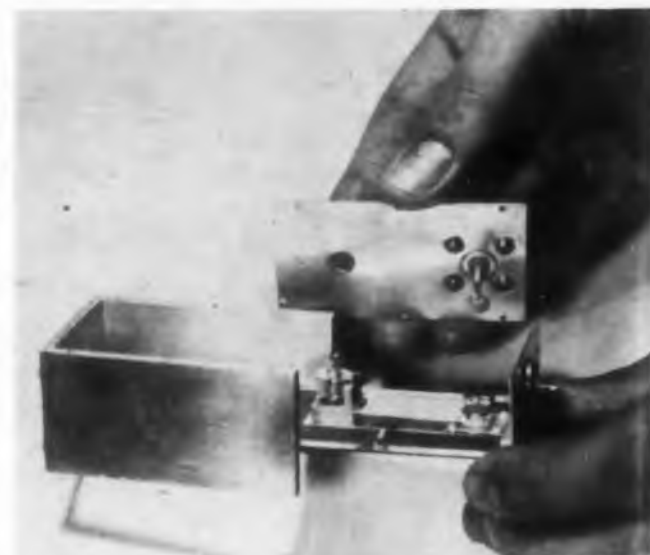


Fig. 1. Strip-line circuit and printed board connect directly to the ceramic tube in this 1200 mc oscillator.



the **narda** microwave
corporation

118-160 HERRICKS ROAD, MINEOLA, L. I., N. Y. • PIONEER 6-4650

CIRCLE 679 ON READER-SERVICE CARD



Fig. 2. Six-stage if amplifier using ceramic tubes squeezes neatly into 2½ cu in.



Fig. 3. No sockets in this broadband amplifier. Components are soldered directly to the gold-plated ceramic tube.

As an example, in Fig. 1, a General Electric type 7486 is combined with a strip-line circuit and a printed board in a 1200 mc oscillator. Both the strip-line and the printed board are secured directly to the ceramic tube. A high impedance probe (shown in the man's right hand) takes the output directly from the tube.

Fig. 2 shows how simple and compact a 60 mc, six-stage, if amplifier can be. Using GE type 7462 tubes, this amplifier provides a 90 db gain with a noise figure of only 1.2 db.

No socket is used in the 400 to 450 mc broadband amplifier of Fig. 3. The gold-plated GE 7296 mounts on a bracket, the plate tank coil is soldered directly to the anode, the grid is grounded, and filament and cathode chokes are attached directly to soldering lugs on the tube.

These tubes are manufactured by General Electric's Receiving Tube Department at Owensboro, Kentucky.

NEED A TAPE WORKHORSE?

"SCOTCH" BRAND Sandwich Tapes

wear longer, cut head maintenance even in digital work

1
22
336
9578
34916
872271
6355009
74400932
330562217
7703220522
88806111956
437773220071
5662225436662
33200973327106
777894440032119
5522789007830062
49340062112213977
322273460007244119
8890026782334110024
44033219077823224422
922247323680274118034
5687321900333405589226

3350668322118856723323
440329996779233001166
68220032320011237787
8300337444323801232
211345788821723309
56697700329008022
9210322431102143
473761670553762
30723881760203
2762030784301
942427750593
63090410782
2490589547
317130273
46302222
6006736
592181
26700
3259
746
53
2



Tote that tape—change that reel—clean that head! If your project atmosphere sometimes seems that way, "SCOTCH" BRAND Sandwich Tape comes to the rescue. How about the possibility of getting over 50,000 passes out of a computer tape? And if that sounds attractive, consider the value in a tape that has no rub-off, won't give you any head build-up, drastically reduces maintenance and replacement on costly head assemblies.

One user found that the simple change to "SCOTCH" BRAND Sandwich dramatically reduced head replacements. And—where heads previously had to be cleaned after every run, "SCOTCH" BRAND Sandwich Tape cut cleaning to once a week.

The secret's in the Sandwich—the high potency oxide magnetic coating is sandwiched between the tough polyester base and a thin protective plastic layer. The coating never contacts the head—you get smooth, low-friction tape movement, plus an end to rub-off, head build-up, and a reduction in erosion of the critical slit in the recording head. Though the 50 micro-inch protective layer causes some slight reduction in high frequency response, the plain facts are that Sandwich Tape packs up to 600 pulses per inch in digital work—has broad usage in AM, FM, or PDM applications.

In "SCOTCH" BRAND Sandwich Tape you have a tape workhorse, pulling a big load over long distances. One user reported fewer drop-outs with each successive pass. As his recording heads were cleaned, the contaminates proved to be in the system, not the tape. Speaking of drop-outs, beware the villainous cigarette—often a culprit. One careless gesture and an ash can cause 40 to 60 drop-outs.

Whatever your application—data reduction, acquisition or control programming—count on 3M technology to create tape of higher uniformity and reliability for error-free performance.

"SCOTCH" BRAND High Output Tape No. 128 gives you top output at low frequencies, even under extremes of ambient temperatures. "SCOTCH" BRAND High Resolution Tape No. 159 lets you pack more bits per inch, offers extra playing time. Finally, for top performance at low cost per foot, "SCOTCH" BRAND Instrumentation Tapes Nos. 108 and 109 remain the standard for the industry.

Where there's no margin for error, there's no tape like "SCOTCH" BRAND. For more details, write Magnetic Products Div., Dept. MBQ-109, 3M Co., St. Paul 6, Minn., or mail reader inquiry card.

"SCOTCH" is a registered trademark of 3M Company, St. Paul 6, Minnesota. Export: 99 Park Avenue, New York, N.Y. In Canada: London, Ontario. © 1959 3M Co.



SCOTCH BRAND MAGNETIC TAPE
FOR INSTRUMENTATION

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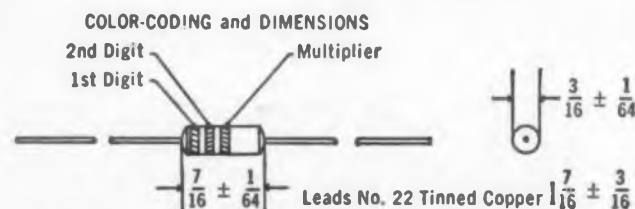
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THE MOST IMPORTANT ADVANCE IN DECADES! Now—in miniature size—you can get maximum inductance to 1000 μ h (more than 60 times the 15 μ h previously available). The revolutionary MINI-STAB line supplements the Jeffers Type 101 Inductor line to provide you with stable inductance values from 0.15 to 1000 μ h!

MINIATURIZATION WITHOUT LOSS OF STABILITY! Jeffers MINI-STAB inductors give you both stability and miniaturization.

Miniaturization is achieved through more efficient use of coil winding space.

Stability comes from using an open magnetic circuit as obtained with a conventional powdered iron coil form.



PART NUMBER	INDUCTANCE (Microhenries)	MEAS. FREQ. (MC)	Q MIN.	SRF MIN. (MC)	D.C. RES. MAX. at 25°C (OHMS)	CURRENT RATING (MA)	COLOR-CODING		
							1st	2nd	3rd
1311-1	18 ± 10%	2.5	50	25	1.8	315	BRN	GRY	BLK
1311-2	22 ± 10%	2.5	50	24	2.0	300	RED	RED	BLK
1311-3	27 ± 10%	2.5	50	20	2.8	255	RED	VLT	BLK
1321-1	33 ± 10%	2.5	50	19	2.5	270	ORG	ORG	BLK
1321-2	39 ± 10%	2.5	50	18	3.0	245	ORG	WHT	BLK
1321-3	47 ± 10%	2.5	50	17	3.5	225	YEL	VLT	BLK
1321-4	56 ± 10%	2.5	50	15	4.2	205	GRN	BLU	BLK
1321-5	68 ± 10%	2.5	50	14	5.0	190	BLU	GRY	BLK
1321-6	82 ± 10%	2.5	50	12	5.5	180	GRY	RED	BLK
1321-7	100 ± 10%	2.5	50	11	6.0	170	BRN	BLK	BRN
1321-8	120 ± 10%	0.79	50	9.0	7.0	160	BRN	RED	BRN
1321-9	150 ± 10%	0.79	50	8.6	8.0	150	BRN	GRN	BRN
1321-10	180 ± 10%	0.79	50	8.0	9.0	140	BRN	GRY	BRN
1321-11	220 ± 10%	0.79	50	6.6	10.0	130	RED	RED	BRN
1331-1	270 ± 10%	0.79	45	4.0	6.8	165	RED	VLT	BRN
1331-2	330 ± 10%	0.79	45	3.6	7.4	155	ORG	ORG	BRN
1331-3	390 ± 10%	0.79	45	3.4	10.6	130	ORG	WHT	BRN
1331-4	470 ± 10%	0.79	45	3.1	11.5	125	YEL	VLT	BRN
1331-5	560 ± 10%	0.79	55	2.9	15.2	110	GRN	BLU	BRN
1331-6	680 ± 10%	0.79	50	2.6	17.0	105	BLU	GRY	BRN
1331-7	820 ± 10%	0.79	50	2.4	19.0	100	GRY	RED	BRN
1331-8	1000 ± 10%	0.79	45	2.2	21.3	90	BRN	BLK	RED

TYPICAL CHARACTERISTICS OF INDUCTOR DESIGNS BASED ON 1000 UH VALUE

INDUCTOR CHARACTERISTICS	JEFFERS MINI-STAB DESIGN	CONVENTIONAL DESIGNS	
		MINIATURIZED*	NON-MINIATURIZED
MINIATURIZATION (WT. IN GRAMS)	1.0	0.5 to 2	2 to 10
STABILITY OF INDUCTANCE WITH TEMP. -55 to +125°C	± 2%	± 10%	± 2%
WITH APPLIED CURRENT (ZERO to 90 MA)	- 1%	- 30%	NIL
WITH APPLIED VOLTAGE (TEST OR SIGNAL)	GOOD	POOR	GOOD

*UTILIZING CLOSED MAGNETIC CIRCUITS SUCH AS TOROIDS, CUP-CORES, ETC.

The MINI-STAB design is in contrast to conventional inductor designs in which miniaturization is usually achieved at the sacrifice of stability (i.e., inductor designs of the closed magnetic circuit type such as toroids, cup cores, etc., tend to be inherently unstable). A comparison of these inductor characteristics is presented in the chart at the left.

MINI-STAB Inductors can be furnished as being capable of meeting requirements of MIL-C-15305A. (Details on request.)



JEFFERS ELECTRONICS DIVISION

SPEER CARBON COMPANY

Du Bois, Pennsylvania

CIRCLE 681 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Optical Superposition Makes Versatile Dual-Beam Scope

A two-gun, dual-beam scope is quite expensive. A very satisfactory substitute can be made using two crt's and optical superposition.

The crt's used in one such instrument are type 902 P1's. One tube is viewed directly through a sheet of plexiglass while the other is viewed by its reflection in the plexiglass. The plexiglass is at an angle of 45 degrees to the planes of the screens of both tubes as shown in Fig. 1. One sweep circuit serves both crt's.

An interior view of the instrument is shown in Fig. 2. The crt's cannot be seen in the photograph because the "A" tube is behind the sweeping switch and the "B" tube is behind a filter capacitor.

Each vertical amplifier is normally connected to its own tube but an arrangement of switches, jacks, and plugs makes it possible to cascade both amplifiers on one tube or to use them as vertical and horizontal amplifiers on one tube.

The sweeping capacitors are connected with a row of separate switches so they can be paralleled for slow sweeps.

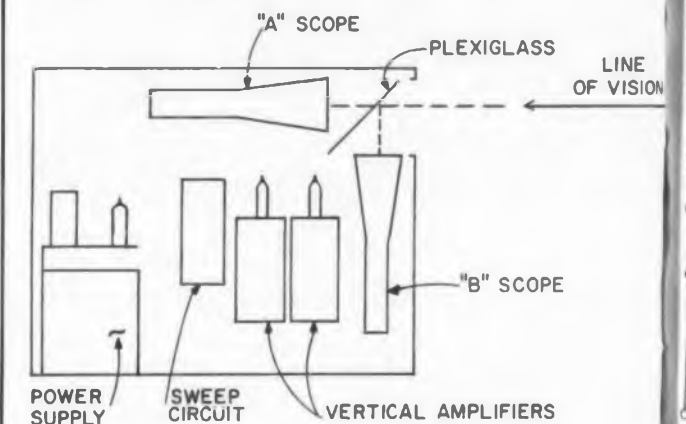


Fig. 1. Layout of optical superposition, dual-beam scope.



Fig. 2. Inside view of the dual-beam scope. The entire instrument is in a case 5 x 13 x 16 in.

The vertical attenuators are step-type and are identical so quick comparison of peak voltages can be made.

The usability of optical superposition has been proved in the military scope, TS-239/U where the coordinate lines are obtained by this method.

A more modern redesign of this scope might use the 3YP tube which was described in *ELECTRONIC DESIGN*, Feb. 18, 1959, p 88.

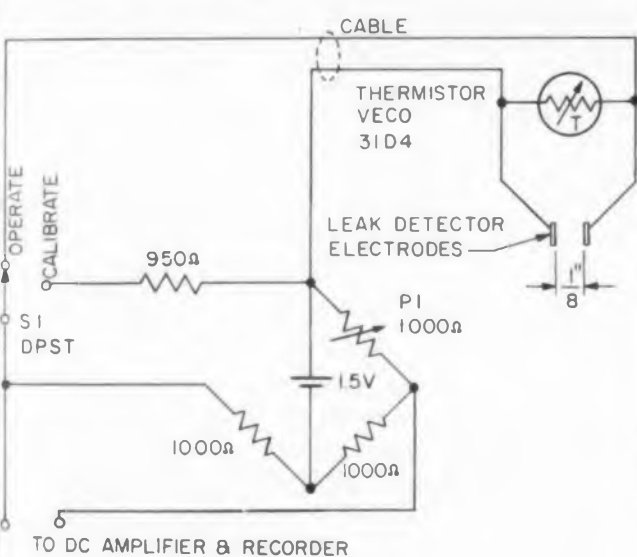
Marriett Dickey, *Electronics Engineer, Richmond, Calif.*

Monitor Heat or Leaks Via Only Two Wires

We had to monitor temperature and water leakage in an underwater, towed vehicle with only two available signal leads.

Both temperature and leakage were to be recorded continuously. The temperature measurement was not required when leakage was indicated.

The circuit shown solves both the problems of temperature measurement and leak detection. It's



Thermistor with leads extended as electrodes, measures temperature or indicates water leaks.

a bridge circuit using a thermistor as the fourth arm.

The thermistor is calibrated at 25 C by replacing it with a 950 ohm resistance. Potentiometer *PI* adjusts the bridge to a reference point.

Leaks are detected by extending the thermistor leads, as electrodes, to the lowest point in the vehicle where water is most likely to collect. A leak shorts out the thermistor and greatly unbalances the bridge. This yields an immediate and obvious full scale indication on the recording.

The entire sensor occupies less than one half cubic inch.

George E. Chambers, *Electronics Scientist, U.S. Navy Mine Defense Labs, Panama City, Fla.*

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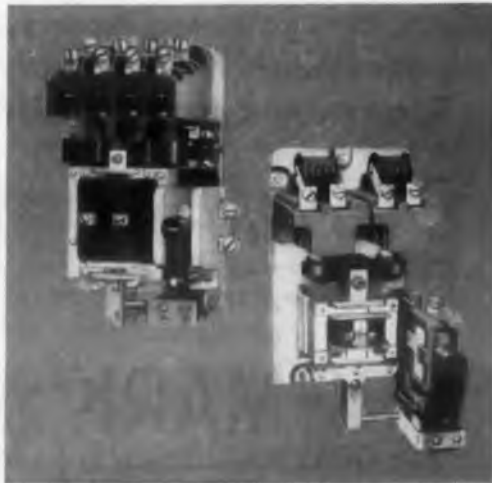
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LINE YOU CAN
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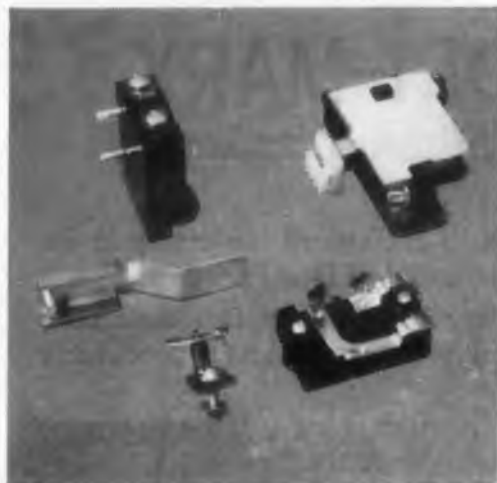
AC Solenoid Contactors • NEMA sizes: 00 to 5



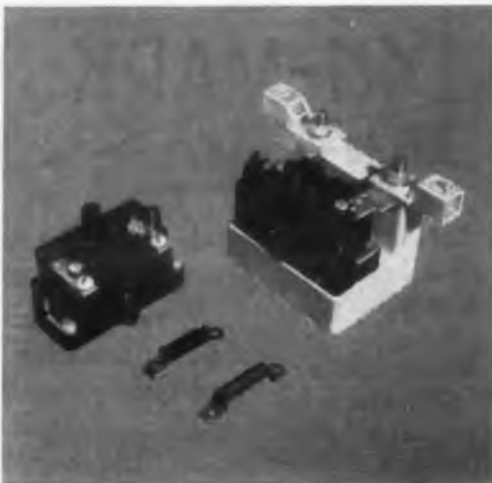
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AC and DC units with DC and AC power plants, dynamic brake contacts



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Dependable thermal O.L. relays



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From the little Size 00's to the powerful Size 5 contactors you'll find maximum reliability built right in . . . whether your application is in motor control, resistive heating or lamp switching.

