

ELECTRONIC DESIGN

OCTOBER 26, 1959

OCT. 26 1959

B 800644

THE LIBRARY OF
CONGRESS
SERIAL RECORD

NOV 12 1959



SPECIALLY DESIGNED COMPONENTS CUT TRANSFORMER-RECTIFIER'S SIZE, WEIGHT... p. 42

der
his
life
and
dio
Ma-

15-
eer
ni-
on,
at

gs:
on,
ons
and

ec-
are

nal
ept.

59



A PARTIAL SHOWING. OVER 60 DIFFERENT SIZE 8 ROTARY COMPONENTS AVAILABLE

Clifton Precision's size 8 rotary components have been tried and proven by customers over the past 4 years. More than 50,000 have been shipped. These are the most accurate and best tested (because they are use tested) size 8 rotary components on the market today.

1. Torque transmitter (26v. input) 2. Torque transmitter (115v. input) 3. Control transformer (lo Z) 4. Control transformer (hi Z) 5. Control transformer (very hi Z) 6. Torque receiver (26v. input) 7. Torque receiver (115v. input) 8. Torque differential (lo Z) 9. Torque differential (hi Z) 10. Electrical resolver (.5 t.r.) 11. Precision computing resolver (feedback winding) 12. Electrical resolver (1 t.r.) 13. Linear transformer (115v. input) 14. Linear transformer (26v. input) 15. Servo motor (1" length, .40 in-oz stall torque) 16. Motor generator (10v. input) 17. Servo motor (53/64" long) 18. Servo motor (35v. center tap) 19. Servo motor (26v. center tap) 20. Motor generator (26v. input) 21. Servo motor (.30 in-oz stall torque) 22. D.C. motor (14v. input) 23. D.C. motor (28v. input)

ENGINEERS — Join the leader in the rotating components field. Write David D. Brown, Director of Personnel, Dept. E-10

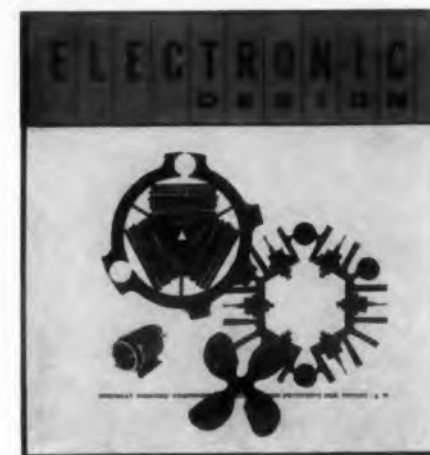
CLIFTON PRECISION PRODUCTS CO., INC.
CLIFTON HEIGHTS

cppe
P. A.

Sales Office: 9014 W. Chester Pike, Upper Darby, Pa.—Hilltop 9-1200, TWX Flanders, Pa. 1122

CIRCLE 1 ON READER-SERVICE CARD

HIGHLIGHTS OF ISSUE



Specially Designed Components Cut T-R's Size, Weight (Cover) 42

A new series of light and small Transformer-Rectifiers was made possible by using specially designed components. Each of the components in the T-R's—transformer, rectifier, heat-sink, fan—was constructed for minimum weight, minimum volume and maximum performance. Three of the components (fan, heat-sink with rectifiers, and transformer) are shown on the cover. Our artist has taken some liberties with the basic shapes of the components and located them in three planes, each of which is determined by the component's position in the unit.

Design Procedure For The Schmitt Trigger 24

Design steps, together with a typical example, for calculation of circuit parameters. Tedious experimentation is avoided.

Waveguide Flange Design For Better Microwave Performance 28

The waveguide flange has been too long neglected. Author Lou Virgile shows how to design better flanges to minimize vswr and maximize power handling capabilities.

Automatic Circuit Tolerance Tester For Checking Reliability And Failure Trends 32

Extreme limit values for circuit components are rapidly switched into circuit setups for reliability evaluation. The ability to predict possible failures facilitates correct design.

NEWS

- Space Electronics: Key Conferences in U. S. And
Canada Consider Its Ups And Downs 3

EDITORIAL

- Overtime Is Needed To Get Us Into Space 23

FEATURES

- Design Procedure For The Schmitt Trigger 24
Detailed design procedure eliminates time-consuming trial and error method L. L. Kleinberg
- Waveguide Flange Design For Better Microwave Performance 28
Considerations for improving the waveguide flange L. G. Virgile
- Automatic Circuit Tolerance Tester For Checking Reliability And Failure Trends 32
Automatic switching of extreme limits for circuit component value enables rapid evaluation of reliability K. S. Packard, M. Goldstein, N. Stone, J. Cavallari
- Making The Most Of Flat Cables, Part 2 36
Shaping flat cables and some terminations that can be used are covered in this last article G. E. Robert Smith, W. Richter
- Get Higher Torque From Multipole Hysteresis Motor 40
Novel rotor design shrinks this multipole hysteresis motor to one tenth the conventional size
- Specially Designed Components Cut Transformer-Rectifier's Size, Weight 42
A new "Y" transformer, high-current silicon diodes, and other components make it possible
- PC Peg Boards Speed Breadboard Layout 94
Idea for Design
- Thermoelectric Cooling Of Photomultipliers 110
Russian Translations
- "How To Invent" 126
A review of a new book by Forrest E. Gilmore, an engineer

DEPARTMENTS

- | | | | |
|-------------------|-----|----------------------|-----|
| Washington Report | 18 | Russian Translations | 110 |
| Meetings | 20 | Report Briefs | 112 |
| New Products | 44 | Standards and Specs | 120 |
| Services | 76 | Letters | 122 |
| New Literature | 78 | Careers | 126 |
| Ideas for Design | 94 | Career News | 128 |
| Patents | 104 | Career Brochures | 136 |
| Books | 106 | Advertisers' Index | 140 |

KELLOGG

TYPE "L" RELAY

miniaturized • versatile • reliable



Kellogg's Type "L" Relay features—

- High operating force:** greater sensitivity, gram pressure, springs per pileup.
- Rear mounting:** for ease of wiring.
- Wide coil variety:** single or double wound, for any circuit needs.
- Bifurcated stationary springs:** for independent contact action and high reliability (single contacts also available).
- Heavy duty bronze yoke and stainless steel bearing pins:** for long life and stable adjustment.
- Single or double arm type armatures available.**
- Hermetically sealed models,** if desired.
- Operating speed:** minimum of 1-2 milliseconds.
- Contact points:** gold, silver, palladium, tungsten; others available.
- Residual:** adjustable and fixed.
- Time delay:** heel-end slugs and armature-end slugs for release time delay and operate time delay, respectively.
- Terminals:** slotted.
- Weight:** net, 2-1/4 oz.
- Dimensions:** 2-1/4" L x 1-1/8" W, height ranges from 17/32" to 1-1/16" (max.)
- Operating voltages:** up to 220 volts D.C.

Backed by Kellogg and International Telephone and Telegraph Corporation. Inquiries are invited. Send for a free catalog on Kellogg relays, components.



Kellogg Switchboard and Supply Company, 6650 South Cicero Avenue,
Chicago 38, Ill. Communications division of
International Telephone and Telegraph Corporation.
Manufacturers of Relays • Hermetically sealed relays • Switches

For Reliable Communication...

NEW RAYTHEON CK7246

1.25 VOLT SUBMIN TRIODE

OPERATES TO 500 MC.

This Raytheon filamentary subminiature triode was developed under U. S. Signal Corps contract, and is now commercially available for use in battery-operated communications equipment. Circuit applications include:

- Superregenerative detector
- High frequency oscillator
- Class C amplifier
- Frequency multiplier
- Mixer

TYPICAL OPERATING CHARACTERISTICS Class A Amplifier

| | |
|-----------------------|-----------------|
| Filament voltage (dc) | 1.25 v. |
| Filament current | 150 ma. |
| Plate voltage | 105 v. |
| Plate current | 4.5 ma. |
| Grid voltage | -2.5 v. |
| Transconductance | 2700 μ mhos |
| Amplification factor | 22 |

Class C Oscillator (465 mc.)

| | |
|-----------------------|---------|
| Filament voltage (dc) | 1.25 v. |
| Filament current | 150 ma. |
| Plate voltage | 105 v. |
| Plate current | 6 ma. |
| Grid current | 0.9 ma. |
| Power output | 60 mw. |



Typical CK7246 Circuit 465 mc. Class C Oscillator

L_1 : 1 turn No. 12 copper,
 $\frac{3}{4}$ inch O.D.

RFC: bifilar wound
8 turns #26 En.
 $\frac{1}{8}$ " I.D., 1" long

C_1, C_2, C_3 : 250 μ f feed-thru
button type

R_1 : 4.7K $\frac{1}{2}$ w.

R_2 : 10K 2w pot.

STAFF

EDITOR: Edward E. Grazda; MANAGING EDITOR: J. A. Lippke; ASSOCIATE EDITORS: L. D. Shergalis, G. H. Rostky, H. Bierman, R. N. DeFloria; ASSISTANT EDITORS: T. E. Mount, D. S. Viebig, L. N. Tolopko, A. Corneretto; CONTRIBUTING EDITORS: S. H. Hubelbank, E. Brenner, B. Bernstein, E. Kahn, B. B. Daien; EDITORIAL ASSISTANTS: M. S. Buckley, A. M. Sickler, A. R. Abramoff, R. N. Ross, R. M. Moore; ART DIRECTOR: R. A. Schulze; TECHNICAL ILLUSTRATOR: B. L. Armstrong; ART ASSISTANTS: C. Bank, D. Ramos; PRODUCTION MANAGER: T.V. Sedita; ASST. PRODUCTION MANAGER: H. De Polo; PRODUCTION ASSISTANTS: M. C. Alexich, C. E. Moodhe, CIRCULATION MANAGER: N. M. Elston; ASST. CIRCULATION MANAGER: A. C. Lovett; READER-SERVICE: J. E. Medina.

CO-PUBLISHERS

T. Richard Gascoigne
James S. Mulholland, Jr.

ACCURACY POLICY

Recognizing the power of the printed word to influence, it is *ELECTRONIC DESIGN*'s policy:

1. To make all reasonable efforts to insure accuracy of editorial matter.
2. To promptly publish corrections brought to our attention.
3. To not knowingly publish misleading advertisements.
4. To reserve the right to refuse any advertisement.

SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U.S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letterhead: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally.

ANY ADDRESS CHANGES FOR OLD SUBSCRIBERS NECESSITATE A RESTATEMENT OF THESE QUALIFICATIONS. Subscription rate for nonqualified subscribers—\$25.00 per year U.S.A., \$30.00 per year all other countries. Single copy \$1.50.



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. 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.



INDUSTRIAL TUBE DIVISION

55 CHAPEL STREET, NEWTON 58, MASSACHUSETTS

RELIABLE MINIATURE & SUBMINIATURE TUBES • GAS & VAPOR TUBES • CATHODE RAY TUBES • HARD-GLASS POWER TUBES
BOSTON: Blgelow 4-7500 • NEW YORK: Plaza 9-3900 • CHICAGO: NATIONAL 5-4000 • LOS ANGELES: NOrmandy 5-4221
BALTIMORE: SOuthfield 1-1237 • CLEVELAND: Wlnton 1-7716 • KANSAS CITY: Plaza 3-5330

GOVERNMENT SALES . . . BOSTON: Blgelow 4-7500 . . . WASHINGTON, D. C.: MEtropolitan 8-5205 . . . DAYTON: BALdwin 3-8128

Small order and prototype quantities available directly from your local Raytheon electronic parts distributor

CIRCLE 3 ON READER-SERVICE CARD

Space Electronics: Key Conferences in U.S. and Canada Consider Its Ups and Downs

SPACE ELECTRONICS developments—new techniques that are rocketing the art forward and old side effects that could ground it ignominiously—were on the agenda of major conferences in this country and Canada in the last month.

The sessions were:

- A communications symposium at Utica, N.Y., at which this nation's progress in space electronics equipment was weighed and found capable of meeting the challenge of the future, if industry exerted itself.

- A telemetering conference in San Francisco that disclosed, among other advances, hitherto classified information on ICBM and IRBM firings.

- Canada's largest scientific assembly, the IRE show, which stressed the vitality of the Canadian electronics industry and reported among space gains two radical developments in equipment.

- A meeting in Chicago on radio interference reduction at which speakers warned that clogged airwaves could imperil the American defense system and missile launchings.

The **Atlas**, this country's first ICBM, roars aloft majestically at Cape Canaveral, Fla., symbolic of space achievements that imbue the electronics industry with optimism.

- Another Chicago meeting, the National Electronics Conference, which had as one goal the updating of registrants on Space Age electronics.

- A down-to-earth gathering of value engineers at Philadelphia that pointed to impressive savings resulting from value analysis and set as a goal three missiles for the price of one.

Utica

At the Fifth National IRE Communications Symposium in Utica (Oct. 5-7), Maj. Gen. Harold W. Grant, Air Force director of Communications-Electronics Headquarters, told a press conference that electronics was not holding up the nation's progress in space exploration. Present equipment,





CONTROLLED RELIABILITY BEYOND



DESIGN

Basic reliability of an electronic component lies in its design. U.S. Relay has gone beyond this step by protecting already-proven designs with a new, contaminant-free production and test facility that is unique in the industry.

A 12,000 square foot manufacturing and test area which incorporates a most elaborate system of temperature, humidity and dust controls, is now in use. Positive pressure rooms, automatic shoe scrubbers, special lint-free garments for employees and air locks are a few of the precautions in effect. Control systems automatically record and warn of increases in air-borne particles, changes in room pressures and ambient temperatures.

Complete laboratories have been installed for testing components under all operating conditions encountered by missiles and conventional aircraft. This includes a specially designed Random Motion, Sine Wave, Vibration test system. Solid state switching for pulsing circuits and Flip-Flop network designs are now being investigated and formalized for production.

Specify U.S. Relay-Electronics components for unparalleled reliability.



For information write to:

U.S. RELAY-ELECTRONICS



A Division of A·S·R Products Corporation

717 NORTH CONEY AVENUE, AZUSA, CALIFORNIA, DEPT. ED

Engineers with relay and/or electromechanical experience desiring employment under ideal working conditions with above average advancement program, contact J. Kendall, Chief Engineer.

CIRCLE 8 ON READER-SERVICE CARD

NEWS



Maj. Gen. Harold W. Grant, Air Force director of Communications-Electronics Headquarters, who addressed the Fifth National IRE Communications Symposium in Utica, N.Y.

he said, can handle guidance and data transmission for any space probe the country can launch at this time. The military leader expressed confidence that the electronics industry would keep ahead of developments in rocketry.

But far from complacent, General Grant balanced his optimism with stern reminders in a formal opening address to the meeting.

"The Air Force believes," he said, "that it is no longer enough—in fact it is no longer consistent with the plans for our country's survival—to put together by piecemeal methods a communications system that aims merely to catch up or keep pace with current military requirements. Rather we must anticipate further needs and future weapons.

"We must be ready for them before they have completed the journey from the drawing board to the factory and actually come into being. To meet the anticipated requirements of the future air weapons is the mission of a program known to most of you as 480-L, or the AIRCOM Modernization Program."

Referring to costs, General Grant continued:

"It is becoming more and more apparent that the communications-electronics phases of weapons systems development represent a rapidly increasing share of the total cost of national weapons. Balanced against these rising costs is the unde-

able fact that to perform these essential functions by other than electronic means is impossible.

"I strongly feel, however, that if we are to accomplish our program objectives at a price we can afford, we must strive to obtain technological breakthroughs comparable to those that have been made in the fields of weapon yield and propulsion. It is the unfortunate fact that the communications-electronics field has notably lacked such a breakthrough.

"There is very little in the way of fundamental technique that we are using today that does not antedate World War II. The bulk of our advances have consisted of doing the same old things in a bigger and better way.

"This 'bigger and better' approach will not meet the challenge. It is too slow and vastly too expensive."

Symposium Draws 1000

More than 1,000 attended the symposium, conducted by the Rome-Utica Chapter of the Professional Group on Communications, IRE. Papers were presented, and 27 exhibits were on view. Plans were announced to expand the gathering next year to 75 exhibits.

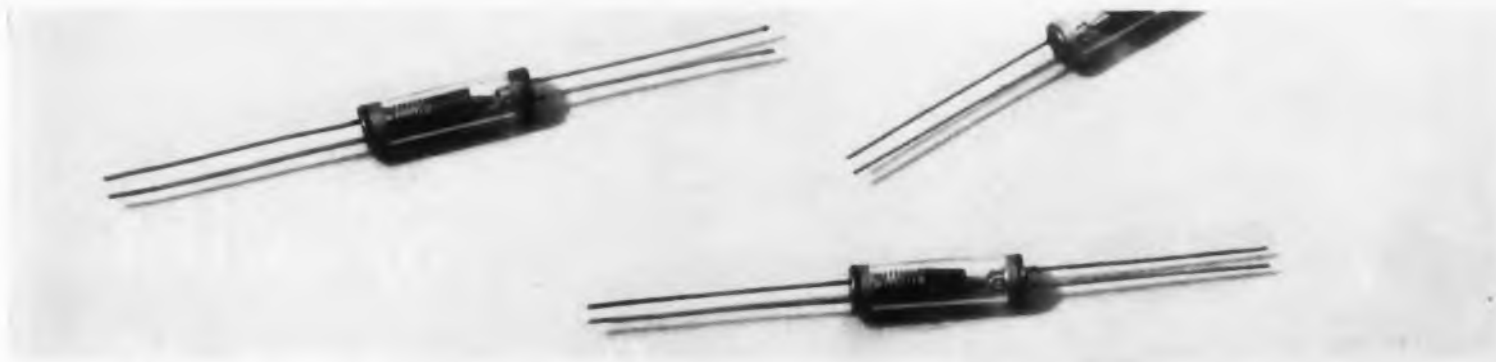
Digital communications were explored in six unclassified sessions. One paper, by A. P. Brogle of the Army Signal Research and Development Lab, Fort Monmouth, N.J., discussed the results of a study of basic factors to be considered in selecting a system.

"A fundamental problem of recent system developments," Mr. Brogle reported, "is the selection of the method of transmission which yields best over-all performance for least total cost in required equipment. For an acceptable solution, this choice must be made within the permissible limits of these factors and under the constraints of restricted bandwidth, specified transmission media and modulations, given power outputs and transmission losses, predicted noise levels, and so forth."

The paper described a technique "for evaluating transmission distortion and the effects of noise in these systems directly in terms of the pulse error rate." A new method of transmission called biternary was cited and compared with quaternary transmission as a means of doubling the channel capacity of PCM systems without requiring increased bandwidth or transmission facilities.

"Binary transmission," the paper said, "is more tolerant to the effects of all types of interference than quaternary transmission and significantly reduces a major problem of quaternary transmission of excessive errors due to low frequency cut-off effects. The use of biternary transmission is planned in present and future military pulse code modulation systems." (Continued on page 6)

HUGHES THERMAL RELAYS



FOR RELIABILITY



IN GUIDED MISSILES

Hughes now makes commercially available a completely reliable single action switch. Used in the Falcon, field proven as a reliable missile, this Hughes relay is engineered to meet the most exacting of requirements.

With unusual speed of action, firing signal triggers the release of constrained contact...contact closes upon fixed contact point...switch circuit becomes permanently closed.

In a typical application, 3.0 volts DC applied to a firing circuit of 1.2 ohms fires within 0.3 seconds.

For additional information please write: Hughes Semiconductor Division, Marketing Department, 500 Superior Avenue, Newport Beach, Calif.

SPECIFICATIONS

MECHANICAL—Body Size: Maximum diameter 0.252"; length .920".
Total weight: Less than 0.1 oz.

ELECTRICAL—Before Firing: Insulation resistance is greater than 200 megohms. Minimum breakdown voltage 600 volts.

Firing: 2 volts minimum required. Actual voltage dependent upon closing time desired.

After Firing: Circuit resistance less than 0.3 ohm.

ALTITUDE—Any.

OPERATING TEMPERATURE: -55°C to +125°C.

SEMICONDUCTOR DIVISION

Creating a new world with ELECTRONICS **HUGHES PRODUCTS**

© 1958, Hughes Aircraft Company

CIRCLE 9 ON READER-SERVICE CARD

TESTED PERFORMANCE IS PROOF
OF U.S. SEMCOR RELIABILITY!

SPECIFY
U.S. SEMCOR
DIODES...
RECTIFIERS...
SOLID TANTALUM CAPACITORS

Semiconductor devices today... for the Electronics of tomorrow!

VOLTAGE REGULATING DIODES
1N163 through 1N2171A

LOW POWER ZENER DIODES
1N1927 through 1N2007

MEDIUM POWER ZENER DIODES
1N1875 through 1N1998

HIGH POWER ZENER DIODES
8.2 to 100 volts, up to 85W

DOUBLE ANODE ZENER DIODES
7.5 volts to 36 volts

SOLID TANTALUM CAPACITORS
33 mfd to 330 mfd capacitance

LOW POWER RECTIFIERS
1N1839 through 1N1874

MEDIUM POWER RECTIFIERS
1N1907 through 1N1924

HIGH POWER RECTIFIERS
PIVs from 50 to 500 volts

HIGH VOLTAGE RECTIFIERS
PIVs up to 1500 volts

HEAT MOUNT DIODES
Medium power, 7/16" to 3/2" stud

COMMERCIAL RECTIFIERS
1N2122 through 1N2114

There's just one sure proof of performance: Test it; Put our subminiature solid state devices to any trial you choose. You'll find they stand on their own merits... and you'll take pride in your products made with reliable U. S. SEMCOR components. Write, phone, or wire collect to Sales Engineering Department today!



U. S. SEMICONDUCTOR PRODUCTS
3540 West Osborn Road • Phoenix, Arizona • Evening 2-1341

A Division of
General
Industries, Inc.

NEWS

F. de Jager and J. A. Greefkes of N. V. Philips' Gloeilampenfabrieken, Eindhoven, the Netherlands, discussed FRENA, a system for the transmission of speech at very low signal-to-noise ratios.

"For signal-to-noise ratios between 3 and 12 db, the intelligibility of ssb modulated speech can be increased by transmitting the amplitude and frequency information via two different channels, fulfilling different requirements as to bandwidth and signal-to-noise ratio," the paper reported. "At

Teamwork News Coverage

The following ELECTRONIC DESIGN staff members furnished on-the-spot coverage of the meetings in this space report:

Lawrence D. Shergalis—Fifth National IRE Communications Symposium in Utica, N.Y.

Thomas E. Mount—1959 Space Electronics and Telemetry Show in San Francisco.

Alan Corneretto—IRE Canadian Convention and Exhibition in Toronto and National Electronics Conference in Chicago.

Howard Bierman—Fifth Conference on Radio Interference Reduction and Electronic Compatibility in Chicago.

George H. Rostky—Value Engineering Conference in Philadelphia.

the receiver these two signals can be recombined to give a reconstruction of the original speech signal, which is only partly influenced by the noise.

"By choosing a special type of modulation, these two signals can be transmitted as one signal of nearly constant amplitude.

"The FRENA system combines a fairly drastic degree of clipping with two measures that are taken to diminish distortion. Firstly the clipping procedure is not performed on the audio speech signal but on a ssb modulated signal, so that many of the distortion components fall outside the wanted frequency band. Secondly, the amplitude information is not entirely discarded, the main envelope of the speech signal being transmitted via a second information channel having a narrow bandwidth of approximately 100 cps.

"In this way the 'frequency information,' as found in the zero-crossings of the clipped ssb

signal, is separated from the 'amplitude information,' as contained in the envelope, and the mode of transmission of the two signals can now be adapted to their different demands as regards bandwidth and signal-to-noise ratio.

"At the receiving side the two signals are recombined to give an approximation of the original speech signal."

Electromagnetic Interference Problems

"Evaluation of Electromagnetic Interference Problems Using Computer Simulation Techniques" was the subject of a paper by D. R. J. White and W. G. James of the American Machine & Foundry Co., Alexandria, Va. The two described a digital computer simulation program for use by communications system and equipment designers who must consider electromagnetic interference.

Their simulation program is designed "to predict and analyze the interference experienced by an airborne receiver located in an electromagnetic environment."

"This environment," the paper said, "results from its associated transmitters, termed the 'test transmitter,' from a large deployment of discrete transmitters, and from atmospheric and cosmic noise sources.

"For each transmitter expected to contribute significantly to the signal environment, all parameters influencing its emitted signal strength are simulated and the results entered into computer storage. Among these parameters are modulation, antenna patterns, frequency signatures, and so on.

"Representations of propagation phenomena which modify emitted signals are entered into the program with tabulations of noise levels. Receiver antenna patterns, frequency response and detection characteristics also are simulated, along with signal acceptability criteria.

"All postdetector inputs from other than the test transmitter are summed, and the ratio of the test transmitter signal power level to the sum of all others is determined. The resultant ratio is modified in accordance with the postdetector characteristics to yield a receiver output channel signal-to-noise-plus-interference ratio."

One objective of the simulation program, according to the paper, "is to provide a tool for determining the effect of the interference on information transfer by the system under test." Another objective "is to make this tool sufficiently flexible that one may readily determine whether changes in the emitter environment, test transmitter or receiver characteristics, or any combination of these, will serve to reduce the interference level, and to what extent reduction will occur."

"The user," the designers said, "might evaluate changes in such factors as the test transmitter

TOUGH ENOUGH FOR AIRBORNE RADAR

Hughes microwave tubes

Rugged, compact, light in weight... all Hughes Microwave Tubes have withstood the most severe requirements of airborne radar systems and therefore can be applied in the most taxing of environmental problems.



KU BAND BACKWARD WAVE OSCILLATOR

The Hughes Type LOU-2 is a precision built oscillator which tunes over the frequency range of 12.4 to 18.0 kmc. Typical power output over band is 10 to 60 milliwatts. The tube is housed in a self-contained permanent magnetic focusing package so that a separate power supply for a focusing electromagnet is not required.



S-BAND TRAVELING WAVE AMPLIFIER

Periodically focused, the type MAS-1A has a peak power output of one kilowatt over a band of 2-4 kmc at duties up to 0.005. The tube has a gain of 30 to 33 db, giving an excess of one kilowatt over most of the band. When two tubes are operated in cascade, the one kilowatt output can be obtained with a drive on only one milliwatt.



S-BAND BACKWARD WAVE AMPLIFIER

The Hughes type PAS-2 is a narrow-band, voltage-tuned amplifier that is designed for use as an r-f preamplifier stage in contemporary radar communications and other microwave receivers. Features: frequency range 2.4-3.5 kmc, insertion noise figures on order of 4½ db, tube noise figures of less than 5 db, voltage-tuned, crystal protection, spurious input signal elimination, cold isolation greater than 80 db and image rejection.

For additional information please write: HUGHES PRODUCTS, Electron Tube Division, International Airport Station, Los Angeles 45, California.

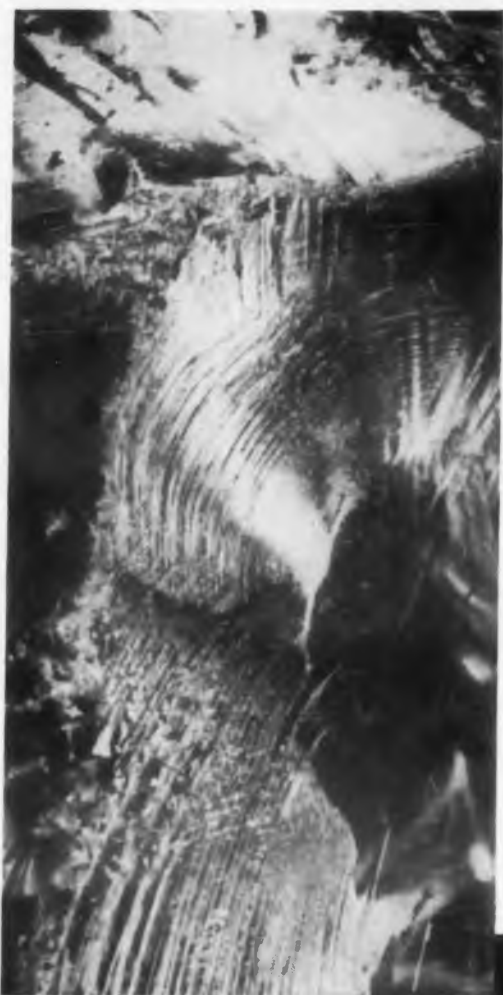
For export information, write: HUGHES INTERNATIONAL, Culver City, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

© 1959, HUGHES AIRCRAFT COMPANY

CIRCLE 11 ON READER-SERVICE CARD



Enlarged photograph of raw crystal



BULOVA CRYSTAL CONTROLLED ULTRA-STABLE SHIFT OSCILLATORS

Bulova shift oscillators are all that any electronics engineer could ask for in miniature crystal controlled packages!