Meticulous attention to design features guarantees you top-notch performance . . . especially where hi-reliability is a "must." All AC and DC contactors for example, come equipped with simple, fast-acting, trouble-free solenoids. There are no complicated linkages or potentially troublesome pins or bearings . . . no adjustments needed either.

The main and auxiliary contacts are of the double break type designed for

maximum reliability even where high in-rush currents are met. Contacts are accessible for inspection, too!

Other key contactor design features include: identical mounting centers for AC and DC; all units designed for front-of-board wiring and mounting; magnetic blowouts furnished above 25 amp. size on DC; fully accessible terminals make installation easy.

On your next control job, standard or special, specify W/L Control Components. Send for detailed Control Catalog: Ward Leonard Electric Co., 77 South St., Mount Vernon, N. Y. (In Canada: Ward Leonard of Canada, Ltd., Toronto.)

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Result-Engineered Controls Since 1892



IDEAS FOR DESIGN

Tape-Puncher and Roll-Feeder Speeds P-C Paste-Up

Printed circuit masters sometimes require hundreds of lines and lands. (A land is the opaque circle corresponding to the electrical contact at the end of each line.) Masters are prepared faster and more accurately, and corrected more easily



Printed Circuit lands are punched, positioned and pasted in P-C master with this precision device.

by means of pre-cut, adhesive backed, opaque plastic lines and lands. These are usually placed by hand on dimensionally stable polyester film.

Some applications of printed circuits, however, require that the land be located to extreme accuracy. Since hand placement of lands to any degree of accuracy is tedious and time consuming, a commercially available coordinate layout machine having an accuracy of 0.0015 inch can be used. A mechanical device for placing lands has been designed at Sandia Corporation for use with this machine, as shown in the photo.

When the machine is positioned in accordance with the P-C engineering drawing, a punch is struck and the land is cut from a roll of opaque tape and impressed on the film at precisely the required location. On masters with hundreds of lands, important savings in time, money, and manpower are achieved—and without sacrificing the required high degree of accuracy.

The device consists of a compound punch, and a tape feed mechanism. The punch is a 3-inch long barrel containing an outer punch, an inner punch, springs, and at the lower end, a die. A series of dies may be made for various land sizes and shapes. The tape feed mechanism consists of a supply and a take-up reel, the tape running across the bottom of the punch in a slot between the punches and the die. Striking the handle

the punch drives the outer punch through the die, cutting the land, and impressing it on the master. When travel of the outer punch is stopped by the table on which the work is supported, the handle picks up the spring-loaded hollow inner punch. This inner punch strikes the land and cuts the small center hole in the land.

The engineering drawings for this device are contained in AEC bulletin Sand-3 Tape Punching and Roll-Feeding Device. Copies are available from the AEC Technical Information Service Extension, PO Box 62, Oak Ridge, Tenn., Attn: Engineering Materials Section.

Calculate Iron Core N and L Quickly

Whenever an iron-cored coil has an air gap exceeding 3 per cent of the core length, the inductance is primarily determined by the area and length of the air gap. It is essentially independent of the incremental permeability (assumed greater than 100). The inductance in henries is given by the simple relation

$$L = \frac{3.2 N^2 A}{10^8 l}$$

where N is the number of turns, A is the gap area, l is the gap length (inch units). This formula is useful in the design of relays, chokes, solenoids and similar devices.

Lawrence E. Cowles, *Electronic Design Engineer, Superior Oil Co., Bellaire, Tex.*

Quick and Clean Pilot Light Jewels

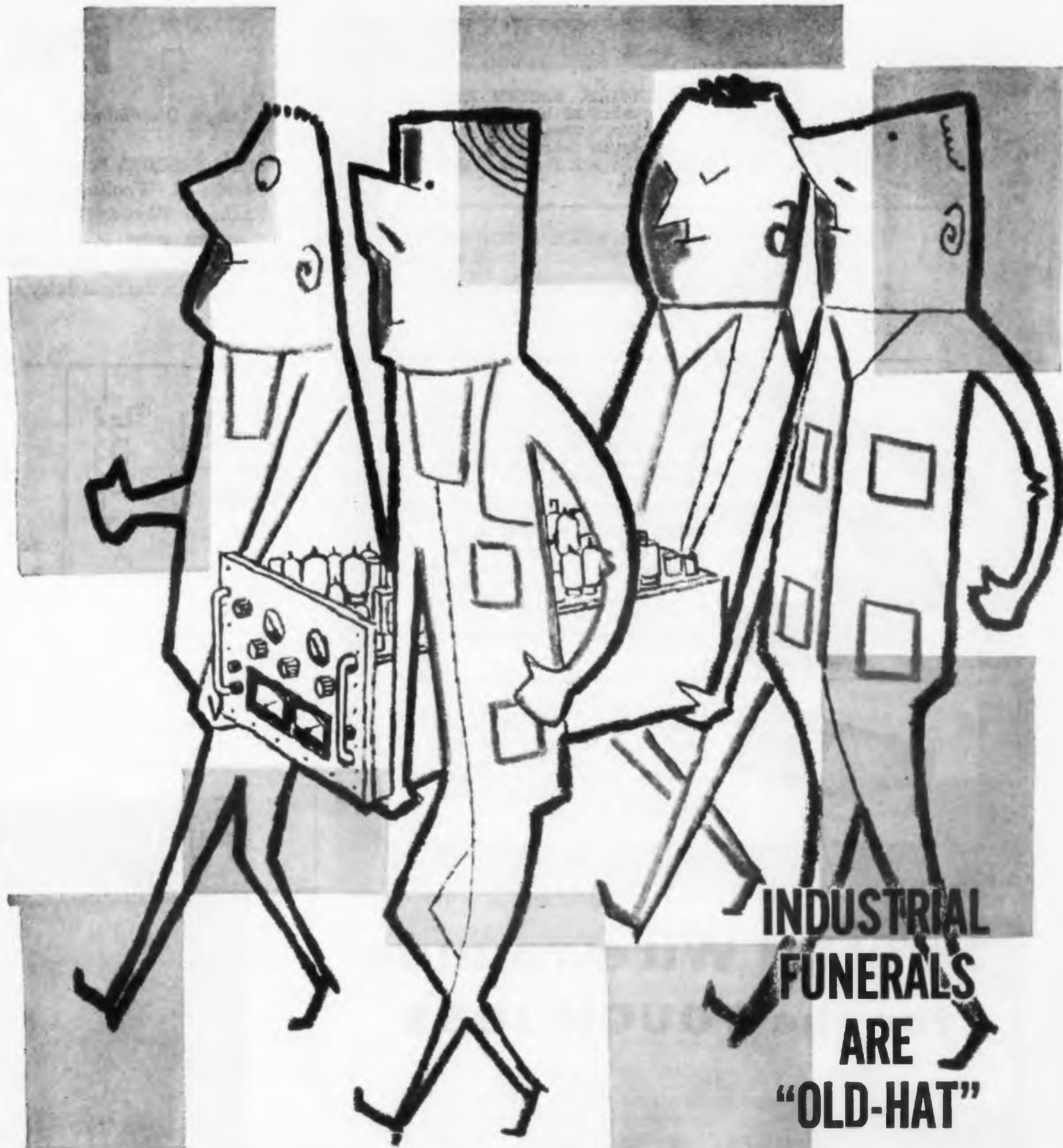
A method for making quick and inexpensive pilot-light "jewels" is often needed on experimental test panels. A simple solution is provided by colored cellophane or plastic tape.

After drilling the desired-size hole for the "window," a strip of colored tape is pasted over the hole on the inside surface of the panel. Any size hole may be employed, and covered with tape of the desired color. Light shining through the various tape colors gives a soft, pleasing display—functional as well as decorative.

Joseph Leeb, *Electrical Engineer, Bulova Watch Co., 549 Green Valley Road, Paramus, N.J.*

Oops!

A misprint crept into the caption for Fig. 3 in the Idea for Design on firing series VR tubes (ED, Sept. 2, 1959, p. 33). The caption should read "for firing three VR's in series, supply voltage must equal the sum of the operating voltages of VR1 and VR2 and the ignition voltage of VR3."



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While we're the first to admit that pallbearers have a definite place . . . we're last to agree that their place is in industry.

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The nation's first and leading manufacturer of slides
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HIGH DISSIPATION RESISTORS: Space-wound, mica-insulated types for instruments, business machines and other exacting uses. Operate continuously at 175°C dissipating 7½ watts in air or 15 watts against metal.



HEAVY-DUTY PRECISION RESISTORS: Wound with glass-insulated, low-TC wire, "G" Type resistors handle 5-10 times the wattage of standard-size precision types. Available in 1½ to 20-watt types with full-load tolerances to 0.25%.



SURGE RESISTORS: Used in high voltage rectifiers, as high current meter multipliers, or as bleeders, these resistors handle 150 watts up to 22½ KV. 100 ohm to 3 megohm types available with 1% tolerances standard.



CORONA-PROTECTED RESISTORS: Ideal for corona control in kilovoltmeters, these Taylor-type high voltage resistors consist of five 0.1% Shallcross resistors mounted in spun aluminum cases. Each unit handles 5 KV (7½ KV max.). Several units may be screwed together for measurements up to 200 KV.



EXTERNAL METER RESISTORS: Sectional wirewound resistors fitted into hermetically-sealed, glazed Steatite tubes with ferrule-type terminals. Resistances up to 6 megohms, ratings from 1¼ to 5 watts at voltages up to 6 KV. Standard tolerances 0.5%; 0.05% on request.

Special Wirewounds for the TOUGH JOBS

When your resistor applications call for the unusual in shape or size . . . the critical in terms of performance and reliability . . . consider Shallcross. Chances are that after 30 years of designing and manufacturing precision wirewound resistors, even the most extraordinary requirements can be met.

Beyond the "specials" shown above, Shallcross regularly produces the widest selection of highly reliable ceramic and encapsulated wirewound resistors available today.

Inquiries for specific types will receive prompt attention. SHALLCROSS MANUFACTURING COMPANY, 4 Preston Street, Selma, N. C.

Shallcross

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PATENTS

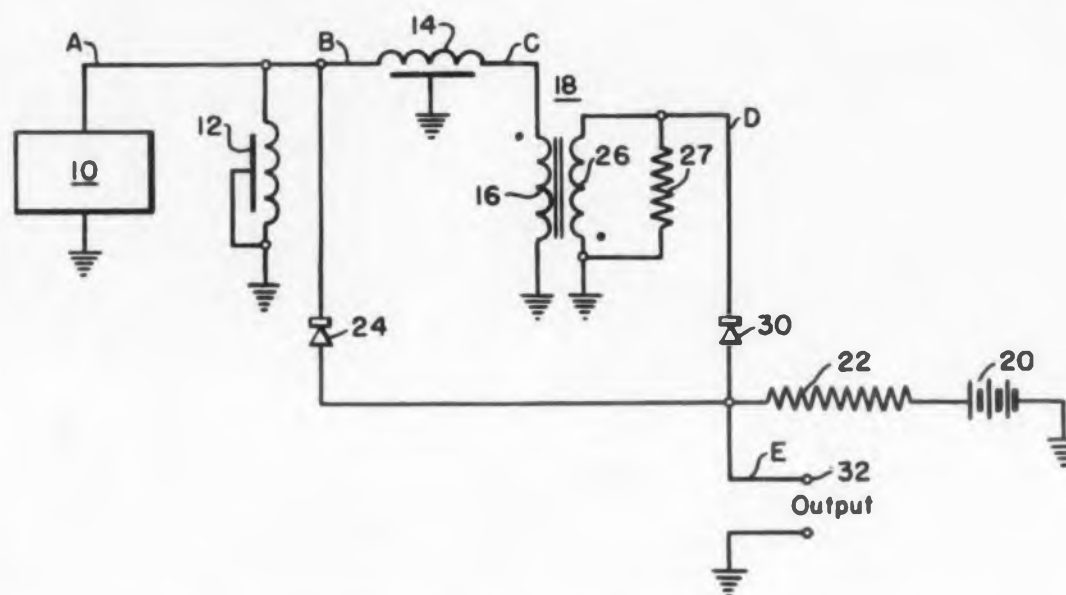
Pulse Length Discriminator

Patent No. 2,896,093. Peter A. Castruccio and Martin G. Woolfson. (Assigned to Westinghouse Electric Corp.)

An output pulse is available across terminal 32 when the pulse width of generator 10 equals the time delay of line 14.

The duration of the output pulse is twice the delay time in line 12.

When a negative pulse is applied by generator 10, the pulse travels down shorted line 12 and, after reflection, the pulses cancel to produce a resultant pulse delayed in time equal to the duration of the applied pulse and having a pulse



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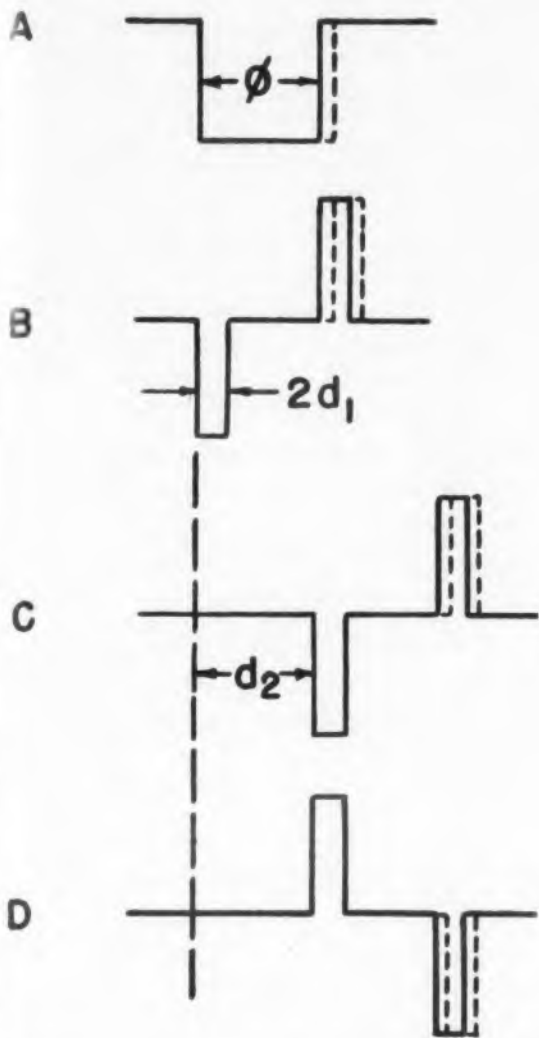
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ELECTRONIC DESIGN • October 14, 1959



width twice the delay of the line. This pulse passes through line 14 after an interval d_2 equal to the length of the applied pulse. The two pulses simultaneously cut off diodes 24 and 30 such that a pulse appears in the output as long as both pulses are "on." The diodes are biased by battery 20 to produce negligible output if either diode is independently cut off.

Correction

Patent No. 2,855,524 on semiconductive switching by W. Shockley was listed incorrectly as 2,885,524 in the Sept. 16 issue.

FREEDOM



Our inertial guidance systems utilize two-degrees-of-freedom gyros. If you would like to do advanced work with these and have had at least a year of engineering experience, please write Mr. C. T. Petrie, Manager, Research & Engineering Staff.