Consider this new Bulova custom designed 18.5mc shift oscillator. Here's an assembly of two oscillators operating at 18.5mc. One is fixed, with a $1 \text{ pp } 10^7$ stability. The other is a variable with equal stability, $1 \text{ pp } 10^7$. The shift is accomplished by means of a variable air capacitor. How-

Department A-1361, Electronics Division, Bulova, 40-06 62nd Street, Woodside 77, New York

ever, the same shift, at the same frequency, can be affected with a varicap.

This new ultra-stable shift oscillator is only one of many recent advances made by Bulova Electronics. For information on these specific units, or on how Bulova experience, in mastering component and system reliability, can help your program, write—



BULOVA

CIRCLE 12 ON READER-SERVICE CARD

NEWS

power, frequency, polarization, location or operational doctrine, or in the antenna of the receiver, the front end noise level, or the if bandwidth."

Harold J. Pratt Jr. of Melpar, Inc., Boston, examined known factors that could conceivably influence earth-space communications.

"In most instances," he said, "accurate propagation and noise data do not exist for earth-space communications. Therefore, results already established for ground-ground or ground-low altitude systems have been extrapolated where they appear valid, or theoretical data have been calculated using mathematical models."

In his paper, "Propagation, Noise and General Systems Consideration in Earth-Space Communications," he analyzed the various propagation, noise and general system aspects and attempted to predict the optimum ranges of operating frequencies for such systems.

"The atmosphere is shown to be nearly transparent to rf transmission between 80 and 15,000 megacycles," Mr. Pratt said. "Various noise sources, both internal and external to the system, were investigated and a relative system sensitivity spectrum plotted."

Maximum available transmitter power and antenna parameters were predicted for the 1965-1970 era.

"Using the 'beacon' and 'radar' equations and considering fading effects and system weights and sizes," the paper said, "the optimum frequency range for one-way and two-way earth-space communications systems is determined to be 2 to 6 kilomegacycles."

"Use Of Optical Frequencies For Space Communication" was the subject of a paper by Cecil B. Ellis of General Precision Lab., Inc., Pleasantville, N.Y.

He reported that the spectrum from the infrared through the visible to gamma rays had been surveyed for signaling from earth or an earth satellite to a spaceship at planetary distances.

"The best region for signaling from a satellite vehicle," Mr. Ellis reported, "appears to be from —1000 to 400 angstroms.

"One information bit per second could be sent for a distance many times the diameter or the solar system. If the source is to be on the earth's surface, the best frequency region would be 4000 to 3000 angstroms. One could probably then reach the neighborhood of Mars at one bit per second when that planet is closest to the earth. Greater distances would be possible at slower information rates."

Mr. Ellis' analysis showed that neither the longer wavelength infrared region nor the short-wave X-ray and gamma ray regions were likely to prove useful for this application. For work in

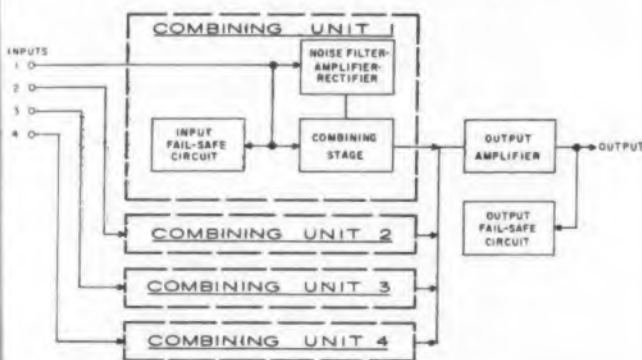
these parts of the spectrum, he noted, the photomultiplier might be replaced by a photoconductor for the infrared and by a scintillation counter for the x-rays and gamma rays.

San Francisco

The 1959 Space Electronics and Telemetry Show in San Francisco (Sept. 29-30) drew 700 registrants and 35 exhibitors. In sharp contrast to WESCON, held in the same city just a month previous, most registrants attended to hear the papers rather than to browse through a multitude of new products and services.

Noteworthy among the papers was "A Diversity Combiner for Telemetry," by Clifford Hall of Nems-Clarke. It described a combiner that accepts the outputs of four receivers and produces a single output. Since considerable effort to improve rf transmission between missiles and telemetry receiving stations has increased use of multi-receiver stations, Mr. Hall's paper was considered timely.

Rf fields reaching the ground from a missile fluctuate rapidly in strength and polarization



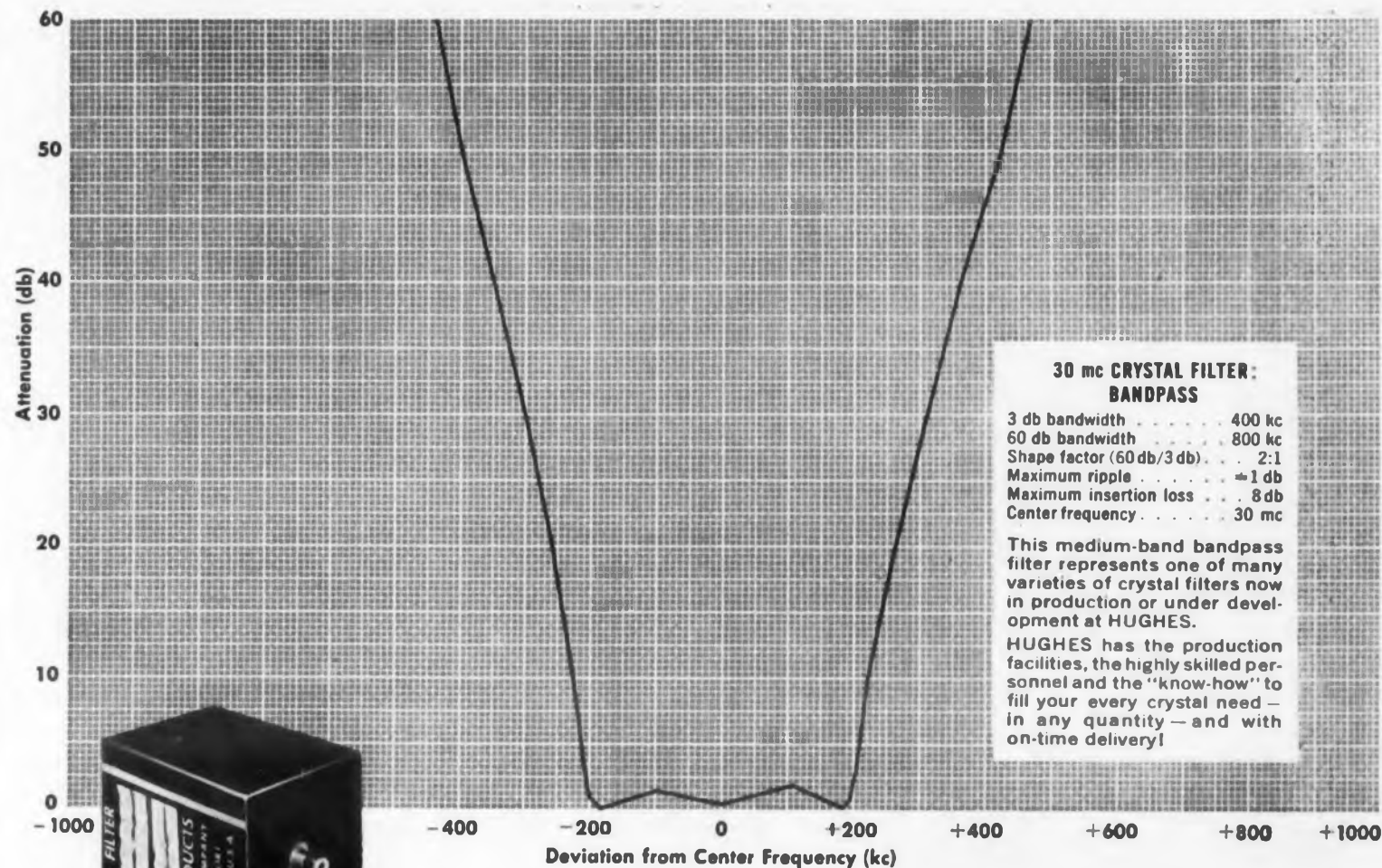
Nems-Clarke diversity combiner for telemetry, described to San Francisco space electronics show, provides one strong output from four receivers. Signal polarization and strength from a missile fluctuate, but with right-and-left-polarized antennas and variously placed receivers, signal loss is minimized.

while the missile is in sight. When more than one antenna and receiver are connected to a combiner, the outputs result in a single signal of a quality often much higher than that of the output of any one receiver.

In Mr. Hall's diversity combiner each receiver contributes to the output in proportion to its signal-to-noise ratio. When the receiver output noises are uncorrelated, the combiner signal-to-noise ratio is equal to or higher than the best receiver signal-to-noise ratio.

A common cathode combining circuit is used in the combiner. Each receiver's contribution to

(Continued on page 11)



TIGHTEN YOUR "SPECS" WITH HUGHES CRYSTAL FILTERS

Your difficult filtering problems solved with high-performance, precision crystal filters custom-designed and produced for you!

If you face tough filtering problems in: Single-Sideband, Doppler Systems, Missile Guidance, Radio Communications, Radar and Navigation, Spectrum Analyzers, Carrier and Multiplexing, Frequency Shift Systems, High Selectivity Amplifiers:

Check these advantages of Hughes precision crystal filters: Small size, light weight, low insertion loss, low passband ripple, precise selectivity, high frequency filtering, quick delivery in quantity, wide temperature stability, high

reliability, rugged resistance to shock/vibration.

Experienced Hughes Application Engineers are available to work with you on your filtering problems. For additional information on crystal filters with center frequencies of 30 kc to 52 mc, and fractional bandwidths of 0.01%-6.0%, write: HUGHES PRODUCTS, Industrial Systems Division, International Airport Station, Los Angeles 45, California. For export information, write: HUGHES INTERNATIONAL, Culver City, California.

INDUSTRIAL SYSTEMS DIVISION

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

© 1959, HUGHES AIRCRAFT COMPANY

SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

CIRCLE 13 ON READER-SERVICE CARD



COMPACT!

miniaturization in
a nutshell by



DISTRIBUTED BY



AVNET

EASTERN SALES

70 STATE STREET
WESTBURY, L. I., N. Y.
ED 3-5800 1Wx WESTBURY N. Y. 2617

DAYTON 39, OHIO
4180 KETTERING BLVD
AXMINSTER 8 1458 1Wx -DY 410

MELROSE PARK, ILL.
2728 NO. MANNHEIM RD.
GLADSTONE 5-8160
1Wx -FRANKLIN PARK 2187

WESTERN SALES

SUNNYVALE, CAL.
1262 NO. LAWRENCE STATION RD.
P. O. BOX 568 REGENT 6 0300



LOW POWER ZENER DIODES
VOLTAGE REGULATING DIODES
(0.005% Reference Element)

TANTALUM CAPACITORS
(E. y Solid)

MEDIUM POWER ZENER DIODES
DOUBLE ANODE ZENER DIODES
HIGH POWER ZENER DIODES
LOW POWER RECTIFIERS
HIGH VOLTAGE RECTIFIERS
MEDIUM POWER RECTIFIERS
HIGH POWER RECTIFIERS

CIRCLE 14 ON READER-SERVICE CARD

NEWS

Tuning in at Random on the Conferences . . .

Lunik Uses PDM with Two Frequencies

The day the Soviet moon-circling satellite reached the moon, its PDM telemetering signal changed character sharply. A different type of modulation went into action at a much higher pulse frequency. Both types of telemetering signal, picked up by Western scientists, are still being analyzed by Space Technology Labs, several of the scientists told *ELECTRONIC DESIGN* in Chicago, but there is no real chance of learning much about Lunik's instrumentation setup from data so far recorded.

Of Engineers and Reliability

Dr. C. S. Draper of the Massachusetts Institute of Technology, recognized as this country's foremost guidance experts, told a National Electronics Conference navigation and guidance session in Chicago: "Any engineer worth his salt doesn't have to be reminded of the importance of reliability. And he understands that reliability is not quality control. Very often the grumbling feedback to parts people over failures are unjustified, because very often it is the equipment design that is just no good."

Utica Communications Symposium to be Permanent

The national administrative committee of IRE's Professional Group on Communications Systems voted to allow the Rome-Utica Chapter to hold a permanent yearly National Communications Symposium in Utica. Expanded facilities will be available when Utica's new civic auditorium is completed early in 1960.

Information Scientists Needed, OTS Chief Warns

Speaking at the opening luncheon of the National Electronics Conference, J. C. Green, director of the Office of Technical Services, told many of this country's electronic leaders that the answer to the problem of "exploding technical information" was the creation of information scientists or researchers on the same corporate levels as technical scientists and researchers. These new specialists, he asserted, would have central responsibility for seeing that all information from all sources promptly reaches the people who could use it.

GE Offering Company Value Engineering Service

General Electric, which founded the discipline of value engineering in 1947 under the leadership of Larry Miles, has organized a Value Engineering Service, *ELECTRONIC DESIGN* learned at Philadelphia. This month GE started selling the new service to its more than 100 departments around the country.

(Continued from page 9)

the combined output is controlled by sampling the receiver output.

Missile 'Drop Outs' Analyzed

Up to now, information concerned with ICBM and IRBM firings has been pretty well classified. It was with some interest, therefore, that those in attendance heard "Radio Frequency Propagation to and from ICBMs and IRBMs," by William Drake and Fred Howell, of Space Technology Labs. An analysis was made of a large number of missile launches to learn the whys of data "drop outs."

Typical difficulties were traced to antenna ionization, flame attenuation, antenna pattern (narrow beam width) and pressure shock wave. The paper presented a number of remedies:

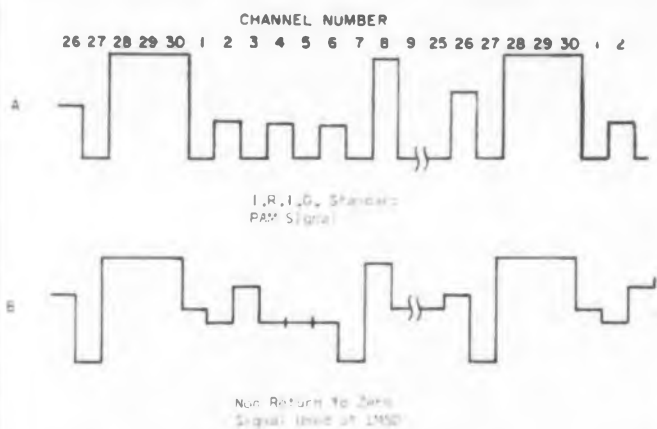
- To stop antenna ionization, one should reduce the transmitter power to below the level that will result in sustained breakdown.

- To avoid flame attenuation, one should place airborne antennas as far as possible from the rocket exhaust. This ensures a better look angle between the antennas and the ground stations during a period of low aft aspect angle. Flame attenuation will be only slightly reduced.

In general, the authors urged that ground stations be placed for maximum aft aspect angle during powered flight—in particular not too near the launcher. A medium-gain antenna near the launch site will give adequate coverage during the first minute of flight, the paper reported, and high-gain tracking antennas placed down-range, where they have aft-aspect angles better than 90 degrees, will give excellent coverage from the time the missile appears over the horizon. This, in spite of the low transmitting power recommended in the first point.

Decom for a Wildcat System

William Kroll of the Lockheed Missiles and Space Division described "A Decommutation



Lockheed's "wildcat" telemetry system, presented at San Francisco conference, has 100 per cent duty cycle. Upper signal is IRIG standard PAM signal with reference pulses. Lower curve is non-return to zero signal.

Electronic Products **NEWS**

by **CARBORUNDUM**
Registered Trade Mark



Having transistor troubles? THERMISTOR AND VARISTOR TEST KITS available for development and experimental work

Interest in the temperature-sensitive and voltage-sensitive characteristics offered by GLOBAR® ceramic type non-linear resistors is now being demonstrated in many electronic applications. In transistorized circuits, for example, GLOBAR thermistors help to stabilize I_c variations with temperature and to prevent thermal run-away. GLOBAR varistors protect transistors against over-voltage.

For those who would like to experiment with possible applications, test kits are available at a very nominal charge. Bulletins GR-2 on varistors and GR-3 on thermistors give physical and electrical characteristics, types and sizes available and other pertinent data. Just drop a line to Global Plant, Refractories Division, Dept. EDR 109, The Carborundum Company, Niagara Falls, N. Y.

CIRCLE 712 ON READER-SERVICE CARD

GRADED SEALS—KOVAR® ALLOY to Pyrex-type Laboratory Glass

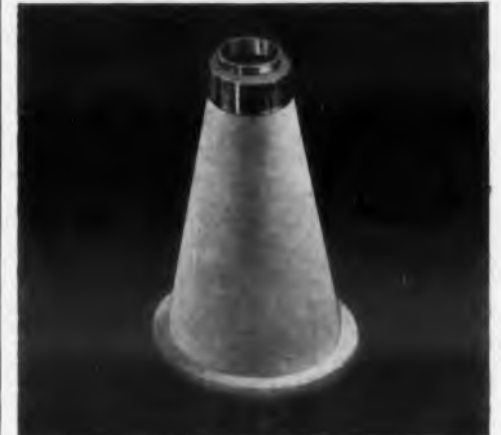


One of the many examples of glass-to-metal sealing made possible by KOVAR alloy is the graded seal shown here. This is a tubular transition piece for hermetically joining metal tubing to laboratory Pyrex-type glassware. The metal end, which can be joined to other metals, is of KOVAR alloy. Its thermal expansion characteristics are almost identical with those of borosilicate hard glass, which is used for the first glass section, fused to the metal. Succeeding glass sections, graded in thermal expansion coefficient, connect the borosilicate glass to the Pyrex-type glass, which can be fused to laboratory Pyrex systems.

Stock sizes are from $\frac{1}{8}$ " to 1.9" diam. at the metal end and from $\frac{3}{8}$ " to 14" overall length. For further information, write to Latrobe Plant, Refractories Division, Dept. EDS 109, The Carborundum Company, Latrobe, Pa.

CIRCLE 714 ON READER-SERVICE CARD

Large Ceramic-to-Metal Assembly solves problem in new electronic devices

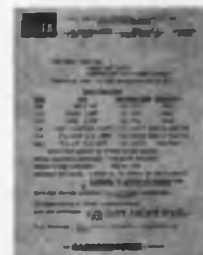


The problem of sealing a heavy metal ferrule to a large ceramic cone was brought recently to Carborundum's Latrobe Plant. Team effort involving research and long experience in producing high strength, high temperature, vacuum tight ceramic to metal assemblies resulted in the final design shown above. The ferrule is bonded to a dense, 96% alumina cone. It will withstand assembly and operating temperatures far above the range of soft solders and is extremely rugged.

Carborundum has facilities for manufacturing ceramic-to-metal assemblies to meet a wide range of specialized requirements. Our engineers will welcome the opportunity of discussing your particular problems. Write to Latrobe Plant, Refractories Division, Dept. EDC 109, Carborundum Company, Latrobe, Pa.

CIRCLE 713 ON READER-SERVICE CARD

NEW DATA SHEET ON HIGH TEMPERATURE RESISTORS



New Technical Data available on high temperature resistors—type SP. All essential technical information, including watt ratings, sizes, resistance ranges, terminations, temperatures, overload capability etc., are included. For your copy, write to Global Plant, Refractories Division, Dept. EDR 109, Carborundum Company, Niagara Falls, N. Y. CIRCLE 715



CERAMIC PARTS AND METALLIZED ASSEMBLIES

KOVAR ALLOY

CERAMIC RESISTORS

VARISTORS

THERMISTORS

CIRCLE 712 THROUGH 715 ON READER-SERVICE CARD

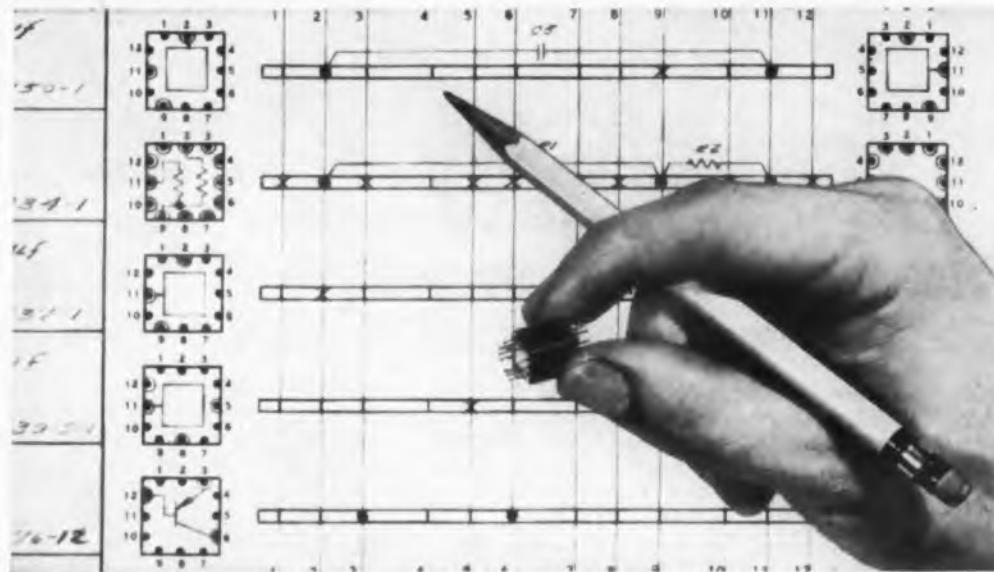
Status Report on RCA Micromodules —
dramatic new devices for high-density parts packaging

How soon will you see your electronic products in Micromodule form?

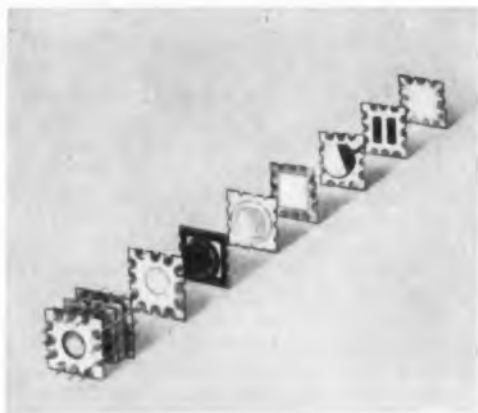
The excitement over Micromodules is still mounting! We haven't seen such enthusiasm and activity since the early days of transistors. Scores of electronic equipment designers and manufacturers are asking: "How soon can I see my product in Micromodule form?" Our answer: *Right Now!* We'll take your circuit, breadboard, or black box, evaluate it and convert it to module form. In fact, you will find that end-equipment in Micromodule form is probably only *one design cycle away!*

Special Presentation Now Ready!

RCA Field Engineers are prepared to show you a presentation that will clearly explain the potentialities and the current working realities of Micromodules for application in military computers, digital devices for missiles and satellites, airborne or portable communication equipment, or submarine electronics. Many designers who have seen this presentation were so impressed with the possibilities of extreme miniaturization and increased reliability of Micromodules that they have immediately placed orders to begin micromodularization of their equipment. Call your RCA Field Representative today and he will set up a presentation for you at your convenience.



RCA Micromodules, today's most exciting, most practical answer to high-density parts packaging, make possible equipment with modular parts densities to 600,000 per cubic foot. Result: important space savings over existing miniature equipment and an amazing increase in the number of circuit functions per cubic foot. Increased reliability through redundancy, room for more circuits to improve accuracy, precision, control and sensitivity are other significant advantages offered to designers.



Micromodules, developed through the joint efforts of RCA and other leading component manufacturers, in cooperation with the U.S. Army Signal Corps, are units in which several microelements are combined to perform specific functions such as amplifier, oscillator, or divider. The microelements are tiny ceramic wafers .310

inches square and 1/100th inch thick, on which conducting, semiconducting, and insulating materials are fused to provide the electrical characteristics of basic electronic components such as resistors, capacitors, and transistors. The microelements are interconnected and encapsulated to form Micromodules.

RCA FIELD OFFICES

East: 744 Broad Street, Newark, N. J.
HUmboldt 5-3900
Northeast: 64 "A" St., Needham Heights 94, Mass.
Hillcrest 4-7200
East Central: 714 New Center Bldg., Detroit 2, Mich.
TRinity 5-5600
Central: Suite 1154, Merchandise Mart Plaza
Chicago, Ill., WHitehall 4-2900
West: 6355 E. Washington Blvd.
Los Angeles, Calif., RAymond 3-8361
Gov't: 224 N. Wilkinson St., Dayton, Ohio
BAldwin 6-2366
1625 "K" St., N.W., Washington, D.C.
District 7-1260

ALSO AVAILABLE AT YOUR LOCAL
RCA SEMICONDUCTOR DISTRIBUTOR



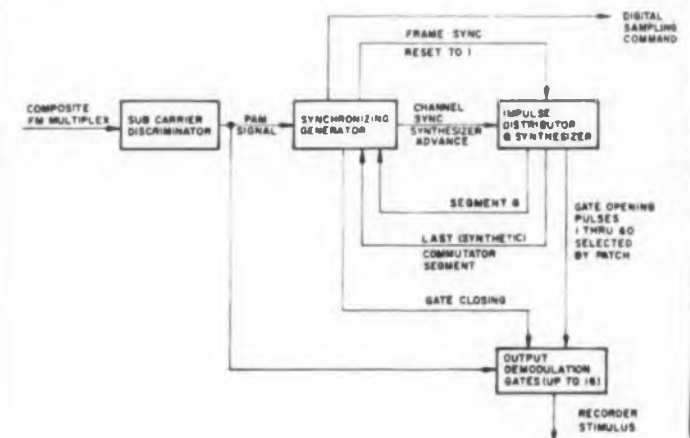
RADIO CORPORATION OF AMERICA
SEMICONDUCTOR & MATERIALS DIVISION • SOMERVILLE, N. J.

NEWS

System for FM/FM Telemetry" that permits doubling of the information capacity of a commutated telemetry channel. This is done, it was reported, by using a non-return to zero PAM signal.

Outstanding features of the decom system were given as:

- Continuous coverage of commutator speeds from below 60 to more than 600 points per second without resorting to plug in devices.
- Accommodation of 30, 45 or 60 commutators,
- Automatic synchronization when the signal first appears and sustained synchronization when commutator speed changes occur,
- Accommodation of commutator speed changes of ± 30 per cent during a run,
- No effect on operation of the system should loss of frame synchronization occur for several frames.



System block diagram of Lockheed telemetry system for non-return to zero decommutation.

Deep Space Talking

Two approaches to space-to-earth communication were presented. Pasos and Heninger of the Philco Corp. described "A Reactance-Modulated FM Transmitter for Space Communications or Telemetry." A cavity oscillator using a planar power triode in a grid isolation circuit generates power in the 2 kmc region. The transmitter developed at Philco uses crystal diodes coupled into the cathode cavity to obtain a variable reactance for fm.

Jensen of Philco, however, solved some of the problems involved in using a voltage tuned magnetron. Since this tube is so efficient, it is a logical choice for space transmitting. But since it is basically a wide-band device, new techniques in high-voltage regulation and afc to maintain a stable frequency had to be developed. Jensen's paper, "A New Telemetry Transmitter Using a Voltage Tuned Magnetron for Space Environment," described some of the design solutions.

The technique uses a crystal oscillator output against the multiplied crystal frequency's mixed signal with the magnetron frequency. The frequencies from crystal and mixer are switched, amplified, detected, amplified and finally synchronously detected to provide correction to a saturable reactor regulator. With this technique, a wide band device like the voltage tuned magnetron can be used in a narrow-band application with good frequency stability, it was said.

Toronto

Two themes, the strength of the Canadian electronics industry and the importance of space electronics, dominated the fourth annual IRE Canadian Convention and Exhibition in Toronto (Oct. 7-9). Some 8000 registrants saw more than 120 exhibits. More than 100 papers were presented.

In the well-attended space meeting, R. K. Brown of Canada's Defense Research Board reported on the development of equipment for studying the ionosphere from above, using rockets and satellites. For the project, the board has designed a sounding and telemetering set that will develop a peak power of 80 watts for sounding, a 0.8-watt average power and a telemetry average power of 25 watts. A solar-cell array will supply 7 watts at a cost of \$3000 per watt.

The set, which will operate between 2 and 15 mc, was designed on the basis of the following loss figures:

| | |
|---|----------|
| Thermal noise (over 30 kc bandwidth) | -159 dbw |
| Cosmic noise | + 45 db |
| Antenna losses | + 10 db |
| Space transmission losses | +103 db |
| Receiver signal-to-noise | + 10 db |
| | + 19 dbw |

T. A. Randall of Aeronca, in a paper on lunar communications, emphasized that only a little work, relatively, has been done on space receivers and even less on transmitters and antennas for space use. Especially needed, he said, are power sources, receiver circuitry that will track doppler shifts in transmitter frequency, and space-vehicle directive antennas with high stability and coverage from broad to narrow bandwidth.