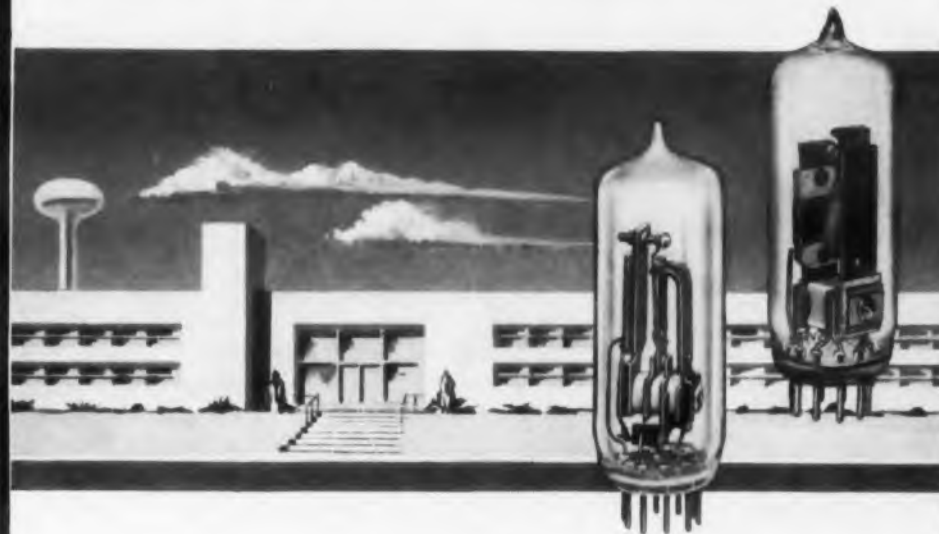


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SPECIFICATIONS

Time delay.....Preset 3 to 60 seconds
Contact arrangement.....SPST or SPDT
Heater voltage...6.3, 26.5, 117 AC or DC std.
Weight.....Less than one ounce
Base.....Miniature 9 pin
Size.....T6 1/2 bulb—Max. hgt. 2 3/8"

New DIGITAL MOTORS

Stepping motors for high reliability applications. Meet the requirements of assured reliability and long life for aircraft, missile and automation systems.

FEATURES | Bi-directional • Positive lock • Dynamically balanced • Simplicity of design • High pulsing rate.

New ULTRASONIC DELAY LINES

Enables development engineers to employ new concepts in existing and projected applications. Low in cost, small in size and simple to operate.

SPECIFICATIONS

Delay range.....5 to 6000 microseconds
Tolerance.....± 0.1 microsecond
Signal to noise ratio.....Greater than 10:1
Input and output impedance.....50 to 2000 ohms
Carrier frequency.....100 kc — 1 mc
Delay to pulse rise time.....Up to 800:1

WRITE FOR COMPLETE COMPONENTS CATALOG 159

ELECTRONICS DIVISION

CURTISS-WRIGHT

CORPORATION • WEST CALDWELL, N. J.

CIRCLE 687 ON READER-SERVICE CARD

IMPULSE

A DIGEST OF NEW DEVELOPMENTS
IN ELECTRONICS AND AUTOMATION

PUBLISHED BY ROME CABLE CORPORATION, ROME, N. Y.
PIONEERS IN INSTRUMENTATION CABLE ENGINEERING

ELECTRONIC "VOICE" FOR MUTES. Persons who have lost their voices through surgical removal (laryngectomy) or paralysis of their vocal cords should be heartened by the news of an artificial "voice," utilizing electronic parts, that is presently being developed. This artificial larynx—cylindrical in shape, 2 inches in diameter and 3 inches long—is held against the throat to produce a slightly mechanical but highly intelligible sound. User can control pitch, thus giving speech a natural conversational sound not previously obtainable. Frequency can be adjusted to correspond with the normal range of pitch of a woman's voice, when desired. Utilizing the principle of a vibrating transducer, the device consists of a modified telephone receiver and a transistorized pulse generator, and is powered by a battery.

TELEMETRY STATIONS-IN-THE-SKY. Aircraft of one Air Force squadron at the Missile Test Center in Florida act as "flying laboratories" in gathering data from missiles and locating nose cones. Nine of the planes are KC-54's—elaborately instrumented aircraft that are complete telemetry stations in themselves. Instrumentation is the latest and best of its type, giving them multiple capability. They obtain missile mid-course and terminal flight telemetry data, measure re-entry radiation and assist in nose cone recoveries. In addition to the nine KC-54's, this squadron has other planes which have various jobs over the missile range, including simulating cruise missile flights and helping to align ground missile-tracking equipment.

THOSE JAPANESE IMPORTS. Japanese electronic products are being imported in increasing numbers. In the first quarter of this year alone, our imports from Japan were almost four times greater than in the first quarter of 1958—an estimated \$24-32 million of retail business. An increase of 36% of imported transistor and other wireless communications equipment is anticipated for the fiscal year beginning last April 1.

GOT TROUBLES? If you're troubled by equipment-wiring problems, you should consider the record being established by Rome Synthinol 901, a special 105° PVC compound for wire insulation and jacketing. Developed in Rome Cable's laboratory and first introduced in 1949, Rome Synthinol 901 has proved by test and actual use to be superior to conventional PVC compounds in many ways. A new booklet—so new it hasn't even been delivered by our printer yet—describes the properties and uses of this amazing compound. Be the first on your block to own a copy. We'll put your name on the advance-mailing list and send you a free copy as soon as it's available. Drop a line to IMPULSE, c/o Dept. 11-10, Rome Cable Corp., Rome, N. Y.

STATE OF SOVIET ENGINEERING. What is the state of Russian engineering as witnessed at the Soviet Exposition in New York City last July and part of August? Visitors studying the Russian electronic equipment and components at close range noted that most of it would probably meet all applicable JAN-MIL specifications. Modular design was very evident and transistors were widely used, but less use was made of printed circuits than in this country. As a result, transistorized equipment lacked full miniaturization. New circuit ideas? Not many to be seen. If anything, Russian engineers tend to overdesign—putting four stages where a more sophisticated single stage might do the job. But substantial progress was shown in electron-device work—especially traveling-wave tubes and transistors. There was no evidence of integrated or semiconductor solid circuits.

These news items represent a digest of information found in many of the publications and periodicals of the electronics industry or related industries. They appear in brief here for easy and concentrated reading. Further information on each can be found in the original source material. Sources will be forwarded on request.

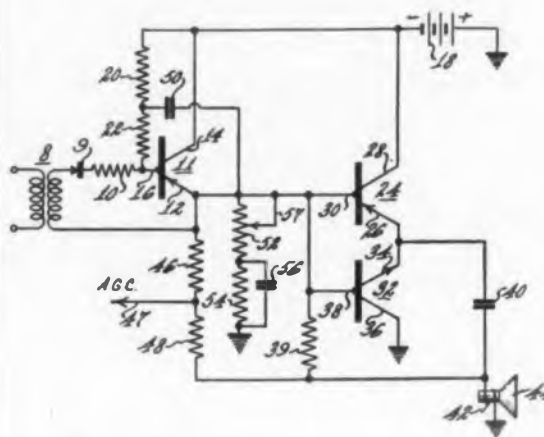
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PATENTS

Push-Pull Signal Amplifier

Patent No. 2,878,380. David D. Holmes.
(Assigned to Radio Corporation of America)

A push-pull transistor amplifier is driven at high output power without feedback. At low power the distortion is



low due to feedback.

Driver stage 11, a pnp transistor, directly connects to the base electrodes of the complementary-symmetry pair, pnp transistor 24 and npn transistor 32. For

high power output, volume control resistor 52 is at maximum resistance so that each output amplifier is driven between base and emitter. The output appears across speaker 44 which is connected between the emitter and collector electrodes. In this instance, the common emitter connection for the selected components produces negligible feedback. However, in the low output condition control resistor 52 is shorted and the output effectively is in series with the input. The output amplifiers are now connected as common-collector stages, i.e. the input is between base and collector, and output is between emitter and collector. To reduce distortion, the speaker voltage is fed back to cancel the input signal.

Self Recycling Pulse Stretcher

Patent No. 2,899,554. Samuel A. Rose.
(Assigned to Hughes Aircraft Co.)

The significant advantages of the diode triode pulse stretcher circuit are:

- The cathode follower permits high charging currents to quickly charge the condenser to peak signal value
- A long time constant set by the value



NEW!

...for measuring harmonics and noise
from 30 cycles to 100 kc

FREQUENCY RANGE: 30 cycles to 100 kc., ± 300 cycle vernier.

VOLTAGE RANGE: 100 microvolts to 300 volts full scale.

BANDWIDTH: -3 db at 10 and 30 cycles round top; 100 cycles and 1 kc. flat top.

MONITOR OUTPUT: Meter output and a voltage proportional to dial setting provide graphic display on oscilloscopes and X-Y recorders.

DIMENSIONS: 10½" H, 14" W, 11¼" D overall.

Wt. 28 lbs.

Write for complete information

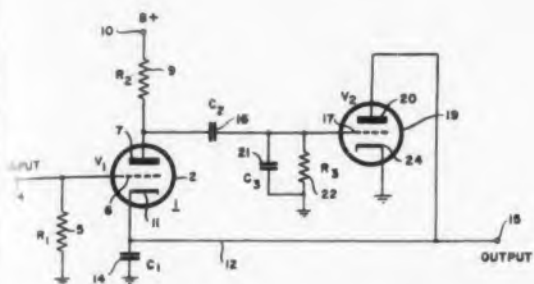
Quan-Tech
LABORATORIES

QUAN-TECH LABORATORIES

Morristown, New Jersey

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ELECTRONIC DESIGN • October 14, 1959



the internal heater-cathode leakage

Autorecycling abruptly to zero

When the input is a positive-going pulse, capacitor C_1 voltage follows to the peak value and the voltage drop across resistor R_2 cuts off triode 19. Capacitor C_3 discharges through resistor R_3 until triode 19 again conducts to fully discharge capacitor C_1 .

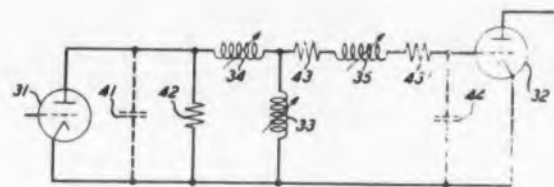
Broad-band Amplifier Employing Parallel-Series Coupling Network

Patent No. 2,899,508. W. M. Goodall and Harrison E. Rowe. (Assigned to Bell Telephone Labs., Inc.)

A parallel-series tuned network has been designed as interstage coupling in a wide-band high-gain amplifier. Applied to amplifiers using tubes with high input to output capacitance ratios (3 or more)

characterized by gm of 30,000 μ hos, a five stage network produces 27 mc pass-band centered at 70 mc with an overall gain of 64 db.

In the schematic is shown a single stage of the amplifier wherein the parallel



resonant arm essentially comprises coils 33 and 34 and the series resonant arm containing coils 33 and 35 with resistor 43 in the grid of the following tube. Tube 31, for example, has input and output capacitances of 22 μ f and 4 μ f, respectively.

Resistor 43 is placed in series with the grid to maintain constant bandwidth as amplification is changed. Ordinarily, as the transconductance of a tube is changed to vary the gain, a resistance is reflected into the grid. Since the value of resistor 43 is relatively high compared to the reflected resistance, the gain remains constant.



OK Boss, you tell 'em how we're gonna revolutionize the party line telephone system with transistor oscillators controlled by . . .

NEW REEVES-HOFFMAN LOW FREQUENCY CRYSTALS

New Reeves-Hoffman low frequency crystals, type RH8-DP, offer excellent frequency stability over a temperature range of -55° to $+105^{\circ}$ C. Available from 4 to 15 kc, they are designed for use not only in telephone carrier and communications systems, but in aircraft navigation, guided missile, sonar, telemetering and test equipment as well. These crystals meet MIL C-3098B specifications for shock, vibration, aging and moisture resistance.

WRITE FOR BULLETIN RH8-DP



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Chassis-Trak slides are available in nine lengths, designed to support from 175 lbs. to 275 lbs. . . . in either the

"basic" model (pictured above), which tilts freely upward, or the "detent" model, which tilts and locks in seven different positions . . . and they are available from stock now!

Before making a slide selection, investigate the extra-strong, pencil thin slide that is built for standard racks and cabinets . . . Chassis-Trak.

"Detent" model, locked in one of seven different positions.

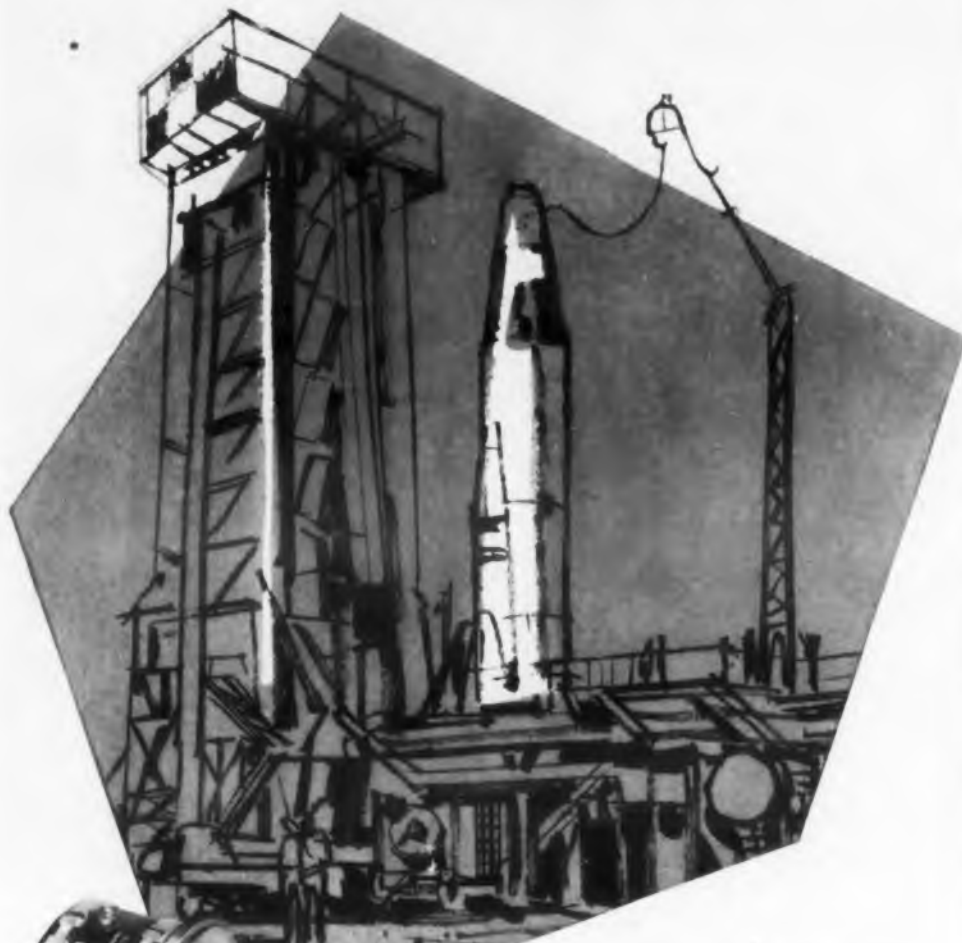


For further information contact:

525 South Webster, Indianapolis 19, Indiana
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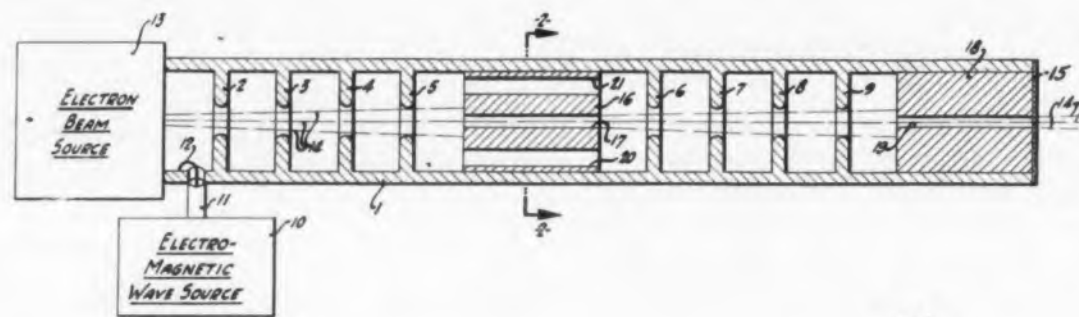
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JANESVILLE, WISCONSIN

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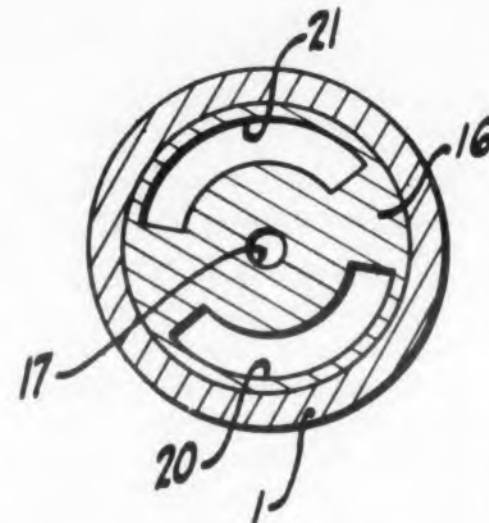
PATENTS



Linear Accelerator

Patent No. 2,899,598. Edward L. Ginzton.
(Assigned to Trustees of the Leland Stanford Jr. University)

X-rays and neutrons are generated in a conventional linear accelerator due to stray electrons which bombard the slow-wave structure. Where the structure consists of high-conductance copper or silver, the X-ray emission may last as long as 13



AEROPOT

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AERO ELECTRONICS CORP.
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ELECTRONIC DESIGN • October 14, 1959

hours after the electron beam is extinguished.