Radical Advances Reported

Two radical developments were reported in the panel discussion that followed the space electronics papers. One, a "thermo-electron converter" power source, was described by Mr. Brown as a giant diode. In the device, a cylindrical, chemically heated filament is enclosed with 0.005 inches of tolerance in another cylindrical element. The converter was said to develop 0.5 volts at 5 amperes "with very high efficiency."

The other development, described by a Crosley

after routing,
clip and save

a continuing series on technical topics
of specific interest to engineers

Folio 59-7

REFERENCE
DATA FILE



notes on the life expectancy of capacitors

*"At half past nine by the meet'n-house clock,—
Just at the hour of the Earthquake shock!
What do you think the parson found,
When he got up and stared around?
The poor old chaise in a heap or mound,
As if it had been to the mill and ground!
You see, of course, if you're not a dunce,
How it went to pieces all at once,—
All at once, and nothing first,—
Just as bubbles do when they burst.
End of the wonderful one-hoss shay.
Logic is logic. That's all I say."*

From the "One-Hoss Shay" by
Oliver Wendell Holmes

The designer and builder of the One-Hoss Shay achieved an interesting objective of some modern-day designers—a product utilizing component materials of great uniformity and well-coordinated life expectancy.

In capacitor design the One-Hoss Shay concept would result in enormously expensive units since materials normally vary in their physical and electrical characteristics. Therefore, the manufacture of capacitors with perfectly uniform characteristics from one to the next would involve a complex process of detailed selection of their component materials, and uniform assembly procedures. Economical and practical capacitors must accordingly be designed with two points in mind:

- 1) They will have a finite, but should have a very low, failure rate.
- 2) They will have a finite, but should have a long, life expectancy.

Exact determination of these levels for any capacitor design is a complex process of analysis and testing. A few of the highlights of these methods will be discussed below.

It has previously been shown (1) that the life expectancy of paper-oil dielectric capacitors is inversely proportional to the fifth power of the applied DC voltage. Further studies (2) indicate that one responsible mechanism for this exponential relationship is gassing of the oil. The life expectancy was also found to be halved for each ten degree Centigrade increase in operating temperature, over the normal range. This effect is probably analogous to the familiar chemical rule concerning the electrolytic action rate of solutions. Thus the actual measured life under a set of test conditions can be translated into expected life under another set of conditions of voltage and temperature, as follows:

$$L_2 = \left(\frac{E_1}{E_2}\right)^5 \cdot T_1 \cdot 2^{-\left(\frac{t_2 - t_1}{10}\right)}$$

where L_2 = expected life in hours
 E_1 = test voltage
 E_2 = actual working voltage
 T_1 = time duration of test in hours
 t_1 = test temperature in degrees Centigrade
 t_2 = actual operating temperature in degrees Centigrade

This relationship applies only to a failure caused by the actual degradation of the paper-oil dielectric brought about by the stresses of voltage and temperature. It would be most misleading to say that each and every failure experienced in any production lot will obey this law—some failures may be the result of manufacturing errors or material flaws.

This basic formula, although evolved for paper-oil capacitors, appears to apply to other types, such as mica and plastic film, but the fifth power law does not hold for these types since their molecular structure is significantly different. A voltage exponent of seven to ten appears to be appropriate for these types. It is also possible that the rule of halving of life expectancy with each ten degree Centigrade rise in temperature may not strictly apply to materials other than paper-oil because of their inherently different sensitivity to temperature, and due to different ranges of operating temperature. These points are the subject of much continuing investigation.

The formula shown has thrown a new light on the use of accelerated conditions as a production evaluation tool. Accelerated tests have, in certain instances, become a processing procedure, offering two major advantages:

- 1) So-called "early" failures can be eliminated to a high degree by proper over-stressing.
- 2) Life expectancy can be better evaluated since measured results are available in a short time.

Thus accelerated, or "screening," tests can serve a highly useful purpose where very high degrees of reliability are required, and must be measured or estimated quickly. This processing and evaluation, of course, involve additional expense, and are therefore not used for run-of-the-mill products. They also do not ensure a good product if the design or manufacturing controls are basically inadequate, and must never be used to sort good units from an inherently bad population.

One additional point should be made before we summarize an example: since, unlike the One-Hoss Shay, we cannot have all production capacitors fail simultaneously, some attention must be paid to the distribution of the failures with regard to time. It is important to know the shape of the failure rate curve.

Some hypothetical numbers can be used to illustrate the previous discussion. Assume that a group of 200 silvered mica button capacitors, designed for 500 WVDC and 125°C., is subjected to an accelerated test of 1000 VDC and 150°C. for 50 hours. At the end of this time, a failure level of one per cent is found, and the failures have occurred at 10 and 40 hours (we assume they are "pure" dielectric failures). Assuming a voltage exponent of 8 to apply, we may use the expected life equation as follows:

$$L_2 = \left(\frac{1000}{500}\right)^8 \cdot T_1 \cdot 2^{-\left(\frac{125 - 150}{10}\right)}$$

therefore, $L_2 = 1435 T_1$

or, under actual conditions, these failures would have occurred at 14,350 and 57,400 hours of continuous operation. These failures then represent 0.035 and 0.009 per cent failures per 1000 hours, respectively. These times to failure correspond to over 16 and 65 years of normal, intermittent service.

References:

- 1) J. R. Weeks, Capacitor Life Testing, Bell Laboratories Record, Vol. XXIV, No. 8, August, 1946.
- 2) Harold Basseches and Mary W. Barnes, Gassing of Liquid Dielectrics Under Electrical Stress, Industrial and Engineering Chemistry, Vol. 50, No. 6, June, 1958.

SC-59-8

SANGAMO ELECTRIC COMPANY, Springfield, Illinois
--designing towards the promise of tomorrow

CIRCLE 15 ON READER-SERVICE CARD

NEWS

engineer, is a space antenna wound in an extended spiral then compressed to coil-spring form. From its 2.5-inch compressed height the antenna (weighing 1.5 ounces) springs open to a 6-foot length.

Space applications were the background for much of the discussion in the solid-state session. G. C. Sziklai of Westinghouse pointed out the advantages of molelectronic equipment for space use in his paper on molecular electronics, and A. C. H. Hallet of the University of Toronto did the same for the properties of metals at very low temperatures.

In all, there were 25 technical sessions, covering nearly the whole range of the electronic art.

Among the products on display were:

- Bach-Simpson's frequency controller-indicator, which won the best-Canadian-designed-component award at the show. (Bach-Simpson won last year's inaugural contest with an oscilloscope.) The novel device uses a synchronous motor to drive an ac generator that provides a voltage varying with the frequency being measured. The unit is said to be about one-third the size of standard frequency meter-controllers.

- Raytheon's GP803 scan converter, which won the best-product-design award. The unit was developed for bright radar display of air traffic (See *ED* June 24, 1959; p. 3).

- A filament-voltage regulator designed by C. P. Clare Canada, Ltd., in which a mercury-wetted relay cuts a resistor into the filament circuit of vehicular communications equipment to limit the effective heating voltage applied to the load. The unit reduces battery-generator input surges from 40 to 5 per cent.

Announced at the convention dinner was the establishment of a region Gold Medal Award for technical or administrative contribution to research or development.

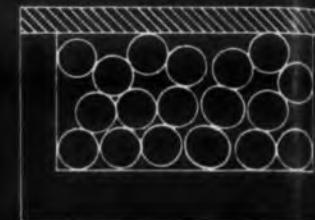
Chicago

The Fifth Conference on Radio Interference Reduction and Electronic Compatibility, held in Chicago (Oct. 6-8), heard this warning by G. P. Sutton, chief scientist of the Advanced Research Projects Agency in Washington:

"Failure to achieve a satisfactory and relatively interference-free environment may seriously compromise the effectiveness of our defense system. . . . Radio interference may mean the loss of lives, expensive equipment or strategic advantage."

In a keynote address to 300 engineers at the conference, Mr. Sutton urged more general consideration of problems of frequency allocation, radiated power requirements, antenna directivity and other factors to minimize interference.

*Balance your
insulation
system with
the better
properties of . . .*

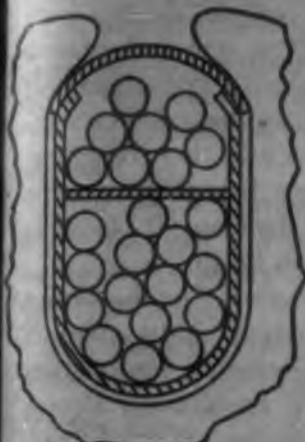


Random Wound Coil

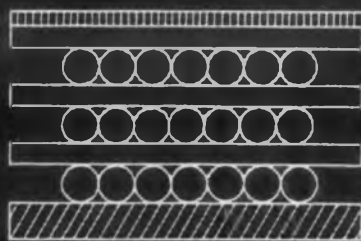
PHELPS DODGE NYLEZE®

*The extraordinary advanced film magnet wire
that combines . . . Windability, Varnishability, Solderability,
Thermal Stability (Class B 130° C.) . . . all in one wire!*

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



Stator Wound Motor



Layer Wound Coil



Wound Rotating Armature

Remarkable Windability—slick, hard surface permits wire to wind into space more compactly. Excellent resistance to winding abrasion in automatic equipment.

Outstanding Varnishability—withstands wider variety of hot varnish solvents. Ideally suited for *hot dip* in high speed varnishing operations. Excellent for encapsulation or potting.

Easy Solderability—solders or dip-tins at 650-750° F. without cleaning or stripping. No damage to copper conductors.

Unusual Thermal Stability—rated Class B temperature with a thermal life of 20,000 hours at 135° C. when tested according to AIEE #57 procedures (unvarnished). Provides unusual film “cut-thru” resistance at high temperatures.

Nyleze®—with the strongest combination of balanced film wire properties—builds greater strength and reliability into modern insulation systems.

FIRST FOR
LASTING QUALITY
—FROM MINE
TO MARKET!



PHELPS DODGE COPPER PRODUCTS
CORPORATION

INCA MANUFACTURING DIVISION
FORT WAYNE, INDIANA

CIRCLE 16 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

A multi-fold increase in launched space vehicles for weather observation, scientific exploration, biomedical investigations and communication repeater stations is scheduled for the near future, Mr. Sutton indicated. Unless spectrum allocation is determined in advance and undesired emission eliminated, he asserted, chaos will result. Telemetry data may be rendered useless and valuable scientific programs voided, he warned.

Three Vital Phases in RFI Reduction

In the military area, as altitudes, velocities and mobility of vehicles increase, communication-electronic (C-E) systems increase in complexity, power output and spectrum utilization, the conference was told. A. H. Sullivan Jr. of Engleman & Co., Washington, predicted that “in time, interference aspects may predominate over all other considerations in engineering C-E systems.”

He presented three vital phases in planning an interference-free C-E system:

- Prediction of interference, based on known data and measurements concerning (1) system and equipment performance, (2) ambient electromagnetic environment and (3) propagation and frequency data.

- Engineering the C-E system for maximum compatibility with the electromagnetic environment, based on data furnished by prediction.

- After installation of the system, reducing existing interference not foreseen during the prediction phase.

Prediction Techniques Described

Relatively small systems or individual pieces of equipment can conceivably be “cleaned up,” the conference heard, by effective shielding, adequate filtering and rerouting of cables and leads. For major military installations, however, RFI headaches must be reduced to a minimum during the initial planning stage.

Site selection, equipment to be used, operating frequencies assigned—all must be evaluated for minimum interference interaction, it was stressed.

C. E. Vlasky of the Georgia Institute of Technology outlined the method of constructing Mutual Interference Charts from which a systematic selection of operating frequencies can be obtained for adjacent equipment with maximum freedom from interference.

Missile Hazards Noted

A film depicting numerous missile launchings—some successful, some failures—offered grim evidence of the potential dangers of RFI.

H. R. Austin of Motorola, Inc., Chicago and F. E. Rock of General Electronics Lab, Inc., Cambridge, Mass., presented a paper on the interference possibilities open to a satellite communications system from mutual, galactic, terrestrial and airborne sources.

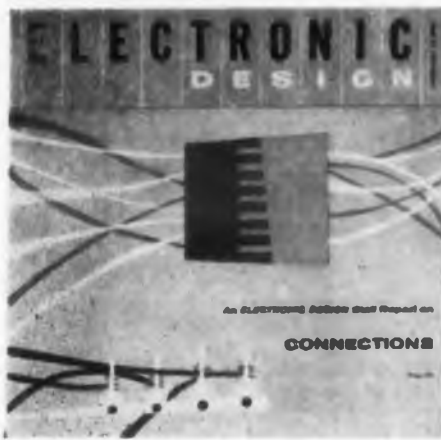
(Continued on page 16)

reprints

TO HELP YOU IN YOUR DESIGN WORK

These reprints are offered to you by Electronic Design

In answer to the many requests of our readers, ELECTRONIC DESIGN offers these 2 valuable reprints for your files to keep you up-to-date on the most current developments.



CONNECTIONS

16 page comprehensive report from the Feb 18th issue concerning the latest advancements in the field: • Connections Between Equipment • Connections Inside Equipment • RF Connections. Included are such items as cable connectors, connectors used with rack mounted equipment, printed circuited connectors, terminal blocks. Read ELECTRONIC DESIGN's finding on this enormous field of electrical connections.

Circle 749 on Reader Service Card

MICROELECTRONICS

ELECTRONIC DESIGN offers this important 12 page staff report from the April 29th issue to keep readers alerted to the newest techniques, processes and the current status of developments in microminiaturization. The growth is phenomenal—2 years ago microelectronics was in the laboratory stage. Now it is causing a revolution in electronic packaging.

Circle 750 on Reader Service Card



For single copies, circle the correct Reader Service Number and with your reprint you will be sent a handy coin card for your remittance.

CONNECTIONS

| | |
|----------------|--------|
| 1 copy | \$0.50 |
| 5 copies | 2.00 |
| 10 copies | 3.50 |
| 25 copies | 7.50 |

MICROELECTRONICS

| | |
|----------------|--------|
| 1 copy | \$0.50 |
| 5 copies | 2.00 |
| 10 copies | 3.50 |
| 25 copies | 7.50 |

For multiple copies fill out the coupon below.

MAIL TO DEPT. C-9/16 ELECTRONIC DESIGN, 830 THIRD AVENUE, NEW YORK 22, N. Y.

Please send me: .. copies of Connections Report Please Bill Cash Enclosed
 .. copies of Microelectronics

Name

Address

City Zone State

NEWS

H. Kilberg of RCA Service Co., Patrick Air Force Base, Fla., discussed the RFI detection system at the Atlantic Missile Range and presented slides depicting the complex and varied instrumentation in use.

Electrically ignited pyrotechnic devices are used in missiles and aircraft as one-shot energy sources for destructors, explosive bolts, ejection seats and other actuators, it was noted. The hazards of stray electromagnetic radiation triggering such devices and precautions being taken were covered by B. Weinbaum of the Convair Division, General Dynamics Corp., San Diego.

The conference was sponsored by the Army Signal Research and Development Labs and was conducted by the Armour Research Foundation in cooperation with the IRE Professional Group on Radio Frequency Interference.

Space Equipment Shown

The NEC conference in Chicago (Oct. 12-15) featured space equipment and components in many of the 260 exhibit booths.

The requirements for very long range communications equipment, for ultra reliable systems, for massive data handling and for new solutions to old problems were the bases of many of the roughly 110 papers delivered.

A highlight of the conference was a special session at which scientists of Space Technology Labs reported on the findings to date of Explorer VI and three Lunik satellites. Besides revealing new data on the earth's radiation belts and magnetic fields of the earth and moon, the scientists described the Telebit system for digitizing, storing and telemetering data collected by the sensors of Explorer VI.

Attendance at the conference, swelled by a simultaneously held AIEE fall meeting, reached the neighborhood of 10,000.

Philadelphia

The EIA-sponsored Value Engineering Conference in Philadelphia (Oct. 6-7) argued that government and industry were not getting full value for their money. Weapons and communications systems, produced at crash-program speeds, cost millions more than they should, Larry Miles, value engineering chief of General Electric, contended.

Mr. Miles, founder of the 12-year-old movement of value analysis, said that system costs could be slashed without sacrifice in performance. The target, he declared, should be three systems for the price of one.

With crusading fervor, speaker after speaker from major companies—from GE, Radio Corporation of America, Stromberg Carlson, Raytheon—

and speakers from the military—BuShips, BuAer, Army Ordnance; Army Rocket and Guided Missile Agency—all cited outstanding records of cost savings inspired by value analysis.

Savings amounting to millions were attributed to the small but growing army of value engineers.

Conferees complained bitterly of being mistaken for mere cost reductionists. The difference, they argued, is clear:

"The cost reduction man tries to shave the cost out of a part. The value analyst wants to chop the cost out of a function."

The value engineer's golden book starts with: What does it do? What does it cost? What else can do the job? What will that cost?

The conference was hailed as a milestone in value analysis. Announcements of more and more military contracts with value-engineering incentive clauses pleased the unexpectedly large attendance of 360.

(See ED staff report on value engineering Nov. 12, 1958.) ■ ■

CONFERENCE QUOTES...

On Molecular Electronics . . .

"In the next ten years, materials engineers and systems engineers will no longer be separated by a component engineer. The component specialist will become either a materials or systems man, and a new type of engineer will be born, the molecular engineer." *G. C. Sziklai, Westinghouse, after delivering a paper on molecular electronics at the Canadian IRE.*

On Space Guidance . . .

"Although no radically new techniques will be required, present ones need to be improved considerably to be compatible with the severe size, weight and power limitations imposed by space operations, the rigorous reliability requirements for lengthy performance and the uncompromising accuracy demands of space navigation." *Bernard Lee, Emerson Electric, in a discussion of space guidance at NEC in Chicago.*

CIRCLE 17 ON READER-SERVICE CARD ▶



The first and only Germanium Mixer Diode
specifically designed for ultra-low noise performance
in Doppler Radar



| ELECTRICAL CHARACTERISTICS | |
|--|------------|
| IF Test Frequency..... | 20 kc. |
| RF Test Frequency..... | 13,500 mc. |
| Overall Receiver Noise Figure (max.) | 32 db. |
| Burnout..... | 1.3 ergs. |
| <i>For complete information write to — Special Components Department ED 1059</i> | |

This Philco mixer diode is uniquely designed for excellent, low-noise performance in Doppler radar receivers employing audio frequency IF amplifiers. Crystal noise output (flicker noise) is minimized in the 1 to 100 kc. range.

The RF test frequency is 13,500 mc., assuring high performance at either the 8,800 mc. or 13,500 mc. bands now being used.

Philco's exclusive bonded anchor whisker virtually eliminates microphonics. The 1N1838 is hermetically sealed and is designed and field-proven to meet the most stringent military environmental and electrical requirements. It is immediately available in production quantities.

PHILCO®

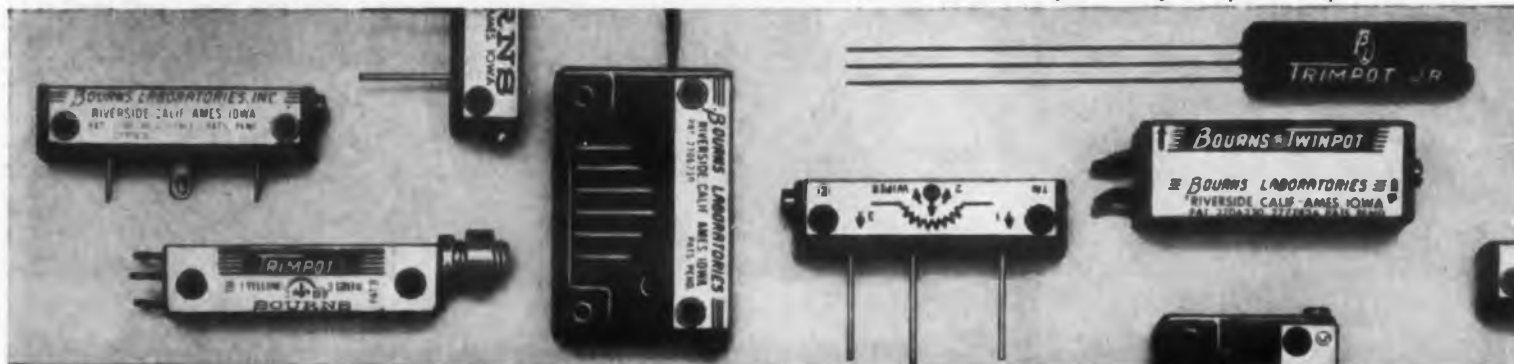
LANSDALE TUBE DIVISION • LANSDALE, PENNSYLVANIA



24 HOUR DELIVERY OF TRIMPOT® POTENTIOMETERS

500,000 STOCKED BY DISTRIBUTORS AND FACTORIES

Immediate "off-the-shelf" delivery is available of the entire line of standard Trimpot potentiometers — 20 basic models . . . 4 terminal types . . . 3 mounting styles! More than 1/2 million units are stocked by franchised distributors across the nation and at Bourns plants in Riverside, California and Ames, Iowa with distributors selling at factory prices in quantities to 2000 pieces. Wherever you are, whatever standard unit you need, there's a Trimpot source close at hand waiting to fill that rush order . . . no need to hold up your prototype or production projects. This fast service is made possible by mechanized production processes, enlarged facilities, and greatly expanded engineering and production staffs. All this is part of our intent to provide the finest customer service program. It is another Bourns plus — in addition to the high quality, reliability, and performance that have won Trimpot potentiometers a place in major missile, aircraft and commercial electronic systems. Write for price quotations and list of representatives and distributors — today. Let us assist you with your special requirements as well.



**BOURNS
Inc.**

P.O. Box 2112q Riverside, California
Plants: Riverside, California
and Ames, Iowa

In Canada: Douglas Randall (Canada), Ltd., licensee

Exclusive manufacturers of TRIMPOT®, TRIMIT®, Pioneers in potentiometer transducers for position, pressure and acceleration.

CIRCLE 18 ON READER-SERVICE CARD

WASHINGTON REPORT



Ephraim Kahn

Electronics Subcontracting To Be Reviewed

Big electronics companies with prime contracts from the Defense Department may be visited by investigators from the House Small Business Committee. They will be asked about their subcontracting programs and what their plans are for throwing more business to smaller companies.

Underlying the committee's activity is its apparent desire to impose some sort of Congressionally approved rules that will force the Government to put more prime contracts in the hands of small firms. The committee's staff has made studies of government buying and small business. Its conclusion is that "although the Department of Defense has contended that the future for small business in Government procurement lay in the subcontracting field because of the innovation of the new complex weapons, the only protection for an equitable share of procurement for small business is still in the prime contracting field."

The group also asserts that it is only in prime contracts that legislative control exists over money spent. In the "subcontracting field, there is no legislative control over the procurement dollars and there is no method established in which Congress is able to follow and direct the procurement dollar to ascertain how much, if any, is going to small business." Efforts of prime contractors to buy from small firms vary widely, "but there is no equality for small business," as the committee's staff sees it. Despite claims of efforts to correct a situation in which the percentage of prime defense contracts going to small business continues to decline, "nothing constructive is being done to overcome this decline."

The fact that small firms are receiving only 3.4 percent of prime contracts for R&D draws heavy fire from the Committee. It says that this portends "a concentration of know-how into the hands of the larger manufacturers. The dominant position of these favored manufacturers may become entrenched if they are permitted to acquire a disproportionate share of the benefits of modern research and development."

A subcommittee of the Small Business Com-

mittee may, in effect, take its case to the country. The group, headed by Rep. Multer (D., N.Y.) "deems it important that small-business firms in the field be given an opportunity to tell their story to Congress."

The committee will, of course, continue its push for increased use of advertised, competitive bidding in military purchasing. It claims, for example, that in connection with a single purchase of radar systems, \$750,000 were saved. Similarly, in a procurement of a radiac system, \$158,000 were saved.

Staff studies of interest to electronics companies are now being made. They include:

(1) The protection of proprietary rights of small firms that develop items at their own expense.

(2) The continued use and increase of negotiated procurement rather than the advertised, competitive method. The group also wants to be sure that bidding procedures have been effectively improved "to guarantee that small business will receive full bid sets, including specifications, drawings, amendments, and so forth, in ample time to permit submission of responsible bids."

(3) The use of restrictive language in specifications which precludes small business from having an equal opportunity to compete.

(4) The nature and extent of Qualified Bidders' Lists, planned procurements, and mobilization-type procurement which exclude small business from having an equal opportunity to compete for Government business.

(5) Whether the Government's buying agencies are putting enough emphasis on the joint-determination and set-aside programs to guarantee that full advantage is taken of the potential of small firms.

(6) Problems in the issuance of certificates of competency and certificates of small business, to determine whether small firms are receiving fair treatment and "to guarantee that when small business concerns are low bidders that they receive the contracts."

Senate Scores "Loose" Patent Procedures

The long-range move in Congress to impose tighter controls over patents in which the government has an interest has been pushed along another notch. The Senate Subcommittee on Patents, Trademarks, and Copyrights has sharply scored the "comparatively loose procedures" used by the Veterans Administration to make the results of its research available to the general public. The agency has not taken title to any inventions but has left this with contractors, reserving the right (which it never used) to compel issuance of royalty-free licenses for patented items.



How permanent magnets "tune in" on trouble

Magnetic Materials Section reports on some of the largest permanent magnets ever cast . . . and on why they are replacing wound-motor fields in modern radar systems



This stator casting of Alnico 5—12" O.D. x 7" I.D. x 3" wide—one of the largest ever made, finds application in today's radar guidance systems.

Radar! It *must* be designed for absolutely uninterrupted operation.

That's why a General Electric 12-inch permanent magnet—one of the largest ever cast—is replacing the wound-motor field in many new radar systems. Besides offering reliable constant power and eliminating outside excitation and external regulating equipment, General Electric permanent magnets never wear out; offer significant savings in cost, weight, and space; provide one-piece, trouble-free operation.

Advantages like these—in large magnets or small—are solving many industrial problems, too. Whether your product is a motor or a control—a generator, magnetic separator, or holding device—there's a powerful General Electric permanent magnet to save you weight, space, and money. For further information regarding a specific application—or for the assistance of a G-E engineer, write: *Magnetic Materials Section, General Electric Company, 7820 N. Neff Ave., Edmore, Michigan.*

MAGNETIC MATERIALS SECTION

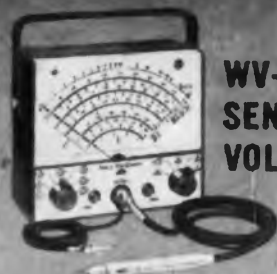
GENERAL  ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS
MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS
CIRCLE 19 ON READER-SERVICE CARD



WT-110A AUTOMATIC ELECTRON-TUBE TESTER

Fast, accurate, punched-card tube tester. Tests for gas, shorts, interelectrode leakage, and overall tube quality. Supplied with 253 punched cards, 24 blank cards, punch, and data for over 1000 types. \$199.50*



WV-98A SENIOR VOLTOHMYST®

Accurately measures ac and dc voltage as well as resistance from 0 to 1,000 megohms. Measures peak-to-peak values of complex waveforms—large 6½-inch meter. Includes special dc/ac-ohms shielded probe and cable. \$79.50*



WV-38A VOLT-OHM- MILLIAMMETER

New RCA VOM includes special 1-volt and 0.25-volt scales for transistor circuit servicing, fuse-protected ohms-divider network, extra-large 5¼-inch meter, polarity-reversing switch, standard dbm ranges. \$43.95* (Also available as WV-38A(K) Kit—\$29.85*)



WT-100A ELECTRON-TUBE MICROMHOMETER

Precision lab instrument for measuring true transconductance (accuracy better than ±3%—control-grid-to-plate (gm) and suppressor-grid-to-plate; electrode currents—plate, suppressor-grid, screen-grid, and control-grid; heater-cathode leakage current; voltage drop across low-voltage rectifier types; forward and reverse currents in small dry-disc rectifiers, and crystal diodes. For production-line testing, equipment design and development, quality control programs, preventive maintenance. Accommodates variety of bases and envelopes. Tests tubes at published ratings or at ratings under which the tube is expected to operate. \$1,075.00*

RCA

Test Equipment For Industry



WV-84B ULTRA-SENSITIVE DC MICROAMMETER

Battery-operated vacuum-tube microammeter measures down to 0.0002 microampere. Designed for general industrial, chemical, and critical laboratory applications. Especially useful in measuring "dark currents" in vidicons and phototubes, as well as minute currents in image orthicons. \$110.00*

*User price (Optional)



WV-77E VOLTOHMYST®

Famous RCA VoltOhmyst performance at a new low price with new in-use convenience features—separate 1½-volt and 4-volt peak-to-peak scales for accuracy in low ac voltage measurements, fuse-protected ohms-divider network, handle storage holder for ultra-slim probes and extra-flexible leads... and more! \$49.95* (Also available as WV-77E(K) Kit—\$29.95*)



WO-33A OSCILLOSCOPE

Small, compact, and portable—only 14 lbs.—this new general purpose 3-inch scope is ideal for TV and color TV servicing, low-level audio work square wave testing of audio and ultrasonic equipment, radio-TV broadcast station maintenance, industrial shop and lab applications. Amazing gain and bandwidth characteristics! \$129.95* (Also available as WO-33A(K) Kit—\$79.95*)

Check RCA—for your industrial test equipment requirements—whether you're engaged in laboratory and production testing, or research and service. Factory-wired and calibrated RCA Test Equipment can provide the accuracy and dependability required in many industrial electronic applications.