Aluminum is used to form successive apertures along the path of the beam. The aluminum structures 16 and 18 are apertured at 17 and 19 to focus the axial electron beam and are of sufficient length to be impervious to stray electrons. Bombardment of loading discs such as 6, 7, 8, and 9, etc., is thereby prevented. Slots 20 and 21 (inductive) are required to pass the electromagnetic wave energy since the long lengths of the aluminum structures reduce the otherwise capacitive coupling.

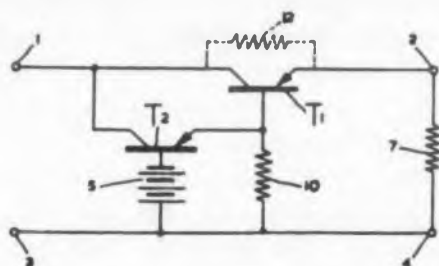
Voltage Stabilizing Circuit

Patent No. 2,897,431. Eric Wolfendale. (Assigned to North American Philips Co., Inc.)

The regulator has two unity emitter-collector current gain transistors connected as grounded collector stages so that the

current drawn from the reference battery is reduced. There is provision for regulation even at zero load current.

The emitter voltage of transistor T_1 follows the base voltage; normally the base is connected directly to the battery. However, as shown, the base current is the emitter-collector current of transistor T_2 . The battery current is effectively reduced according to the base-collector current gain of the second transistor. In addition, resistor 10 is inserted so that the output voltage is regulated at zero load without the need for current reversal in transistor T_2 .



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RATIOS FROM 10:1 to 60:1

MODEL 2900: 2 Pole—4 Pole Induction with A26 Gear Unit

DIAMETER 3 $\frac{3}{16}$ "

LENGTH 7 $\frac{3}{4}$ " to 8 $\frac{1}{4}$ "

HORSE POWER: 1/70 to 1/15 depending on length of stacking.

TORQUE OUTPUT: Up to 60 in. lbs. depending on ratio.

BEARINGS: Permanently lubricated and sealed ball bearings.

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MODEL 29-500: Universal AC/DC or Shunt with A26 Gear Unit

DIAMETER: 3 $\frac{3}{16}$ "

LENGTH: 7 $\frac{3}{4}$ " to 7 $\frac{3}{4}$ "

HORSE POWER: 1/70 to 1/4 depending on length of stacking.

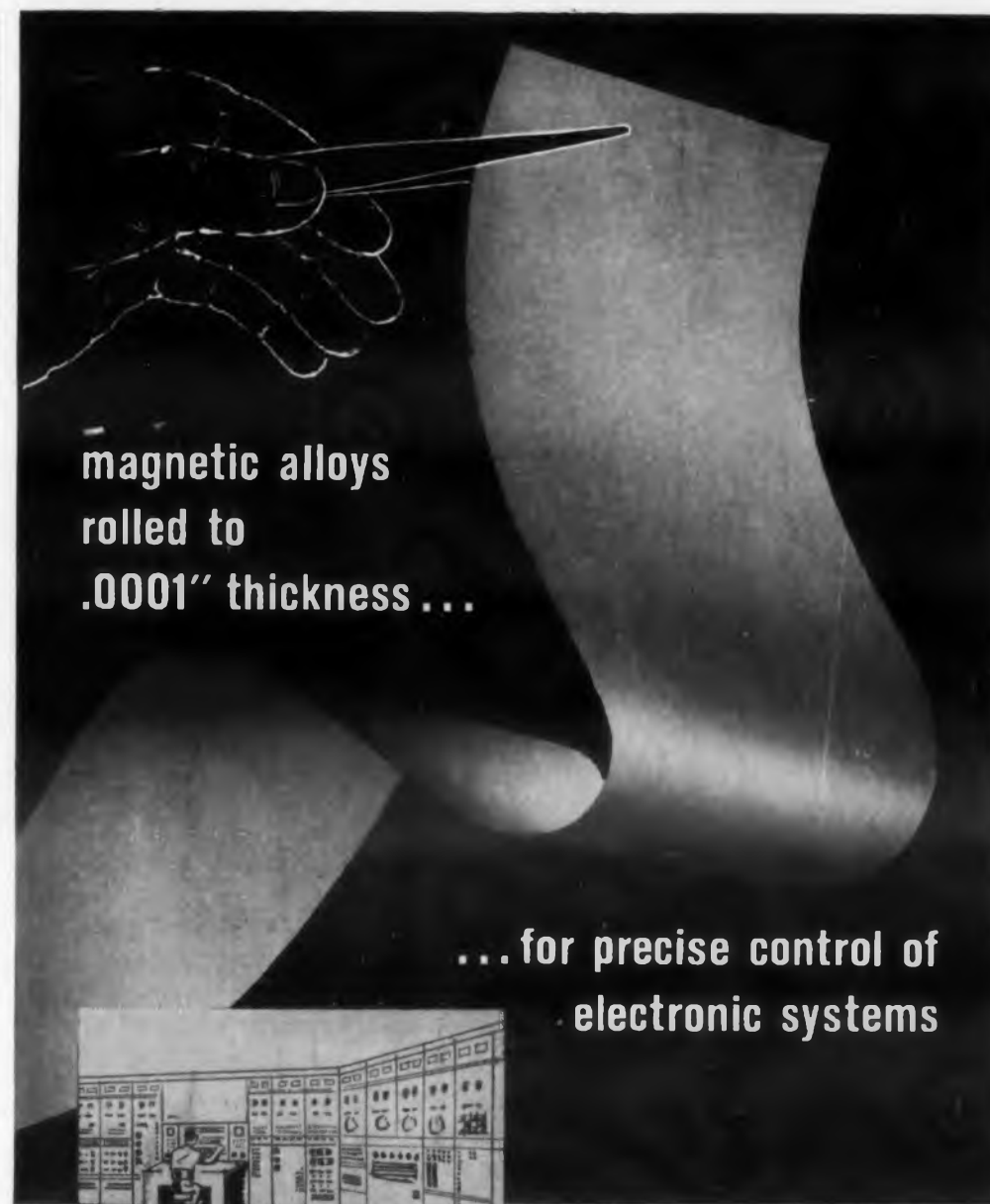
TORQUE OUTPUT: Up to 60 in. lbs. depending on ratio.

BEARINGS: Permanently lubricated and sealed ball bearings.

HOWARD INDUSTRIES, INC.

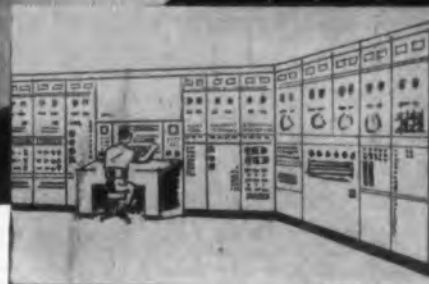
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MODEL 330-M

Krohn-Hite filters are used

In basic electronic instruments for lab or test work, *less than the best* may be a dangerously bad bargain. Unexpected limitations — of range, reliability, precision — can throw out weeks of work on today's jobs, and can make tomorrow's tougher jobs untouchable.

The *best* instrument of its type is probably a bit more expensive, but it's worth buying . . . because you can believe in it today, and will rely on it tomorrow. An example is the Krohn-Hite Model 330-M tunable electronic band-pass filter, for critical low-frequency applications. Here are some facts about it.

FREQUENCY RANGE: continuous coverage from 0.2 cps to 20 kc, with independent control of high and low cut-off frequencies.

CUT-OFF FREQUENCY ACCURACY: plus or minus 5%.

INSERTION LOSS: zero db plus or minus 1 db in pass band.

ATTENUATION SLOPE: nominal 24 db per octave outside pass band, with peaking circuit to reduce corner-frequency loss.

MAXIMUM ATTENUATION: greater than 80 db.

INPUT IMPEDANCE: approximately 22 megohms plus 20 mmfd.

EXTERNAL LOAD IMPEDANCE: 500 ohms or greater.

HUM AND NOISE: less than 100 microvolts rms.

There's a lot more you should know about the 330-M . . . and about the other Krohn-Hite tunable electronic filters, oscillators, power supplies and amplifiers. In all of them, you'll find the same far-ahead engineering, design and construction. Because K-H instruments *are* good enough even for tomorrow's most critical work, they are increasingly chosen today where true reliability and precision are essential.



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BOOKS



The Sound of High Fidelity

Robert Oakes Jordan, James Cunningham, Windsor Press, 200 E. Ontario St., Chicago 11, Ill., 208 pp, \$3.95.

The first consolidation in one book of information necessary to understand the mechanics of high-fidelity sound and its reproduction has been accomplished.

As the fidelity of reproduced sound has increased over the years, so also has the complexity of the equipment used to achieve that fidelity. "The Sound of High Fidelity" is a handbook and guide to the proper operation and maintenance of such equipment.

The book points out that what began as an obsession on the part of a few electronics experimenters and musicians has now blossomed into a major industry.

A man who has felt the breadth and depth of a symphony orchestra through the medium of a stereophonic high-fidelity system is unlikely to ever again be satisfied with monaural sound reproduction.

The book contains a complete history of sound recording, which is only some 80 years old. Modern sound reproduction equipment is shown as the current solution to problems which the recording engineer has had to face from the beginning.

Going through the components of a high-fidelity system one by one, the authors parade the various devices which have filled the major roles. The reader then has a background that makes the "hows" and "whys" of contemporary de-



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ELECTRONIC DESIGN • October 14, 1957

sign a good deal clearer. Excellent pictures and diagrams are liberally used throughout the book.

Electric Motors and Generators

E. T. G. Emery, F. Harrabin, B. C. Lee, L. H. R. Nixon, E. T. A. Rapson, Philosophical Library, New York, N.Y., 384 pp., \$12.00.

The purpose of this book is to provide understanding for those outside electrical engineering, as well as a useful survey for those professionally interested. Avoiding difficult electrical theory and mathematics as far as possible, it describes all types of dc and ac motors and generators: their design, construction, installation, operation, testing, and maintenance. While the emphasis throughout is on the practical, there is an appendix explaining the fundamentals of electrical theory for the benefit of those whose knowledge of the subject is slight or needs brushing up.

The lucid, easily understandable text has been written by a team of highly qualified authors, including the chief engineers of leading firms in the elec-

trical engineering industry, and university and technical college lecturers. Over 400 illustrations, both diagrammatic and pictorial, add to the value of this comprehensive work.

Alcoa Structural Handbook

Aluminum Co. of America, 789 Alcoa Bldg., Pittsburgh, Pa., 350 pp, Free on request.

"Alcoa Structural Handbook" has been used for a decade or more as a reference in several hundred colleges and universities. It is widely used in trade, vocational, and technical schools of all types.

The current revision involved changes in text, general up-dating of tables, and the addition of several new tables. Extensive data on the aluminum-magnesium alloys, and comprehensive coverage of welded structure design are included in the new handbook.

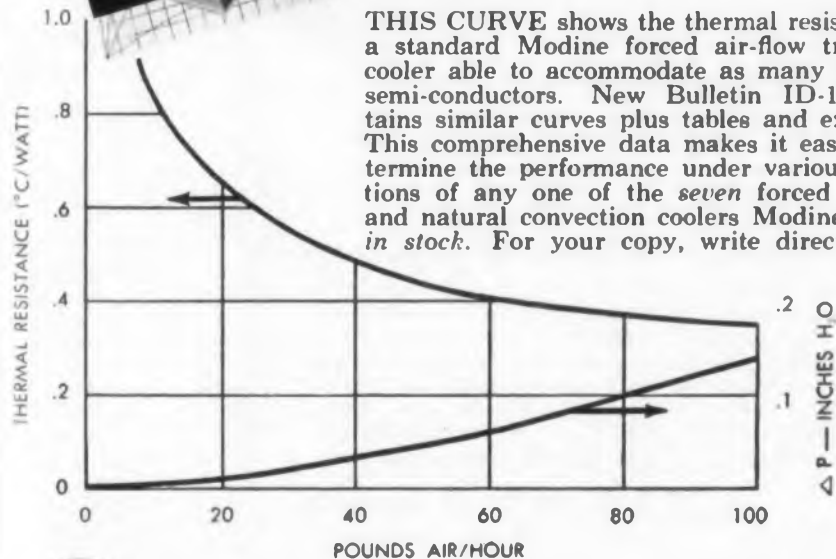
The new edition of "Alcoa Structural Handbook" is available in limited quantity from Alcoa sales offices, or from 789 Alcoa Building, Pittsburgh 19, Pa.

NEW BULLETIN

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TRANSISTOR COOLERS

THIS CURVE shows the thermal resistance of a standard Modine forced air-flow transistor cooler able to accommodate as many as three semi-conductors. New Bulletin ID-159 contains similar curves plus tables and examples. This comprehensive data makes it easy to determine the performance under various conditions of any one of the seven forced air-flow and natural convection coolers Modine carries in stock. For your copy, write direct.



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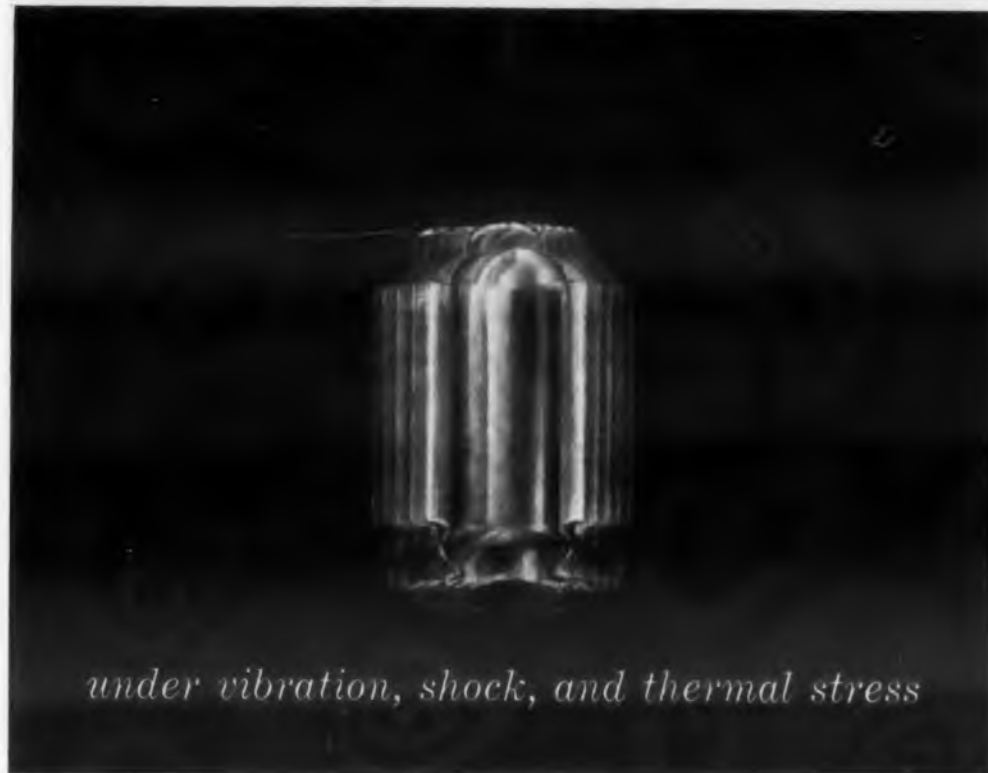
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the TESTS:

- vibration at 500 cps 90 G peak, and at 2,000 cps 65 G peak, for one minute
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- 100 complete cycles of component insertion and withdrawal
- above tests repeated after 15 minutes exposure to temperature of 500°F.

the RESULTS:

- no visible shifting of the component in the holder
- no resonant frequencies developing under vibration
- temperature had no effect on dynamic holding power
- insertion-withdrawals had no effect on dynamic holding power
- force required to dislodge component *increased* during tests

the REASONS:

- severe vibration and shock cause the material of the holder to flex slightly, producing a closer "set" of the holder surfaces to the contours of the held component.

atlee component holders *start out* with a tighter-than-usual grip . . . because of proper contours, construction and materials. As environmental stresses increase, this holding power automatically increases to meet the greater demand . . . because the holders actually mold themselves to the components. Here is an equipment designer's dream come true: the greater the stress, the *greater* the security.