Call your Authorized RCA Test Equipment Distributor for complete technical details and fast delivery!



RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

MEETINGS

Calendar of Events

November

- 2-4 National Midwestern Meeting, "New Frontiers for Aviation," Hotel Lassen, Wichita, Kans.
 - 2-5 11th Exposition of the ARI, Air-Conditioning and Refrigeration Industry, Atlantic City, N. J.
 - 3-5* Mid-America Electronics Conference, Kansas City Section of the IRE, Kansas City Municipal Auditorium, Kansas City, Mo.
 - 4-6* National Automatic Control Conference, IRE, Sheraton-Dallas Hotel, Dallas, Texas.
 - 4-6 Eastern Analytical Symposium and Instrument Exhibit Baltimore-Washington, Delaware Valley, New York and New England Sections of the Society for Applied Spectroscopy, Analytical Groups of the N.Y. and N. J. Sections of the American Chemical Society, Metropolitan Microchemical Society, Hotel New Yorker, N. Y.
 - 4-6 ANS Winter Meeting, American Nuclear Society, Sheraton Park Hotel, Washington, D. C.
 - 5-6 Control Systems Components Conference, IRE, AIEE, SAE, ISA, ASME, Sheraton Hotel, Dallas, Texas.
 - 9-11* 4th IRE Instrumentation Conference and Exhibit, IRE, Atlanta Biltmore Hotel, Atlanta, Ga.
 - 9-11 Radio Fall Meeting, IRE, EIA, Syracuse Hotel, Syracuse, N. Y.
 - 10-12* 12th Annual Conference on Electrical Techniques in Medicine and Biology, AIEE, IRE, ISA, Sheraton Hotel, Philadelphia, Pa.
 - 12-13 American Society of Industrial Designers, Statler Hilton Hotel, New York, N.Y.
 - 16-19 Conference on Magnetism and Magnetic Materials, AIEE, Office of Naval Research, American Physical Society, IRE, and the Metallurgical Society of A.I.M.E. Sheraton-Cadillac Hotel, Detroit, Mich.
 - 16-20 14th Annual Meeting and Astronautical Exposition, American Rocket Society, Sheraton Park Hotel, Washington, D. C.
 - 16-20 5th International Automation Congress and Exposition, New York Trade Show Building, New York, N. Y.
 - 17-19 Northeast Electronics Research and Engineering Meeting, IRE, Boston Commonwealth Armory, Boston, Mass.
 - 19-20 6th Annual Meeting of the Professional Group on Nuclear Science, IRE, Somerset Hotel, Boston, Mass.
 - 23-24 Symposium on Solid State Techniques in Instrumentation, ISA, IRE, AIEE, Benjamin Franklin Hotel, Philadelphia, Pa.
- *Includes meetings described herewith.

11th Annual Mid-America Electronics Conference, November 3-5

The Mid-America Electronics Conference (Maecon-1959), sponsored by the Kansas City Section of the Institute of Radio Engineers, will be held at Municipal Auditorium, Kansas City, Mo. The program will consist of 16 sessions. Papers covering various phases of professional group interests will include: Engineering Education and Management, Simulation and Computers, Technical Writing, Components and Reliability, Guidance and Communication, Trans-

NOW PRICED WITH PRECISION WIRE-WOUNDS!

OHMITE Series 77

PRECISION METAL FILM RESISTORS

**Excellent High Frequency
Characteristics**

High Stability, Low Noise

**Exceeds Military
Specifications**

ACTUAL SIZE

At last you can get quality metal film resistors, with all their advantages, at prices competitive with precision wire-wound units. In fact, some values are actually priced lower.

EXCEEDS MILITARY SPECIFICATIONS—Ohmite metal film precision resistors exhibit great stability under load at ambient temperatures of 150°C and higher, as well as in high humidity. Stability in storage is also excellent. A shelf-life test (covering a period of 4½ years) of 93 units in the 60 to 300 K-ohms range showed less than 0.05% maximum change in resistance. This stability together with low temperature co-efficient, low noise level, and unexcelled high frequency characteristics, are the reasons why Series 77 metal film resistors are demanded for both military and industrial applications.

Write for Bulletin 155

OHMITE
OHMITE
MANUFACTURING
COMPANY

QUALITY
Components

NEW
2-WATT
SIZE

3643 Howard Street, Skokie, Illinois

| Ohmite Basic Style | MIL Sizes | Dimensions (Inches) | | Full Wattage Rating at | | Min - Max Ohms | Max Rated Volts |
|--------------------------|----------------|---------------------|----------|---------------------------|---------------|-------------------|-----------------------|
| | | Length | Diameter | 125°C Amb. | 150°C Amb. | | |
| 771-1 | — | 1½ | .400 | ½ | ¼ | 25-250K | 350 |
| 771-2 | — | ¾ | .600 | ½ | ¼ | 251K-400K | 350 |
| 772-3C | RN65* R192† | ¾ | 1¼ | ¼ | ¼ | 50-125K | 300 |
| 772-3CJ | R192† | ¾ | 1¼ | ½ | ¼ | 50-85K | 300 |
| 772-1 | — | ¾ | 2¼ | ½ | ¼ | 25-250K | 350 |
| 772-1C | — | ¾ | 2¼ | ½ | ¼ | 25-250K | 350 |
| 772-2 | RN72* R194† | 1½ | 2¼ | ½ | ¼ | 25-400K | 350 |
| 772-2C | R194† | 1½ | 2¼ | ½ | ¼ | 25-400K | 350 |
| 772-2CS | RN70* R194† | 1½ | 1¼ | ½ | ¼ | 25-350K | 350 |
| 772-2J | R194† | 1½ | 2¼ | 1 | — | 25-400K | 350 |
| | | 1½ | 2¼ | — | ½ | 25-150K | 350 |
| 772-2CJ | R194† | 1½ | 2¼ | 1 | — | 25-400K | 350 |
| | | 1½ | 2¼ | — | ½ | 25-150K | 350 |
| 772-8 | R196† | 1½ | 1½ | 1 | ½ | 100-1 meg | 500 |
| 772-8C | RN75* R196† | 1½ | 1½ | 1 | ½ | 100-1 meg | 500 |
| 772-10 | — | 2½ | 2¼ | 2 | — | 200-2.5 meg | 750 |
| 772-10C | RN80* | 2½ | 2¼ | 2 | — | 200-2.5 meg | 750 |

*MIL-R-10509C

†MIL-R-19074B

RHEOSTATS RESISTORS RELAYS TANTALUM CAPACITORS TAP SWITCHES VARIABLE TRANSFORMERS R. F. CHOKES GERMANIUM DIODES

CIRCLE 20 ON READER-SERVICE CARD

mission and Control Systems, Adaptive Servos and other Nonlinear Devices, Wave Propagation, Medical Electronics, Communications and Airborne Electronics. Conference Chairman is I. J. Jones, Maecon, Bendix Aviation Corp., P.O. Box 1159, Kansas City 41, Mo.

National Automatic Control Conference, November 4-6

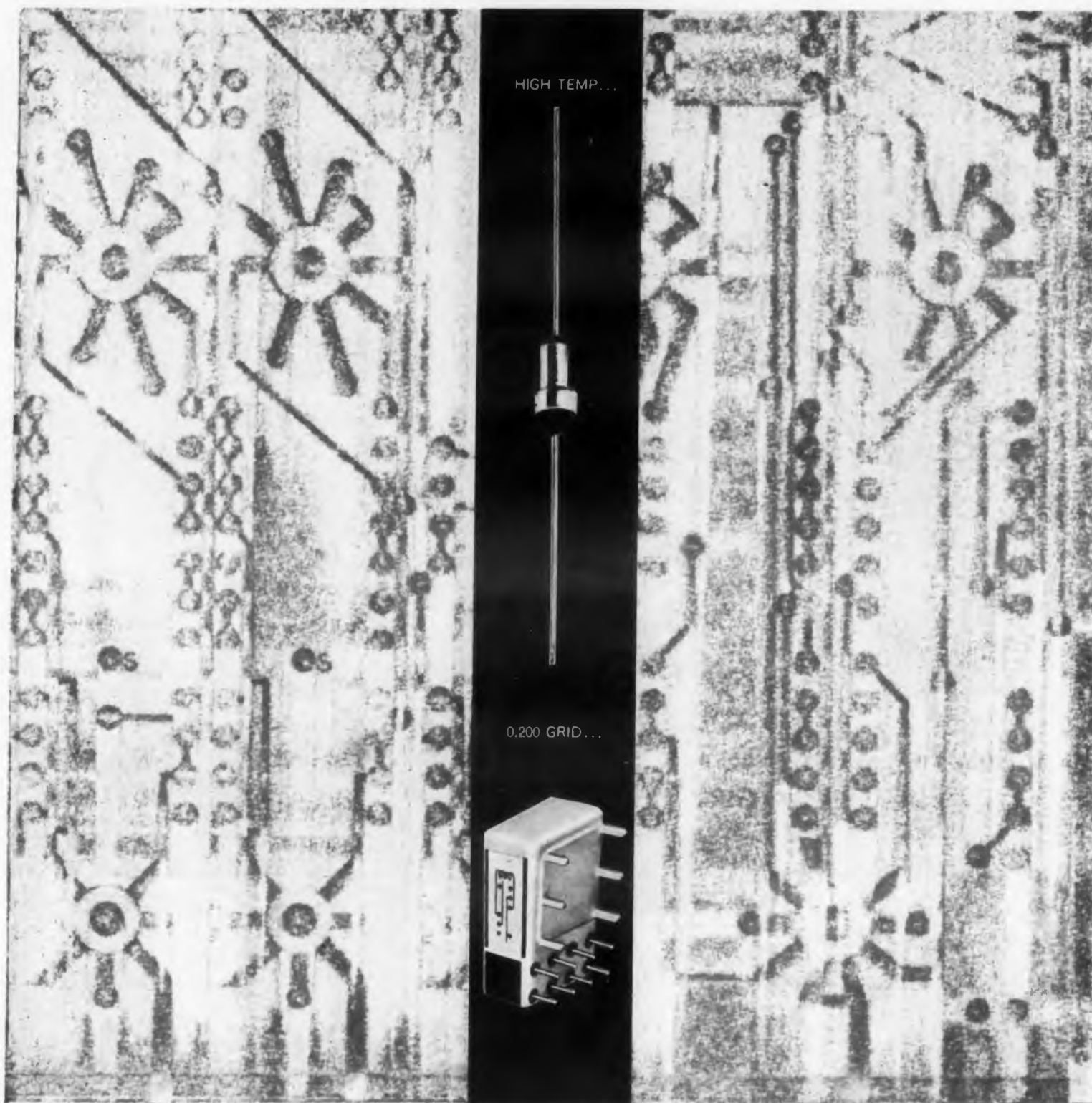
The IRE Professional Group on Automatic Control will sponsor a National Automatic Control Conference in Dallas, Tex., at the new Sheraton-Dallas Hotel. Control groups from other organizations such as the PGIE, AIEE, ASME, and ISA will participate in the activities. One of the prime purposes of the sessions is to have specifications people make their reactions known and also for industrial people to have a "sounding board." The Chairman is Denny D. Pidhayny, Ramo-Wooldridge, P. O. Box 90534 Airport Sta., Los Angeles 45, Calif.

4th IRE Instrumentation Conference, November 9-11

The Atlanta Biltmore Hotel in Atlanta, Ga., will be the site for the IRE Instrumentation Conference. Technical Sessions will include papers dealing with Reliability, Measurements, Data Gathering and Display, Nuclear Instrumentation, Semiconductor Applications, and Missile Satellite Instrumentation. The exhibit will include a wide variety of electronic equipment related to instrumentation, data gathering, and related areas. Chairman is H. N. Zeidler, Technical Program Committee, 1960 Western Joint Computer Conference, Stanford Research Institute, Menlo Park, Calif.

12th Annual Conference On Electrical Techniques In Medicine And Biology, November 10-12

The 12th Annual Conference on Electrical Techniques in Medicine and Biology will take place in the Sheraton Hotel, Philadelphia, Pa. It is sponsored by the Joint Executive Committee in Medicine and Biology, appointed by and representing the pertinent interests of the American Institute of Electrical Engineers, the Institute of Radio Engineers for its group on Medical Electronics and the Instrument Society of America. The objective of the conference is to contribute to the further advancement of the scientific area between the medical and biological sciences and electrical engineering principles, both from an applied and a basic point of view. A part of the meetings will be devoted to various forms of non-ionizing radiation. This includes both biological effects and the use of radiations as a research tool. Conference Chairman is Dr. Herman P. Schwan, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.



NEW PRINTED CIRCUIT RELAY...FEED-THRU CAPACITOR

MODULE RELAY 0.200 grid ■ maximum module height, 0.400 inches ■ 25 g vibration to 2000 cycles ■ integral part of printed circuit ■ ideal for dip soldering ■ long life. **FEED-THROUGH CAPACITOR** thermal shockproof ■ up to 2200 uuf ■ temperature range, -55C to 150C ■ 200 WVDC ■ 0.590 inches maximum height ■ 0.155 inches mounting diameter. Write, wire, or phone!