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* Names on request.

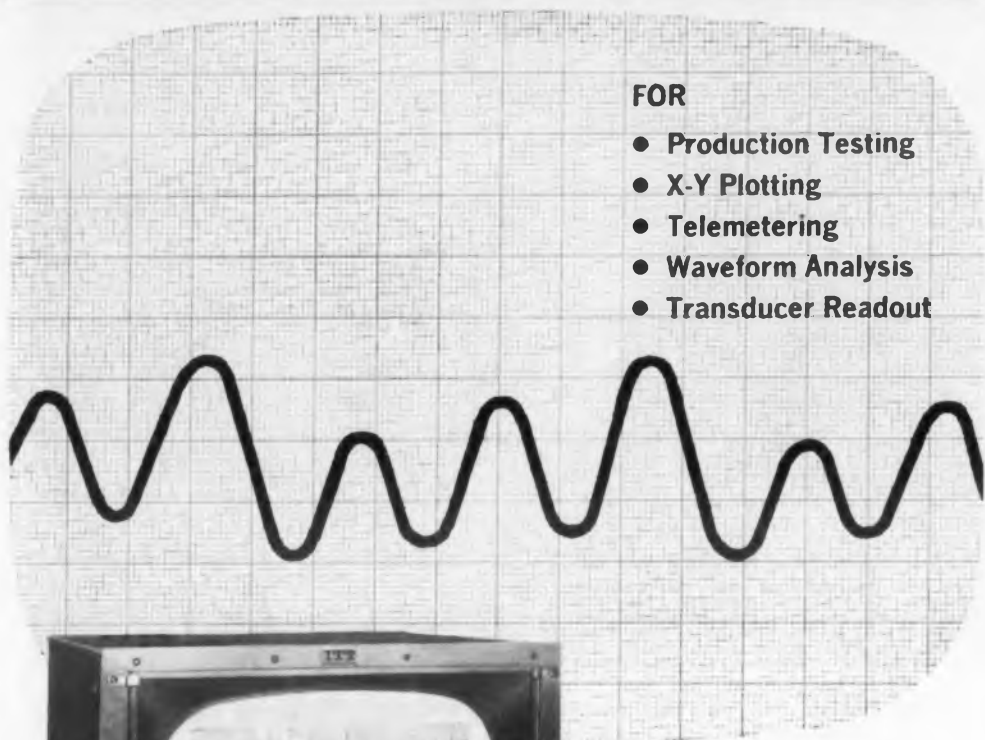
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BRIEF SPECIFICATIONS

Sensitivity:
Models 1735D and 2135D: 10 mv/inch.
Models 1740D and 2140D: 1 mv/inch.
Voltage Calibration:
Attenuators accurate to $\pm 2\%$.
Sweep Speed:
Calibrated from 10 microseconds/inch to 1 second/inch.
Sweep Modes:
Triggered or recurrent.
Linearity:
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BOOKS

Property Measurements at High Temperature

W. D. Kingery, John Wiley and Sons Inc., 440 Fourth Ave., New York 16, N.Y., 416 pp, \$16.50.

This book is intended for the reader who is involved or expects to be involved with the development or application of materials at unusually high temperatures. It concentrates on the factors affecting the properties of materials and their measurement at temperatures above 1400 C. All important high-temperature properties are discussed including heat conduction and radiation, density and thermal expansion, strength, elasticity of solids, viscosity, electrical and magnetic properties, and surface energy.

The author examines the most suitable method for determining each property at high temperatures and provides a basis for comparing various techniques of measurement. He also discusses the reliability and value of the available high-temperature literature.

Graphic Aids to Frequency Response Study of Feedback Control Systems

Boonshaft and Fuchs Inc., Hatboro Industrial Park, Hatboro, Pa., 25 pp, \$5.00.

This new workbook contains a comprehensive set of graphs of linear transfer functions and nonlinear transfer functions and nonlinear describing functions. All graphs have a common scale of 60 db per inch, and 30 degrees per inch is used throughout to permit rapid, accurate reading or replotting. Graph size is 8-1/2" x 11". In addition, 50 transparent Nichols Charts are provided for plotting combinations of the linear terms against which the stability of nonlinear terms may be checked.

The Detection and Measurement of Infrared Radiation

R. A. Smith, F. E. Jones, R. P. Chasmar, Oxford University Press, 417 Fifth Ave., New York 16, N.Y., 458 pp, \$11.20.

After a short introduction on the historical development of infrared tech-

free send for the most widely used

ELECTRONIC SUPPLY GUIDE

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niques, the text deals with the properties and limitations of such thermal detectors as thermopiles and bolometers. A section is devoted to modern photoconductive detectors which use the lead salts PbS, PbTe, PbSe.

The random fluctuations which limit the sensitivity of detectors are then considered, and a comparison of the various types is made. An account is given of the development of infrared spectrometers. The book goes on to discuss electronic techniques used in conjunction with detectors, and also covers the transmission of infrared radiation through the atmosphere.

Forging Product Information

Kaiser Aluminum and Chemical Sales, Inc., Kaiser Center, Oakland 12, Calif., 322 pp.

This forging book is designed to provide the reader with the advantages of both a textbook and a manual. For example, the production of a typical aluminum forging is traced and described in detail from original design, sinking of the

die, progressive forging steps, finishing and through final inspection.

Numerous helpful tables are distributed throughout the text for easy reference. Also, an extensive engineering section is included in the book and gives additional tabular material and data in graph form. An extensive glossary of forging terms is included.

Radar Meteorology

Louis J. Battan, University of Chicago Press, Chicago 37, Ill., 161 pp, \$6.00.

Research in radar by meteorologists, physicists, and engineers has proceeded rapidly since World War II. The resulting literature, however, is scattered in journals and out-of-print conference reports. Here are the advances of the last fifteen years summed up and systematized for the first time in book form.

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Using a Directional Coupler to Measure Impedance

A. I. Zykov

A DIRECTIONAL coupler with a matched load in one of the arms of the secondary waveguide is used to find the modulus of the reflection coefficient ρ in the main waveguide at microwave frequencies. The modulus is calculated from the measured values of the ratio of the signal amplitudes in opposite branches of the coupler (cf., Southworth, G. C., Principles and Applications of Waveguide Transmission). However, in this procedure it is impossible to measure the reflection phase or small values of ρ , since square-law sensing is used, making the signal ratio equal to ρ^2 . At low values of ρ it is necessary to use a wide-range indicator.

A directional coupler with a shorting plunger in the load waveguide is free of these shortcomings. The wave propagating towards the indicator (Fig. 1) may be expressed as:

$$\bar{E} = \frac{\bar{\tau}_1 (1 - \bar{\rho} \epsilon^{-j2\beta l}) + \bar{\tau}_2 (\bar{\rho} - \epsilon^{-j2\beta l})}{1 + \bar{\rho}_i \epsilon^{-j2\beta l}} \quad (1)$$

where

$\bar{\tau}_1 = \tau_1 \epsilon^{-j\varphi_1}$ = transfer factor of coupler in the forward direction

$\bar{\tau}_2 = \tau_2 \epsilon^{-j\varphi_2}$ = transfer factor of coupler in the backward direction

$\bar{\rho} = \rho \epsilon^{-j\varphi}$ = reflection coefficient in the main waveguide

$\bar{\rho}_i = \rho_i \epsilon^{-j\varphi_i}$ = reflection coefficient in the main indicator

λ_2 = wavelength in the secondary waveguide

l = distance from the short-circuit plane to the boundary plane of the waveguide

$$\beta = 2\pi/\lambda_2$$

If the coupler is ideal and the indicator is matched ($\bar{\tau}_2 = 0$, $\bar{\rho}_i = 0$), we get

$$E^2 = \tau_1^2 [1 - 2\rho \cos(2\beta l + \varphi) + \rho^2] \quad (2)$$

It follows from (2) that the ratio of the maximum and minimum readings of the indicator, measured as the reflecting piston is displaced, is $\frac{1+\rho}{1-\rho}$, i.e., it equals the vswr in the main waveguide. Consequently, the vswr region closest to unity becomes more manageable when a coupler with a short-circuiting plunger is used.

For example, if ρ is measured directly using a coupler with load matched to the secondary waveguide, it becomes necessary to measure signals with a ratio of 4 to 10,000 if the vswr is 1.04,

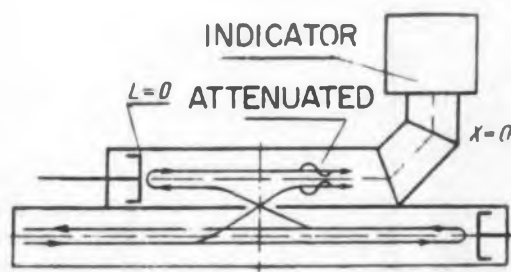


Fig. 1. Directional coupler with shorting plunger.

whereas a coupler with reflecting plunger is usable with a ratio $1.04^2 = 1.08$, which can be done more accurately. Such a directional coupler can also be used to measure the phase of the wave relative to a selected reference plane in the main waveguide.

Let the plane $X=0$ (Fig. 2) be chosen as the reference, and let $L=0$ be the corresponding plane in the waveguide of the coupler. If the plunger is placed in this plane, the indicator will read zero. The following relation exists between the displace-

ment of the piston in the coupler waveguide relative to the plane $L=0$ so as to set the indicator at a minimum when the main waveguide is adjusted for a reflection $\bar{\rho} = \rho \epsilon^{-j\varphi}$, and the displacement of the minimum of the electric field in the main waveguide relative to the plane $X=0$:

$$\Delta X = \frac{\lambda_1}{\lambda_2} \Delta L \quad (3)$$

where

λ_1 — wavelength in the main waveguide
 λ_2 — wavelength in the coupler waveguide

The directional coupler with short-circuiting

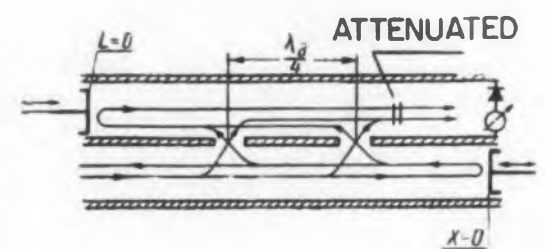


Fig. 2. Reference planes in directional coupler.

plunger, in contrast to the ordinary slotted-line type, is free of the errors due to the inconstancy of the insertion of the probe along the line, and slight skewing of the plunger does not change the amount of reflection.

Measurement Errors

Since real couplers have finite directivity, ($\bar{\tau}_2 \neq 0$) and the indicator may not be perfectly matched ($\bar{\rho}_i \neq 0$), errors are introduced in the

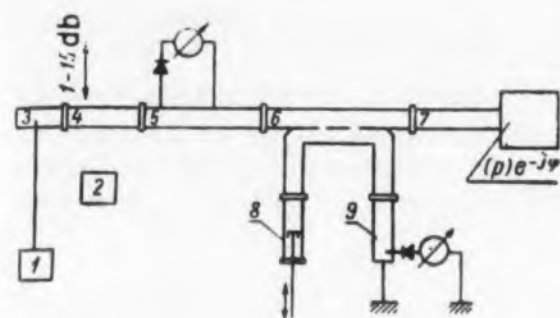


Fig. 3. Comparative measurement of total impedance, using directional coupler with shorting plunger and slotted line.

measurement of the total impedance. These errors can be estimated by using Eq. (1).

We obtain from (1)

$$E^2 = \frac{K - 2(B \cos 2\beta l - C \sin 2\beta l)}{1 + 2\rho_i \cos(2\beta l + \varphi_i) + \rho_i^2} \quad (4)$$

where

$$\begin{aligned} K &= 1 + \rho^2 + A^2 + \rho^2 A^2 + 4\rho A \cos \varphi \cos \alpha \\ B &= \rho(1 + A^2) \cos \varphi + A(1 + \rho^2) \cos \alpha \\ C &= \rho(1 - A^2) \sin \varphi + A(1 - \rho^2) \sin \alpha \end{aligned} \quad (5)$$

By equating the derivative $d(E)^2/dt$ to zero, we obtain the extreme values of the displacement l :

$$M \sin 2\beta l_{ext} + N \cos 2\beta l_{ext} = D \quad (6)$$

where

$$\begin{aligned} M &= B(1 + \rho_i^2) + K\rho_i \cos \varphi_i \\ N &= C(1 + \rho_i^2) + K\rho_i \sin \varphi_i \\ D &= 2\rho_i(B \sin \varphi_i - C \cos \varphi_i) \end{aligned} \quad (7)$$

We obtain from (6)

$$\begin{aligned} \cos 2\beta l_{max} &= \frac{ND - M\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2} \\ \cos 2\beta l_{min} &= \frac{ND + M\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2} \\ \sin 2\beta l_{max} &= \frac{MD + N\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2} \\ \sin 2\beta l_{min} &= \frac{MD - N\sqrt{M^2 + N^2 - D^2}}{M^2 + N^2} \end{aligned} \quad (8)$$

Inserting (8) into (4) we obtain an expression for the square of the ratio of the amplitudes of the maximum and minimum signals received by the indicator:

$$\begin{aligned} \left(\frac{E_{max}}{E_{min}}\right)^2 &= \frac{1 + \frac{2(BM + CN)}{K\sqrt{M^2 + N^2 - D^2}}}{1 - \frac{2(BM + CN)}{K\sqrt{M^2 + N^2 - D^2}}} \times \\ &= \frac{1 + \frac{2\rho_i}{(1 + \rho_i^2)} \cdot \frac{M \cos \varphi_i + N \sin \varphi_i}{\sqrt{M^2 + N^2 - D^2}}}{1 - \frac{2\rho_i}{(1 + \rho_i^2)} \cdot \frac{M \cos \varphi_i + N \sin \varphi_i}{\sqrt{M^2 + N^2 - D^2}}} \end{aligned} \quad (9)$$

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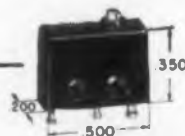
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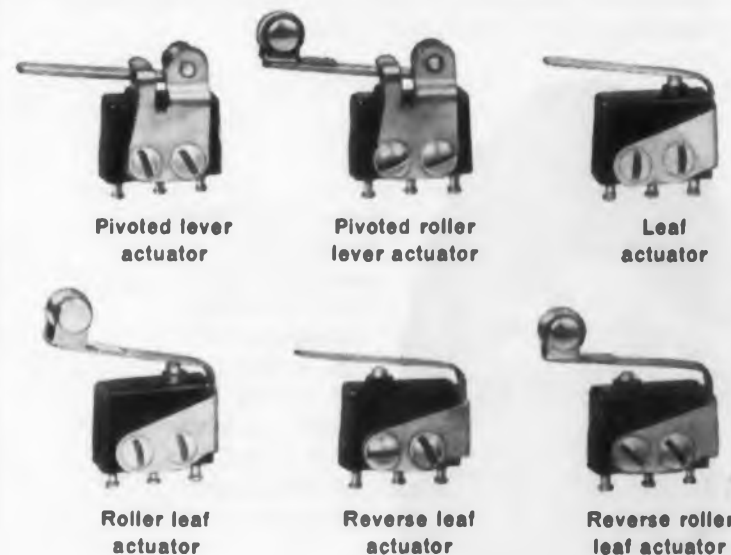
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RUSSIAN TRANSLATIONS

In the general case, when $\rho_i \neq 0$ and $A \neq 0$, Eq. (9) is quite cumbersome. It can be used to obtain the maximum possible error in the measurement of the vswr, which occurs when $\psi = \alpha = \varphi_i = 0$. In this case

$$\frac{E_{max}}{E_{min}} = \frac{1 + \rho}{1 - \rho} \cdot \frac{1 + A}{1 - A} \cdot \frac{1 + \rho_i}{1 - \rho_i} = \kappa \kappa_{coup} \kappa_i$$

where

- κ = vswr in the main waveguide
- κ_i = vswr of the indicator
- κ_{coup} = vswr due to the finite directivity of the coupler, measured with the load in the

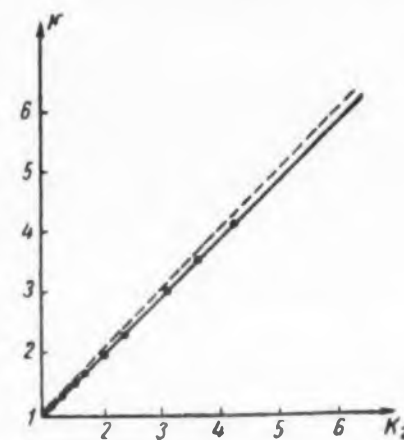


Fig. 4. Comparison of vswr values obtained by the two methods.

main waveguide and the indicator matched.

The maximum possible error in the measurement of the vswr in the main waveguide is

$$\delta \kappa_{max} = \left(\frac{\kappa \kappa_{coup} \kappa_i - \kappa}{\kappa} \right) \cdot 100\% = (\kappa_{coup} \kappa_i - 1) 100\% \quad (10)$$

It must be noted that for equal mismatch of the indicator and load, the maximum measurement error in this method is the same as that produced when an absorbing load is used.

When measuring the ratio of the signal amplitudes in opposite arms of the coupler, the maximum error in the vswr is

$$\delta \kappa_{max} = \left[\frac{1 + \frac{\rho \tau_1 + \tau_2 + \rho_L (\tau_1 + \rho \tau_2)}{\tau_1 + \rho \tau_2 + \rho_L (\rho \tau_1 + \tau_2)}}{1 - \frac{\rho \tau_1 + \tau_2 + \rho_L (\tau_1 + \rho \tau_2)}{\tau_1 + \rho \tau_2 + \rho_L (\rho \tau_1 + \tau_2)}} \cdot \frac{1 - \rho}{1 + \rho} - 1 \right] \quad (11)$$

$$\cdot 100\% = \left(\frac{1 + A}{1 - A} \cdot \frac{1 + \rho_L}{1 - \rho_L} - 1 \right) \cdot 100\% = (\kappa_{coup} \kappa_i - 1) \cdot 100\%$$

That is, it is the same as given by Eq. (10) if $\kappa_i = \kappa$. Both methods are equivalent in the magnitude of the errors.

We obtain from (8)

$$2\beta (l_{min} - l_{max}) = \cos^{-1} \left[\frac{2D^2}{M^2 + N^2} - 1 \right] \quad (12)$$

from which it follows that if the indicator is mismatched, the distance between the extreme positions of the plunger does not equal one-quarter of the wavelength. This can be used to check the matching of the indicator during the course of the measurements.

If a narrow-band indicator is available, the situation can be improved by using a decoupling attenuator, since the power level at the indicator is much higher than that used in measurements of the reflected power. If $\bar{\rho}_i = 0$ and $A \ll \epsilon$ the

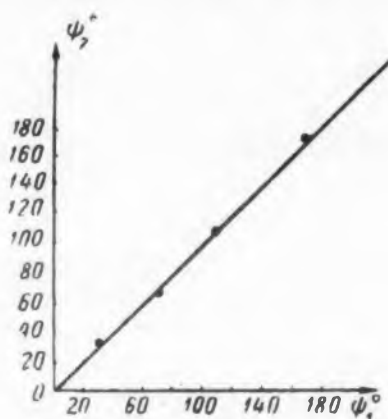


Fig. 5. Comparison of phase angles obtained by the two methods.

error in the measurement of the phase of the reflected wave is

$$\delta\varphi_{max} \approx \left[\frac{\cos^{-1} \left[\left(H \frac{A}{\rho} \right) \cos \varphi + \frac{A}{\rho} \right] - \varphi}{\varphi} \right] \cdot 100\% \quad (13)$$

Measurement Results

Fig. 3 shows the setup for comparative measurement of total impedance with the aid of a coupler with short-circuiting plunger and measuring line.

The directivity of the coupler was 40 db at $\lambda_0 = 10.7$ cm. Measurements were made in continuous operation.

Figs. 4 and 5 show plots of κ_1 vs. κ_2 and ψ_1 vs. ψ_2 , where κ_1 and ψ_1 are the vswr and phase of the reflected wave, respectively, as determined by the coupler with the shorting plunger, while κ_2 and ψ_2 are the corresponding quantities measured with the slotted line. The indicator vswr was 1.02. The difference between κ_1 and κ_2 does not exceed 3 per cent; the phase error is even less.

This was translated from the Soviet Journal Measurement Engineering, No. 3, March, 1959, pp. 44 to 46.

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Gain-Control Transistor

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$$\begin{aligned} v_1 &= h_{11}i_1 + h_{12}v_2 \\ i_2 &= h_{21}i_1 + h_{22}v_2 \end{aligned}$$

the parameter h_{21} , in the common emitter configuration for collector voltage above the "knee" value, is a function of base current as shown in Fig. 1. Below the knee voltage, h_{21} is a function of collector-emitter voltage at constant base current as shown in Fig. 2.

The basic controlled-transistor circuit is shown in Fig. 3. Three control possibilities exist, depending on the choice of parameter values. In the region of low base currents, $I_C R_3 \ll E_{batt}$, $V_c > V_{knee}$ and the control signal controls the base current. For small collector voltages, R_3 is chosen so that

$$V_{batt} - I_C R_3 < V_{knee}$$

and the control signal varies the base bias current changing both collector current and voltage. For large base current, the ratio R_1/R_2 is smaller than in the preceding case and R_3 is chosen so that V_c is below the knee value.

Fig. 1. Variation of h_{21} with base current. The curve for base currents gives maximum h_{21} cannot be used for all transistor types since the curve may be too flat.

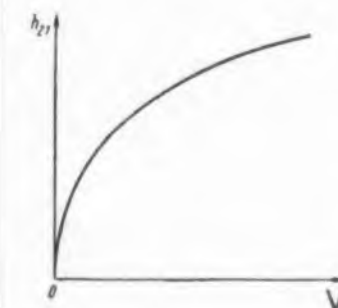
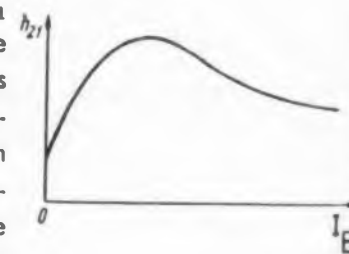


Fig. 2. Variation of h_{21} with collector-emitter voltage at constant base current.

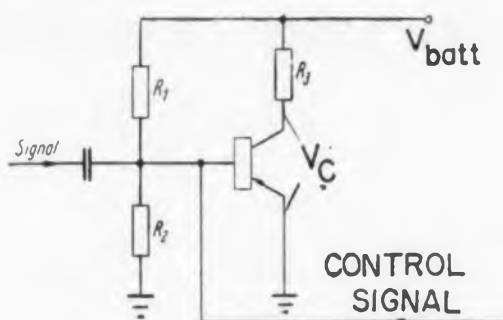


Fig. 3. Basic controlled transistor.

Several applications as well as the variation of other transistor parameters are discussed in the original paper.

Abstracted from an article by L. Steinke, Nachrichtentechnik, Vol. 9, No. 6, June 1959, pp 261-264.

Speech Reception In The Presence of Noise

IT IS GENERALLY known that the intelligibility of speech which is received in the presence of noise can be enhanced by emphasis of the high frequency components. The quantitative results cited below apply when the noise is caused by a combination of sources in the transmission channel or at the receiving end.

A series of measurements shows that the intelligibility of syllables is increased on the average of 37 per cent when the frequency response of the amplifier is nonuniform so that the gain at 4000 cps is 15 db above the gain at 200 cps. The improvement depends on the noise level at the receiving end and on the degree of volume increase. At fixed receiver noise level, high frequency emphasis of 10, 15 and 20 db result in improvement of syllable intelligibility of 27, 30 and 37 per cent respectively. At constant receiver sound level, the corresponding improvement was 4, 14 and 23 per cent.

Detailed experimental procedures and results are cited in the original paper.

Abstracted from an article by O. Brosze, K. O. Schmidt and A. Schmoldt, Nachrichtentechnische Zeitschrift, Vol. 12, No. 6, June 1959, pp 297-300.

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REPORT BRIEFS

Sandwich-Wire Antenna Design

A new microwave line source configuration consists basically of three continuous coplanar conductors. The two outer conductors, parallel to each other, are at ground potential; the excited center conductor is bent into sinusoidal form, with a period (for broadside radiation) equal to the wavelength. The polarization is transverse to the length of the array. Modifications of the basic design include a printed-circuit (metal on dielectric) two-dimensional array fed by a corporate structure feed. Design data, including attenuation and phase characteristics, are given for a flat-plate S-band model. An array to fit a cylindrical surface is discussed. These structures are mechanically simple, have good impedance characteristics, and allow good control over aperture illumination. *Sandwich-Wire Antenna Design, Walter Rotman and Nicholas Karas, Air Force Cambridge Research Center, Bedford, Mass., Dec. 1958, 34 pp. Microfilm \$3.00, Photocopy \$6.30, Order PB 140157 from Library of Congress, Washington 25, D.C.*

Two-Megawatt Magnetic Modulator

A practical design for a two-megawatt magnetic modulator is discussed, and a description of the model constructed and experimental results are given. Substantial agreement between predicted and experimental results is obtained for linear resistive load operation with and without a pulse transformer, and with a pulse-forming network. *A Two-Megawatt Magnetic Modulator, Joseph Antin, Microwave Research Institute, Polytechnic Institute of Brooklyn, N.Y., Feb. 1957, 65 pp. Microfilm \$3.90, Photocopy \$10.80. Order PB 136689 from Library of Congress, Washington 25, D.C.*

Traveling-Wave Amplifiers

The characteristics of traveling-wave amplifiers under large-signal conditions are discussed briefly. The large-signal equations, which were derived taking into account large values of the gain parameter C and the effects of ac space charge and series loss along the helix, are presented. The large-signal equations are valid with reasonable approximations for all values of the operating parameters which are encountered in typical large-signal tubes. The solution of the equations is also briefly discussed. *Large-Signal Traveling-Wave Amplifiers, Joseph E. Rowe, Electron Tube Laboratory, University of Michigan, Ann Arbor, Dec. 1956, 35 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 135511 from Library of Congress, Washington 25, D.C.*

Microwave Instrumentation

New or improved techniques of microwave measurements were investigated through the use of the special properties of ferrite materials. Consideration was given to possible techniques by which variation in ferrite properties can be used with suitable waveguide geometry to give a variable directional coupler. Such a device can, in addition to performing its primary function, act as a variable power divider, a variable attenuator, and by the addition of a ferrite phase shifter, a variable impedance. Various circulator circuits were also considered. The waveguide devices employing ferrites in a coupling region have potential application to broadband variable directional couplers, attenuators, power dividers, circulators, and electronically tuned matching elements. Further work is needed to obtain optimum broadbanding by appropriate changes of geometry or dielectric loading in the coupling region. The investigation of coaxial ferrite devices indicated the possibility of a broadband coaxial gyrator utilizing a mode which propagates down to dc. Variations of this basic scheme utilizing metallic fin loading and non-magnetic dielectric loading were studied and promising theoretical results obtained. In the case of rectangular guide elements, experimental verifications of some of the theoretical analysis was obtained but no complete experimental study was undertaken to exploit the analysis fully. *Application of Ferrite Materials to Microwave Instrumentation*, Max Sucher, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Apr. 1957, 65 pp, Microfilm \$3.90, Photocopy \$10.80. Order PB 130036 from Library of Congress, Washington 25, D. C.

Electron Beams

Part I concerns the investigation of a space-charge-balanced flow, a generalized method of constraining an electron beam intended for use in beam-type tubes (klystrons and traveling-wave tubes) with axial symmetry in the presence of an axial magnetic field. In Part II, an investigation of the problem of controlling and modulating high-intensity electron beams of the sort employed in high-power microwave tubes is described. In Part III activity is reported on a theoretical and experimental investigation of the properties of certain gaseous devices, particularly with regard to the plasma of an arc as a source of electrons for cross-field tubes at extremely high power. *Production and Control of Electron Beams*, D. H. Sloan and Charles Susskind, Electronics Research Laboratory, University of California, Berkeley, June, 1958, 87 pp, Microfilm \$4.80, Photocopy \$13.80. Order PB 135875 from Library of Congress, Washington 25, D.C.

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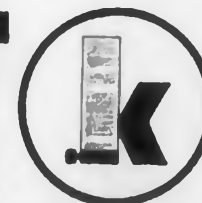
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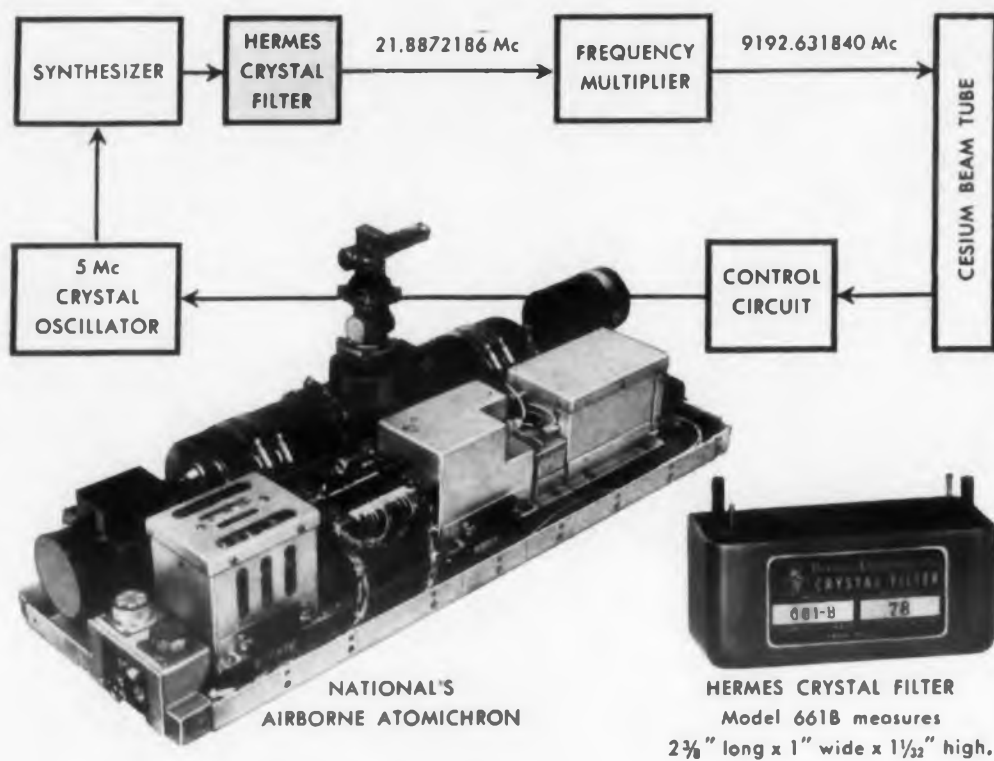
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REPORT BRIEFS

Signal Summing With Electrolytic Capacitors

A method is described for obtaining the algebraic sum of several low-voltage dc signals. The apparatus consists of a polarized electrolytic capacitor and a double-pole double-throw switch for each signal entering the summation. In one position of the synchronized switches each capacitor is charged while in the other position of the switches the capacitors are connected in series for the summation. *Signal Summing With Electrolytic Capacitors*, C. C. Minter, Naval Research Laboratory, Washington, D. C., Apr. 1959, 8 pp, Microfilm \$1.80, Photocopy \$1.80. Order PB 138795 from Library of Congress, Washington 25, D. C.

Steady State Transmission

The purpose of this paper is to present a new method of steady state analysis of a linear network of arbitrary degree of complexity, containing a single periodically varying element. The proposed method makes full use of circuit theory ideas, such as impedance matching and tearing apart, and of iterating techniques which are particularly suitable for automatic computation. The proposed method has the additional feature of leading to the amplitude and phase of all side bands and of giving a bound on the error if the iterations are stopped at any particular point. *Steady State Transmission Through a Network Containing a Single Time Varying Element*, C. A. Desoer, Electronics Research Laboratory, University of California, Berkeley, Dec. 22, 1958, 34 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 139993 from Library of Congress, Washington 25, D. C.

Nonlinear Differentiating Filters

An unconventional method of differentiating a non-stationary electrical signal in the presence of noise is described. The input to a certain passive electrical network is assumed to consist of a signal voltage, having a finite discontinuity at zero time, mixed with a perturbing noise voltage. The electrical network serves the dual purpose of filtering out as much of the noise as possible, and providing in its output the exact value of the time derivative of the input signal in the shortest possible time. In this sense, then, the network shall be called a "differentiating filter." *Nonlinear Differentiating Filters*, George R. Cooper and Jack E. Kemmerly, Purdue University, School of Electrical Engineering, Lafayette, Ind., Feb. 1956-May 1958, 85 pp, Microfilm \$4.80, Photocopy \$13.80. Order PB 137675 from Library of Congress, Washington 25, D. C.

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REPORT BRIEFS

Paramagnetic Maser

A cavity maser has been successfully operated with the *c* crystal axis of the ruby oriented at 82 and 24 deg relative to the dc magnetic field. The amplifier operates at 2600 mc with an X-band pump. Several slow-wave structures for traveling-wave masers have been designed and constructed. These include inter-digital line and comb structures. A completely filled cavity structure is also being fabricated to study its bandwidth capabilities. *Research and Development of a Solid State Paramagnetic Maser, Perry H. Vartanian, Microwave Engineering Laboratories, Inc., Palo Alto, Calif., Jan. 1959, 21 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 140405 from Library of Congress, Washington 25, D. C.*

400-cps Power Supply

A variable voltage, 400-cps power supply has been designed and fabricated for use in the laboratory. The design is electronic in nature. Output from a 400-cps oscillator stage, after amplification in a push-pull voltage amplifier, is fed into a pair of 807 power amplifier tubes. The attainable output voltage is continuously adjustable from 75 to 150 v. Approximately 30 w of output power is available at 115 v terminal voltage; 65 w power output can be attained if the series voltage-control tube is not used. Modifications are suggested to convert the basic unit into a three-phase, symmetrical or non-symmetrical power supply. Regulation of the output voltage can easily be added if desired. *Electronic 400-cycle Power Supply, Loren E. Bollinger, Ohio State University Research Foundation, Columbus, Feb. 1955, 50 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 140575 from Library of Congress, Washington 25, D. C.*

The Corner Array

An antenna has been designed and built which consists of an array located at the bisector of two intersecting conducting planes. The fields existing in such an antenna have been determined by ray tracing and by images. The advantages of using an array rather than a single element with a corner reflector are discussed. The results of an experimental verification are given, showing a 13 degree wide beam from a 60 degree beamwidth from a 30 degree corner array. *The Corner Array, Allan C. Shell, Air Force Cambridge Research Center, Bedford, Mass., Jan. 1959, 31 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 140637 from Library of Congress, Washington 25, D. C.*

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REPORT BRIEFS

Low-Energy Pulse-Measuring Device

The "Thermergistor" is a device that can reliably measure energy pulses ranging from 10 to 200,000 ergs in electrical circuits. The output of this thermistor-heater assembly is linear and repeatable within 5%. It has been used for developing and testing firing circuits, evaluating firing-circuit components, and investigating undesirable electromagnetic coupling between circuits. A low-impedance Thermergistor is constructed by non-inductively winding a short length of resistance wire about a thermistor; a high impedance Thermergistor, by embedding a thermistor in a composition resistor. *The Thermergistor: A Low-Energy Pulse-Measuring Device*, J. C. Chambers and G. R. Bastedo, Naval Ordnance Laboratory, Apr. 1959, 11 pp, \$0.50. Order PB 151686 from OTS, Washington 25, D. C.

Resistor-Transmission-Line Networks

The purpose of this study is to summarize and extend available techniques of distributed-parameter network synthesis. The applicability of lumped-parameter techniques to this problem is demonstrated, as is the utility of several techniques which are peculiar to the distributed case. Additionally, those lumped-parameters synthesis techniques which avoid the use of mutual coupling by the parallel connection of networks are found to be much more powerful when applied to the distributed network problem. *Synthesis of Resistor-Transmission-Line Networks*, N. R. Welsh and E. S. Kuh, Electronics Research Laboratory, University of California, Berkeley, July 1958, 60 pp, Microfilm \$3.60, Photocopy \$9.30. Order PB 140396 from Library of Congress, Washington 25, D. C.

Transistor Crystal Oscillator

The analytical approach presented in this report is based upon the power relationships in feedback oscillators and has been simplified considerably by graphical techniques. Step-by-step design data sheets are given for four common circuits and are followed by six specific design examples. The report includes methods for prediction of output power and voltage and for the design of the feedback network. Sections are included on frequency and frequency stability, crystal characteristics, transistor considerations, and high-frequency experimental work. *Transistor Crystal Oscillator Circuitry*, W. McSpadden, R. J. Shedko, and T. G. Evans, Motorola, Inc., Phoenix, Ariz., Aug. 1957, 157 pp, Microfilm \$7.50, Photocopy \$24.30. Order PB 139070 from Library of Congress, Washington 25, D. C.

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Digital Communication Systems

The work under this contract on the evaluation and comparison of digital communication systems is summarized, and a number of suggestions presented for improving the performance of such systems in the presence of interference and propagation anomalies. In particular, the theories of null-zone reception and communication feedback are emphasized, and certain coding concepts are considered. A critical review of work to date is included, and a number of promising areas for future investigation are outlined. *Evaluation and Optimization of Digital Communication Systems*, S. S. L. Chang, B. Harris and others, New York University, College of Engineering, N.Y., Jan.-June 1958, 100 pp, Microfilm \$5.40, Photocopy \$15.30. Order PB 138488 from Library of Congress, Washington 25, D. C.

Input Adaptive Systems

This work presents a theory for the design of input adaptive control systems. It is assumed that error-free measurement of the system input and the system behavior is permitted, but only limited changes in the system characteristics can be affected by the control variables at the designer's disposal. It is shown that within this limitation for a wide class of inputs and systems and for a certain class of measures of the system performance, an optional adaptive system behaves as a relay or switched system during periods in which the input is reproduced identically. *Theory and Design of Input Adaptive Systems*, Herbert L. Groginsky, Electronics Research Laboratories, Columbia University, New York, N.Y., Sept. 1958, 139 pp, Microfilm \$2.40, Photocopy \$21.30. Order PB 140539 from Library of Congress, Washington 25, D. C.

Transistor Amplifier

A three-terminal transformerless unilateralized common-collector amplifier is described. The device has an active feedback path and uses two complementary type transistors in hook connection. Very high input impedances, up to $r_m/2$, and very low output impedances, from $r_e+r_b/2$ to $r_e+r_b(1-\alpha)$, may be realized. Various compensating circuits for low and high audio frequencies are described; means to reduce the dependence of the compensation upon bias point and temperature are discussed. Extensive experimental verifications are included. *Unilateralized Common Collector Transistor Amplifier*, L. M. Vallese, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Oct. 1957, 28 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 136671 from Library of Congress, Washington 25, D. C.



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CIRCLE 917 ON CAREER INQUIRY FORM, PAGE 239

REPORT BRIEFS

Network Realizability Theory

A general theory of network realizability for linear, passive, time-invariant networks is presented from the point of view of energy conservation and causality. It is shown that four postulates defining the physical nature of a network suffice to give all the analytic properties of the network scattering matrix. These analytic properties define a bounded real scattering matrix, the possession of which is necessary and sufficient for an n -port network to satisfy physical realizability as stated by the given set of postulates. A theorem concerning the necessary and sufficient conditions for the existence of a Faltung-representation is proved and its implications discussed. *Network Realizability Theory and its Application to the Synthesis of Distributed Parameter Matching Network*, L. J. Castriota and H. J. Carlin, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., May 1958, 91 pp, Microfilm \$5.40, Photocopy \$15.30. Order PB 135866 from Library of Congress, Washington 25, D. C.

Drift Transistor

For a vacuum-tube amplifier, high frequency compensation using an infinite LC ladder with identical elements yields maximally-flat amplitude response. The same type of compensation is investigated in connection with a drift transistor. The design criterion for maximally-flat amplitude response is derived. In a numerical example applied to the 2N247 transistor, the amplitude response develops a 10.3 db peak immediately above the nominal cutoff frequency of the ladder, although considerable improvement in bandwidth is obtained. The time delay response also undergoes violent fluctuations. The conclusion is that the identical-element ladder is poor compensation for a drift transistor. Instead, given a desired frequency response it should be possible to synthesize an infinite RLC ladder of non-identical elements. *High Frequency Compensation of a Drift Transistor*, Sid Deutsch, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., Jan. 1959, 22 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 139949 from Library of Congress, Washington 25, D. C.

Parametric Amplification

Parametric amplifiers employing semiconductor junction diodes as nonlinear capacitors have been studied theoretically and experimentally. The theoretical analysis is based upon the principle of harmonic balance and leads to rapidly convergent series representations for the important circuit variables. This approach has the advantage of



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simplicity of application and is probably a more reasonable approximation to the actual physical situation than the conventional calculation based upon Mathieu's or Hill's equation. Parametric amplifiers were constructed at frequencies of 13 kc and 1.14 mc in order to check the theoretical calculations. A bridge circuit was used in some instances to provide improved isolation of the signal and pumping circuits. *Study of Parametric Amplification*, E. E. Bell and Y. P. Vaddiparty, Ohio State University, Research Foundation, Columbus, Ohio, Nov. 1958, 25 pp, Microfilm \$2.70, Photocopy \$4.80. Order PB 140143 from Library of Congress, Washington 25, D. C.

Traveling-Wave Tube, I

This is a final report on the development of an electron tube designated as a low-noise, SHF-band, traveling-wave tube. The electrical specifications included a noise figure less than 13 db and a gain greater than 18 db with less than 5 db variation over the frequency band of 7.5 kmc to 11.3 kmc. The tube developed used a helix for the slow-wave circuit, cavity couplers, coupled helix attenuators, and a three region gun for noise reduction. A program was outlined for the construction of as many of these tubes as possible, each with a modification so as to empirically determine the best design for a broadband low-noise tube. By proper design it was possible to obtain tube noise figures as low as 8.4 db and less than 10.6 db over the band. *Low Noise, SHF Band Traveling-Wave Tube*, Frederick B. Fank and Frederick M. Schumacher, General Electric Microwave Laboratory, Palo Alto, Calif., Dec. 1956, 42 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 140549 from Library of Congress, Washington 25, D. C.

Traveling-Wave Tube, II

Investigations indicate that a transverse current TWT is superior to the longitudinal TWT as far as the minimum obtainable noise figure is concerned. Workable tube structures may be difficult to achieve to realize the theoretical advantages. The transverse-field, transverse-current SHF traveling-wave tube is a promising device, even though it would possess operating characteristics quite different from those of existing tubes. A discussion of the work accomplished and preliminary results obtained are given in this report. *Low Noise, SHF Band Traveling-Wave Tube*, Howard H. C. Chang and Michael J. Ozeroff, General Electric Microwave Laboratory, Palo Alto, Calif., July 1957, 14 pp, Microfilm \$2.40, Photocopy \$3.30. Order PB 140550 from Library of Congress, Washington 25, D. C.



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tional cable locking produced by a cable accessory designed to accommodate a Kellems stainless steel wire strain relief grip. • Prevention of inadvertent loosening insured by a left-hand accessory thread. • The high current capacity and low voltage drop of high-grade copper alloy contacts. Contact sizes 16 and 12 are closed entry design.

These are a few of the reasons it will pay you to specify the Bendix QWL electrical connector for the job that requires exceptional performance over long periods of time. *TRADEMARK

Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec. Factory Branch Offices: Burbank, Calif.; Orlando, Florida; Chicago, Ill.; Teaneck, New Jersey; Dallas, Texas; Seattle, Washington; Washington, D. C.

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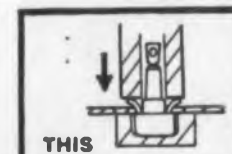
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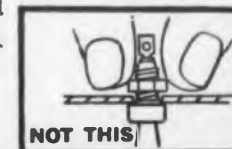
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#110BCSI — Fastens securely by nut. In Nylon or Kel-f. Resilient beryllium copper contact, silver-plated. A standard for many applications.



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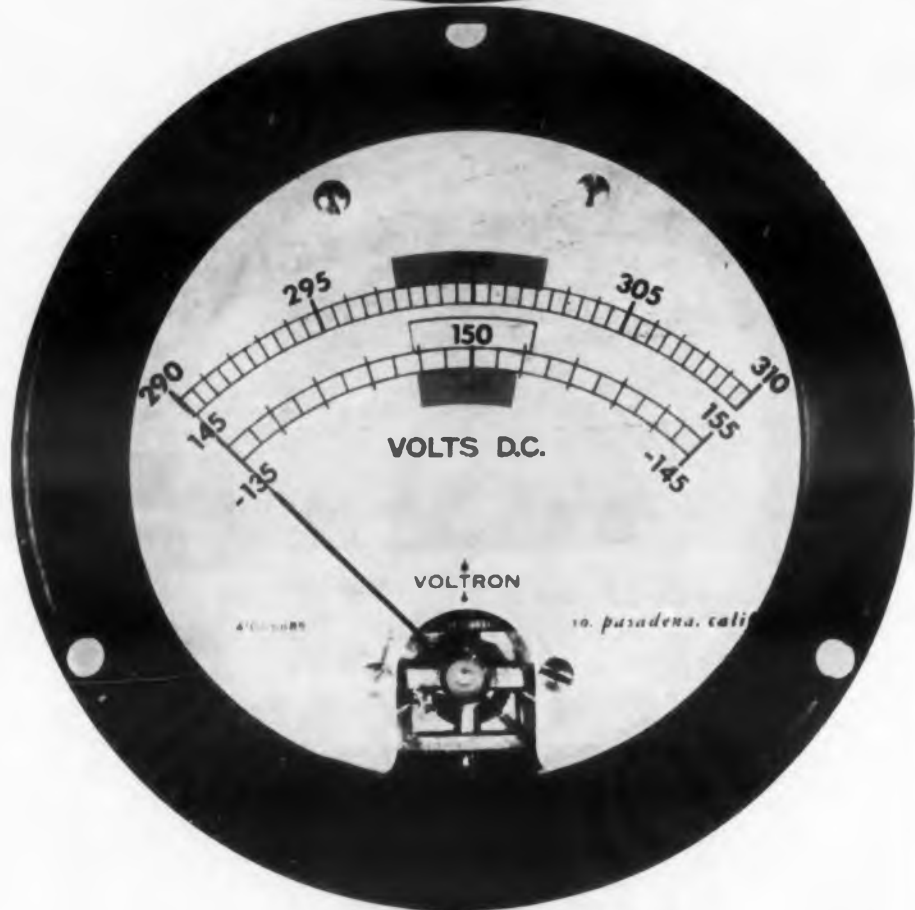
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STANDARDS AND SPECS

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Switch Boots

MIL-B-19257(SHIPS), BOOTS, DUST AND MOISTURE SEAL, WATERTIGHT, THREADED BUSHING MOUNTED SWITCH, AMENDMENT 4, 10 APRIL 1959

The six illustrations of the different types of boots have been revised.

Identification Plates

MIL-P-15024B(SHIPS), INFORMATION AND MARKING FOR IDENTIFICATION OF ELECTRICAL, ELECTRONIC AND MECHANICAL EQUIPMENT IDENTIFICATION PLATES, AMENDMENT 5, 5 MAY 1959

No significant change has been made to that portion of the spec dealing with electrical and electronic equipment.

Enclosures

MIL-E-2036C(NAVY), NAVAL SHIPBOARD ENCLOSURES FOR ELECTRIC AND ELECTRONIC EQUIPMENT, AMENDMENT 1, 17 APRIL 1959

Spot facing requirement has been clarified to establish that it is required for accommodating washers and mounting bolts. It is now required to provide access for the replacement of repair parts from the front of the enclosure without disassembly of the cabinet or removal of any permanently mounted subassembly or part. The requirements for dripproof and watertight enclosures have been drastically changed.

Insulation Materials

Current NEMA, AIEE, ASTM, MIL and FED standards and specs on electrical insulating materials are listed in a pamphlet released by the Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago, Ill.

Engineering Drawings

MIL-D-70327, DRAWINGS, ENGINEERING AND ASSOCIATED LISTS, 16 MARCH 1959

This spec will replace 158 overlapping specs formerly used by the military for the procurement of engineering drawings and associated lists. The types of drawings that the military may acquire are defined. A single system of drawing number

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Clipper

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Here's what
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offers:

- Nickel-plated metal sheathing to prevent damage during clip assembly.
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coding is established. This system uses the manufacturer's identification code as used in the Federal cataloging system to identify the source of the drawing. A standardized order of precedence for design identification of items is also established. Minimum requirements for data to be placed on lists of materials are also outlined.

Publications

MIL-M-16616(SHIPS), ELECTRONIC EQUIPMENT TECHNICAL MANUAL, AMENDMENT 1, 1 JANUARY 1959

The reference to performance standards books and maintenance check off books has been changed to conform to the new specs. The typography requirement has been drastically modified to specify cold-type composition as a requirement except where it is more economical to use hot-type composition. Unjustified right-hand margins are also acceptable. Negatives must now be shipped within 30 days after the shipment of the first equipment. Publication status reports have now been included in this spec. However, these are only required when specified in the contract or order.

MIL-S-21740(SHIPS), SHEET, TECHNICAL DATA, PERFORMANCE STANDARDS, 1 JANUARY 1959

The preparation and handling of performance standards sheets are covered by this spec. These sheets provide a reference list of the minimum acceptable limits for overall operation of electronic equipment.

MIL-M-21741(SHIPS), MANUAL, TECHNICAL, MAINTENANCE STANDARDS BOOK, 1 JANUARY 1959

This spec covers the minimum requirements for the preparing maintenance of standards books and revisions for ship or shore-based electronic equipment. In addition, it covers the requirements for the preparation of reproducible copy, negatives of reproducible copy, typography, reproduction, quantity, approval procedures and packing. This issue supersedes MIL-B-17530(SHIPS) and MIL-B-17535(SHIPS).

MIL-M-21742(SHIPS), MANUAL, TECHNICAL, OVERHAUL AND REPAIR INSTRUCTION, 1 JANUARY 1959

The requirements for the preparation of overhaul instructions are established by this spec. They cover the overhaul and major repair of electronic equipments, systems and test equipment. These instructions shall be prepared as a standard for use by activities engaged in the major repair, rebuilding and restoration of electronic equipment. These manuals will only supplement the basic technical manuals for the equipment.

The triple-threat pot line

Pick the pot to suit your system... be it esoteric or plebeian... from the triumvirates of HELIPOT single turns (1/2" to 3" dia.) or multi-turns (7/8" to 3-5/16" dia.). No need to overspecify... pay only for what you need! Par exemple? The three HELIPOT 1-7/16" single turns, each the leader in its own milieu:



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Scheduled to open about the first of the year, Republic's new Research & Development Center at Farmingdale, Long Island, New York, will comprise seven different laboratory facilities. Included are an Electronic Development Laboratory and a Guidance and Control Systems Laboratory. These modern facilities will contain the most up-to-date equipment obtainable for the research, development and test of advanced astrionic and avionic systems, equipments and components.



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Farmingdale, Long Island, New York

Please write direct to advertiser mentioning *ELECTRONIC DESIGN*

DESIGNING YOUR FUTURE

Money To Start A Small Business



Clarence Wetherill, ECC's Senior Technical Officer. He'll pass on the technical competence of your product. In background are two more executive offices, separated by glass.

EVER DREAM of getting together with a few friends and manufacturing that better electronic mouse trap? Probably the principal obstacle was money—funds for working capital, growth and eventual expansion or modernization.

You may find the solution to your problem in a completely new source of financing for small businesses. The Small Business Investment Act was passed by Congress in 1958. Since then a number of privately-owned small business investment companies have been established to provide individuals or small businesses with long-term and equity funds.

Tax advantages make the operation possible: under the Small Business Act an investment firm gets to keep three out of four dollars of profits, loses only one out of four dollars of losses. In the past most firms or individuals who were in a

position to invest were in a bad tax position; now the current trend in Washington is to look favorably on giving contracts and otherwise helping out small business.

As an especially pertinent example of these new firms, Electronics Capital Corp., 1400 Fifth Ave., San Diego 1, Calif., the largest small business investment company in the U. S., devotes its entire resources to the needs of the electronics industry. The company is staffed by successful former electronics executives and engineers. The corporation's policy is to limit investment of long term funds to the electronics field, because it is a field the company's personnel understand thoroughly.

Prime objective of ECC is to provide continuing financial strength to its client companies during "fair and foul weather."



"You could call the Small Business Investment Act the start of a 'Fourth Banking System,'" Electronics Capital Corp.'s President Charles Salik says.



"Our interest is to keep 'em financially sound through thick and thin." Dick Silberman, executive v.p. of Electronics Capital Corp., describes ECC investment policies.

The firm recognizes the various phases through which an electronics company must pass before it can reach complete financial and management maturity. By relieving financial and other pressures, ECC hopes to accelerate the expansion of a large number of electronics companies.

What It Means to You

Suppose you came up with a product, invention or service concept you thought had real value. How would you go about getting money to implement it?

ELECTRONIC DESIGN talked with Charles Salik, president of ECC, and Richard Silberman, executive vice president, to find out the procedure necessary to obtain financing from ECC. "First," said Salik, "we tell the engineer about ourselves to find out if he's interested in our kind of organization. Then we go over the

proposed technical area of operation with particular regard to its appreciation possibilities." What this means, Salik explained, is ECC tries to get a good idea of how good the idea is. Is the product soundly designed? Is there a market for it? And, most important, is there a good chance that the market can be expanded many times?

"If there is not a good possibility of real appreciation we're not interested," Dick Silberman said, "We don't want to invest in a company that will just get along—we're interested in companies that have a real growth potential. This is what our shareholders are looking for and this is what we're going to give them."

Next step is to investigate the applicant. ECC wants to know something about the engineer's technical background and his record in business. "In particular," Silberman said, "we want people who have some experience in business—who have made some mistakes before, so to speak, and consequently have learned their lesson." ECC requires a projection from the engineer or firm as to what the contemplated organization and sales and marketing operations will be, who the management people will be and how much money the engineer thinks he needs. If this checks with what ECC thinks is reasonable and proper after analysis, negotiations can begin.

Sure You Want Enough?

"Our interest," Silberman pointed out, "is to see the applicant has enough money for what he wants to do. Some people don't ask for enough—they're thinking about short-term capital, while what we are dealing with is long-term financing."

For engineers without much business experience, or small businesses that recognize management problems, ECC provides a management consulting service at nominal cost. In the cases where it is used it is usually negotiated as part of the contract. It is based, according to ECC, as much as possible on areas in which the client needs help. "We have unusually expert management counsel in the electronics area for the client," Charles Salik said. "It's the kind of help small business needs—all consultants are people who have made successes in small electronics businesses. In areas like technology, business procedures, financial planning, sales,

(Continued on p. 238)

Interested in Systems Engineering?



There are systems



...and systems

*...and TOTAL systems
in which the big bird and support
equipment may rank only
as a component.*

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IF YOU ARE QUALIFIED and interested in contributing to programs of "total" scope, it will be of value to you to investigate current opportunities with General Electric's DEFENSE SYSTEMS DEPT., whose work lies primarily in providing total solutions to large scale defense problems of the next 5, 10 and 20 years.

The work here lies almost entirely in the areas of systems engineering and systems management.

Inquire about these positions:

Guidance Equation Engineers	Systems Test Evaluation Engineers
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Forward your confidential resume at an early date.

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CIRCLE 900 ON CAREER INQUIRY FORM

why should you consider going to work for Collins Radio?



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Collins has been the creative leader in electronics for over 25 years. The reason for this leadership is a continuous emphasis on advanced research and development. The results are impressive steps forward in communication and navigation. Collins was first to develop the radio sextant. Collins was first to bounce radio signals off the moon. Collins pioneered the development of single sideband communication, and is currently setting up the SAC global communication system.

Collins offers outstanding opportunities for professional advancement. Each engineer becomes a valuable specialist, or obtains the broad experience necessary for technical administration. And engineers are viewed as Collins' most important source of administrative leaders. In addition, Collins Radio offers you the advantages of your choice of location and project assignment.

If you are an engineer with a degree in EE, ME or Physics, Collins invites you to consider applying your talent and experience toward advancing your career in one of the following areas: With Collins in Dallas—circuit design, radar, microwave and carrier, telephone transmission, missile and satellite tracking and communication, airborne communication and navigation systems. With Collins in Cedar

Rapids—gyro controls, navigation and guidance systems, circuit design, vibrations. With Collins in Burbank—digital communication system transistorized circuit design, component engineering, test equipment design, reliability engineering, system design, and group project administration. U. S. citizenship is required.

Choose your climate and send your resume and home phone number in complete confidence to one of the following:

L. R. NUSS, Collins Radio Company,
855 35th St., N.E., Cedar Rapids, Iowa;

B. E. JEFFRIES, Collins Radio Company,
1930 Hi-Line Dr., Dallas 7, Texas; or

R. J. OLSEN, Collins Radio Company,
2700 W. Olive Ave., Burbank, California.



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DESIGNING YOUR FUTURE

(Continued from p. 237)

advertising, public relations and cost control we can offer considerable profit in experience to the client who uses us."

Each company is evaluated personally. "We can't give examples of some of our contracts because they'd be misleading," Elliot Lewis, Client Development, said. "Each specific case is different—wide open and negotiable."

While ECC generally owns an interest in the new company, policy is to avoid owning more than 50 per cent. "We don't want control of a company," said Silberman. If ECC ever has to make a deal where they own more than 50 per cent of a company a procedure will be set up where the engineer-president can buy back control out of profits.

Group Development is New Concept

ECC's new group development plan shows promise of success. Object here is to promote the "development of companies which have sympathetic fields of interest" and who are able, in terms of management, products and services, to associate in special groups to bid on industrial or military procurement requirements.

In this way individual companies can participate in contracts beyond their present financial and technical capabilities—the "team bid" idea updated. "It's already fairly apparent we are in a unique position to look at the total industry in all its facets," Salik said. "We feel we can be very helpful to our clients fitting them into their proper relationship with the rest of the industry. We have experience in seeing total relationships, a reservoir of up-to-date knowledge of industry, electronics technology and business trends."

ECC, in other words, will help put businesses together in joint ventures. It also "stands ready to sponsor the creation of new companies composed of people with proven experience who can take advantage of opportunities in sensitive areas of the electronics industry."

Companies or individuals with total assets less than \$5 million and whose net income after taxes is less than \$150,000 averaged for the past three years can qualify as ECC clients. Within the framework of this policy, the corporation invests in every facet of the electronics industry. ■ ■

After completing, mail career form to *ELECTRONIC DESIGN*, 830 Third Avenue, New York, N. Y. Our Reader Service Department will forward copies to the companies you select below.

21

(Please print with a soft pencil or type.)

Name _____ Telephone _____

Home Address _____ City _____ Zone _____ State _____

Date of Birth _____ Place of Birth _____ Citizenship _____

Position Desired _____

Educational History

College	Dates	Degree	Major	Honors

Recent Special Training _____

Employment History

Company	City and State	Dates	Title	Engineering Specialty

Outstanding Engineering and Administrative Experience _____

Professional Societies _____

Published Articles _____

Minimum Salary Requirements (Optional) _____

Use section below instead of Reader Service Card. Do not write personal data below this line. This section will be detached before processing.

Circle Career Inquiry numbers of companies that interest you

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Use New Form

To Speed Action

ELECTRONIC DESIGN's new Career Inquiry Service form is designed to help engineers advertise themselves. This new service speeds applicants to the jobs they seek. It is the first such service offered in the electronics field and is receiving high praise from personnel managers.

To present your qualifications immediately to the personnel managers of companies that interest you, simply fill in the attached standardized short resume.

Study the employment opportunity ads in this section, and circle the numbers at the bottom of the form that correspond to the numbers of the ads that interest you.

ELECTRONIC DESIGN's Reader Service Department will act as your private secretary and type neat, duplicate copies of your standardized resume and send them to all companies you may select . . . *the same day the resume is received.* (ELECTRONIC DESIGN will detach the circle number portion of the form, so that no company will know how many numbers you circled.)

The standardized resume will permit personnel managers to inspect your qualifications rapidly. If they are interested, they will get in touch with you directly. In the past much time has been lost through personnel-manager requests for resumes from applicants who proved ineligible.

Mail Career Inquiry Service form to Reader Service, ELECTRONIC DESIGN, 830 Third Ave., New York 22, N. Y.

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Positions in the following areas offer particular challenge at this time:

Reconnaissance Systems	Detection & Identification Systems
Airbourne Equipment	Antenna & Radiation Systems
Ground Data Handling Equipment	Chemistry Laboratory
Simulation & Training Systems	Applied Physics Laboratory
Communication & Navigation Systems	Production Engineering
Ground Support Equipment	Quality Control

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YOUR CAREER NEWS, NOTES, NOTIONS

Recruiting techniques frequently amount to open piracy. Although recruiting officers think of themselves as out proselytizing for their company, their converts frequently consider themselves no better than prostitutes who have been had for an offer of a few more bucks.

Recruitment takes on the aura of a professional activity though, at the National Electronics Conference being held in Chicago this week. A panel session entitled "Recruitment of Scientific Personnel" was conducted Monday evening by the IRE Professional Group on Engineering Management. The tone of the meeting was set at a respectable plane by referring to the recruitment of "scientific" personnel rather than the "hiring" of engineers, and by including two panel participants from universities.

The sponsors of the East Coast Conference on Aeronautical and Navigational Electronics to be held in Baltimore later this month (October 26-28) take the problem of the need for engineers right to the halls of the universities. Industry and government panelists go to the campus of Johns Hopkins University to discuss before students "Opportunities For Engineers Today And Tomorrow." The Director of Placement, J. Lyon Rogers, of John Hopkins University will discuss career evaluation and selection.

• • •

The engineer and his work was the scene of several other papers at NEC. Leadership requirements were discussed at a panel meeting on education for leadership. The occupational hazards of engineers and managers were the subject of a paper by Mr. J. R. Stovall, Jr. of Remington Rand.

The up-coming need of electronic company managers as military-political advisors was the subject of an NEC paper by Mr. Casper M. Bowers. The gist of Mr. Bowers' paper was not available to us at the time this page went to press, but a timely article on this same theme appeared in the SR/Research section of the September 5 *Saturday Review*.

In discussing the peaceful use of atoms, two former AEC lawyers, William Berman and Lee Hydeman, both now at the University of Michigan Law School, stress that engineers as well as legislators and policy makers will have to decide how the results of science will benefit society.

The view taken in this article is that scientists can't tell us where science is taking us. They can inform, can contribute details to enhance under-

ENGINEERS

RESEARCH OPPORTUNITIES

Aeronutronic, a new division of Ford Motor Company, has immediate need for computer engineers to staff its new \$22 million Research Center in Newport Beach, Southern California. Here, you have all the advantages of a stimulating environment, working with advanced equipment, located where you can enjoy California living at its finest.

Look into these ground floor opportunities in research and development work that is challenging and exceptionally rewarding to qualified men.

Positions now open:

- Systems Engineer
- Magnetic Memory Engineers
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- Logical Designers
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Qualified applicants are invited to send resumes or inquiries to Mr. R. E. Durant, Aeronutronic, Box NJ-486, Newport Beach, California.

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CIRCLE 903 ON CAREER INQUIRY FORM

standing, and can remind us of the unusual nature of knowledge and knowledge's refusal to be fettered. But the application of science depends on rules and regulations to be worked out in the main by students and practitioners of law."

The authors illustrate their point by discussing President Eisenhower's Atoms-For-Peace plan which is failing. Science can describe the wonders that could come from nuclear power generating stations and radioisotope laboratories. But these advanced stages of industrialization are far ahead of the needs of these under-developed countries. First steps for these countries should be the building of roads and canals rather than the extraction of mineral deposits and increased productivity for extensive electrification. (The individual can't afford a light bulb in the first place.)

A hydrogen explosion could open the way for irrigation of barren acres and for mining buried minerals. Unfortunately, according to Messrs. Berman and Hydeman, no experiments have been made with the specific purpose of using nuclear explosions for peace. The United States didn't sell its project Plow Share Program well at the Second United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva a year ago August.

It's not too late for a Hydrogen-For-Peace crusade, the article goes on, and the most exciting use is that of earth-moving. The advisory role of scientists and engineers is extremely important. Fear of the additional radiation hazard to the human race may thwart such plans unless the scientific community can prove otherwise. (According to the scientists at the Laurence Radiation Lab radiation for this purpose could be negligible.)

Prospects for peaceful tests to take place in the face of a nuclear weapons ban are good, providing engineers can agree what reasonable peaceful tests are and what kind of internal inspection is adequate.

• • •

A theory about flying saucers is also presented in the September 5 issue of the *Saturday Review*. We are sure every knowledgeable electronics engineer will want to be armed with physicist Donald H. Robey's argument before his next encounter with UFOs—that is, his next cocktail party. In fact, our engineer can bring up the subject by noting the similarity of the partially-melted ice cube in his drink to a flying saucer! Robey traces the likelihood that UFOs are ice-fragments that were once a part of a comet. The UFO controversy continues, but it all started in 1947 and that was the year that the earth's interplanetary space neighborhood was visited by more comets than ever before.

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