COMPONENTS
SPECIFIED WITH
CONFIDENCE



**ELECTRONIC COMPONENTS
SUBSIDIARY OF TELECOMPUTING
CORPORATION**

CIRCLE 21 ON READER-SERVICE CARD

These highly reliable components are available in the following cities:

**SALES REPRESENTATIVES
ELECTRONIC COMPONENTS
SUBSIDIARY OF
TELECOMPUTING
CORPORATION**

EAST COAST

KENNETH E. HUGHES COMPANY

4808 Bergenline Avenue
Union City, New Jersey
Phone: Union 7-3204
TWX: UN CY NJ 797

101 N. 33rd Street
Philadelphia 4, Pennsylvania
Phone: Evergreen 6-3130
TWX: PH 1012

324 Brooklea Drive
Fayetteville, New York
Phone: Neptune 7-9531

MID-WEST

R. EDWARD STEMM COMPANY

5681 W. Lake Street
Chicago 44, Illinois
Phone: Estebrook 9-2700
TWX: CG 3104

123 S. Third Street, Room 1137
Minneapolis 1, Minnesota
Phone: Federal 5-7172

SOUTHWEST

WM. G. MAYS COMPANY

Lone Star Life Bldg.
22331 Gus Thomasson Avenue
Dallas, Texas
Phone: Davis 7-6803
TWX: DL 703

WEST COAST

(Northern California)

LONG & ASSOCIATES

Brewster-Warren Sts. Bldg.
Redwood City, California
Phone: Emerson 9-3324
TWX: Redwood City, Calif., 32

(All other West Coast
Areas Contact)

ROLAND KING, SALES MGR.

Electronic Components
Subsidiary Telecomputing Corp.
12838 Saticoy Street
North Hollywood, California

EDITORIAL

Overtime is Needed to Get Us Into Space

We can postulate the ideal in one step, but it takes many steps to get there. This truism is recognized in practically all fields of endeavor except, seemingly, when it comes to developing space vehicles.

In the area of rocket development we hope to close a nine-year Russian lead in as little as two years. It lately appears that we expect to accomplish this feat with a cut in funds. "It can't be done," says General John B. Medaris as he reports the slowdown of the Saturn timetable because of financial difficulties.

According to the General, if we are going to compete at all with the Russians in conquering space there has to be a solid, well-financed program. He says right now we are straddling the issue. Current predictions of the 1960 budget for defense spending show future cut-backs, which means either a reduction in operating forces or missile activity.

We flounder in indecision while the Soviets efficiently proceed to put up Luniks. President Eisenhower himself may have to decide whether Saturn, for example, will be turned over to the Air Force, or NASA, continued by the Army, or canceled altogether. We seemingly have neither policy nor organization.

While our missile and space vehicle developments may be adequate for national survival, they are not at all adequate to posit us in the role of a world leader. The act that established NASA declared, in the American tradition, that our "activity in space should be devoted to peaceful purposes for the benefit of all mankind." If our free democratic society can outdo our adversary in bringing the fruits of the new frontier, space, to the people of the world we may survive with our liberty and our justice inviolate. But if we cannot tap the resources of space for man's benefit, we face the day of economic impotency. Our political liberties will then be meaningless.

Time, therefore, is a most crucial factor. We need a crash program to meet the challenge before us. We cannot be content to risk our future on the success of one or two long range space programs. The military's current resources should be kept on the job of testing out missile after missile. Until we evolve a national policy, let inter-service rivalry work for us to accumulate a continuum of data and knowledge. We need the sophisticated systems that are on paper, but the sophisticated comes generations after the simple and crude. The time span of several generations must be telescoped for us, and in this period of limited available manpower, overtime, much overtime is needed.

James G. Kuyper



... why not this?



BEHLMAN

INVERTRON®

COMPLETELY ELECTRONIC AC POWER SOURCE

Lets you select the power you need, quickly and easily. No "re-engineering" or preparation of diagrams for proper connections. BEHLMAN INVERTRON conserves the valuable time of your engineering talent, simplifies procedure, saves space and makes work more productive.

For further information . . . WRITE or CALL Victoria 9-5733

BEHLMAN
ENGINEERING COMPANY

ELECTRONICS • MECHANICS • OPTICS
DESIGN • DEVELOPMENT • PROTOTYPE

2911 WINONA AVENUE • BURBANK, CALIFORNIA

Representatives in all principal cities and Canada

CIRCLE 22 ON READER-SERVICE CARD

Design Procedure For The Schmitt Trigger

Leonard L. Kleinberg

Senior Engineer, Guided Missile Lab.
I.T.T. Laboratories
Nutley, N. J.

Although Schmitt trigger circuit analysis is covered in various texts, the information and procedure required for its design are not well-known. Lengthy calculations and time-consuming trial-and-error setups, the usual approaches followed, can be eliminated by the design steps outlined.

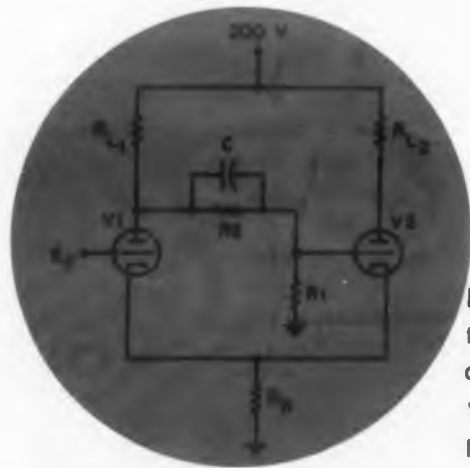


Fig. 1. Basic circuit of the Schmitt trigger using a 6922 dual triode in a voltage comparator application.

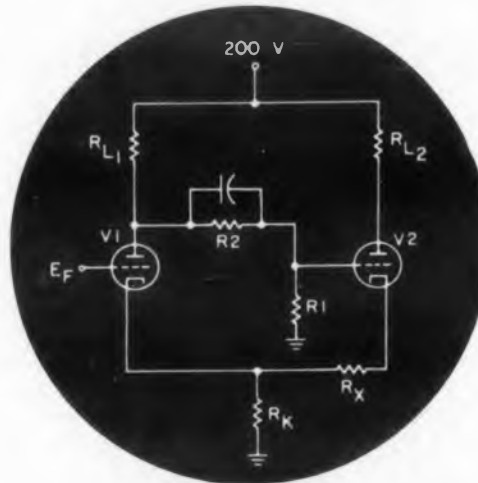


Fig. 3. Schmitt trigger circuit modified to avoid hysteresis.

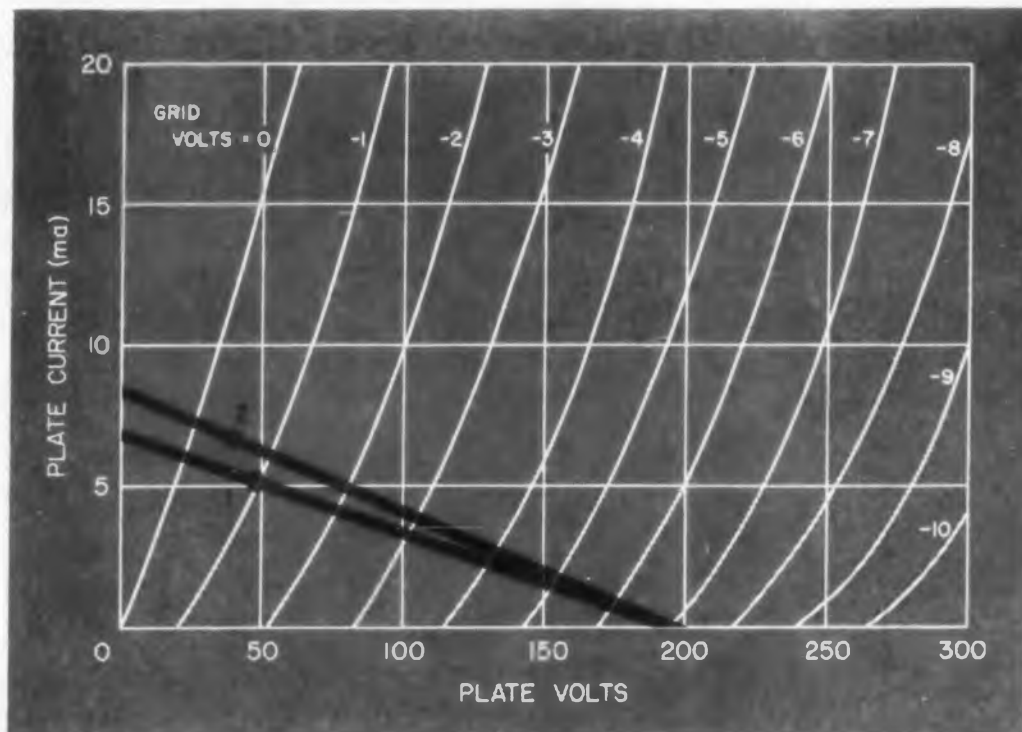


Fig. 2. Plate characteristics of the 6922 tube with load lines inserted for sample design of Fig. 1.

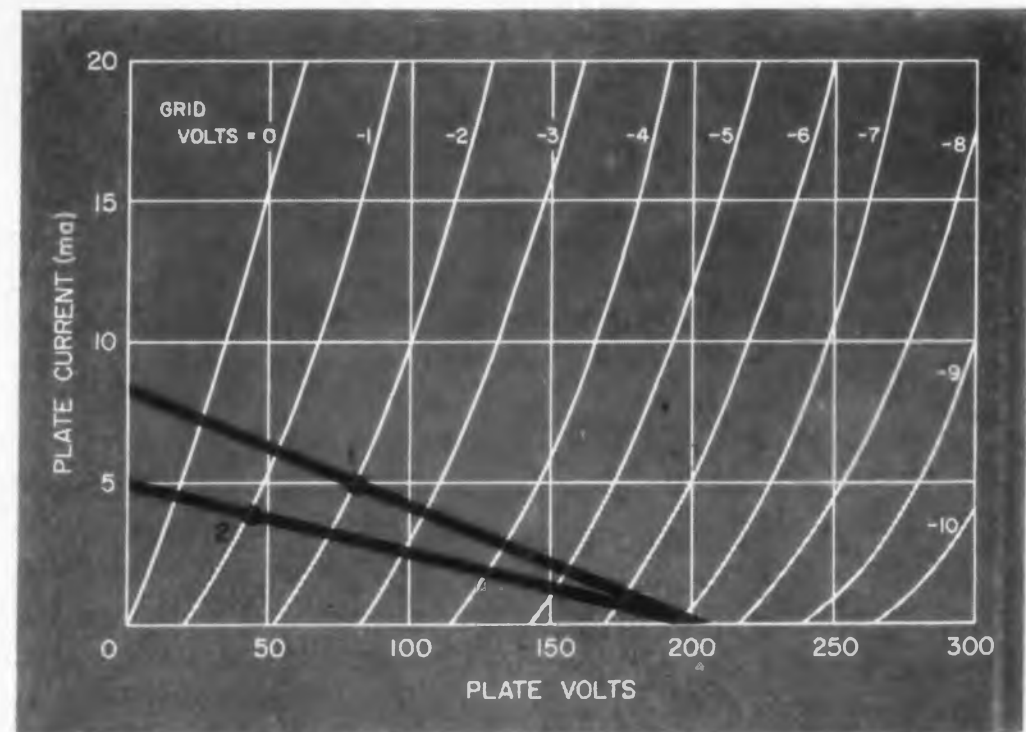


Fig. 4. Plate characteristics of the 6922 tube with the load line drawn for the design shown in Fig. 3.

LABORIOUS calculations and tedious trial-and-error procedures can be eliminated from Schmitt trigger circuit design by following the step-by-step technique presented. Since there are more variables (five) in the circuit than there are modes of operation (two), an algebraic solution is not possible; some conditions must be chosen and others solved for.

Circuit Operation

When T_2 is conducting, the voltage developed across R_k in Fig. 1 is sufficient to maintain T_1 at cut-off. When the grid of T_1 reaches firing voltage E_f , T_1 begins to conduct heavily and T_2 is cut off. The rapid transition of the circuit depends upon the regeneration of T_1 through R_k . As the plate of T_1 falls, the grid of T_2 also falls, reducing the current through R_k . The current through R_k is increased by the conduction of T_1 . However, the decrease in current through R_k due to T_2 is greater than the increase in current due to T_1 . This is easily obtainable through the gain of T_1 and the

$$\text{ratio } \frac{R_1}{R_1 + R_2}$$

The condition of regeneration is that the gain-crossover ratio product be greater than unity.

Another condition that should be imposed upon the circuit operation is that when the transition takes place, T_1 shall operate in its normal grid base region. Quite often T_1 will draw grid current and load the driving stage.

Design Procedure

The following design procedure simplifies calculations of all circuit components and is more rapid than the trial and error technique. Potentiometers may be used in the circuit for appropriate adjustments. The value of E_f is arbitrarily chosen to be 20 v and the tube is a 6922 dual triode.

Step 1. The cathode potential must maintain T_1 at cut-off. The cut-off potential, as obtained from the characteristic curves is approximately -7 v. (Cont. on p. 26)

CIRCLE 23 ON READER-SERVICE CARD ➤



BURTON BROWNE 34-734

ACTUAL SIZE

50 G'S VIBRATION—
250 G'S SHOCK

THE FIRST PREMIUM QUALITY MICRO-MINIATURE RELAY

FILTORS' NEW

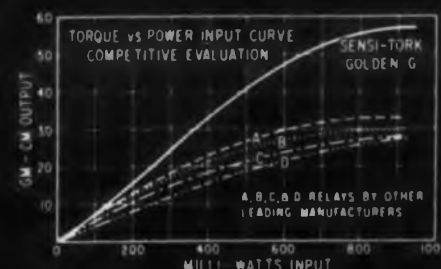
GOLDEN G

Filtors' Golden G is the only relay that will meet 50 G vibration to 3,000 CPS and 250 G shock.

Each Premium Quality Golden G — precision made to provide the finest overall performance characteristics of any relay available — is expertly tested by Filtors Reliability Test Center to the most exacting standards in use in the industry.

The exclusive new "Sensi-Tork" rotary relay motor makes the Golden G unmatched for ruggedness and efficiency. Filtors' newly developed RELAY MOTOR ANALYZER, which can continuously measure magnetic fields, force, armature travel and flux density, was used to plot the actual curves of Torque vs. Input Power, illustrating the great superiority of the Golden G vs. micro-miniature relays from other leading manufacturers.

For more details and specifications of the Premium Quality Golden G call your Filtors representative or write:



Leading manufacturer of hermetically sealed rotary sub- and micro miniature relays.

FILTORS, INC.

Main office and plant Port Washington, N. Y. POrt Washington 7 8220
West coast office 14273 Ventura Blvd., Studio City, Calif. STanley 3 2770



10,000 hour
load-life tests prove
unsurpassed reliability of the
WESTON VAMISTOR®

the precision metal-film resistor that's
proof-tested 6¼ times its own rating!

Top-flight VAMISTOR performance starts back in the shop with Weston Quality Control — the most thorough, stringent system of testing now used to assure VAMISTOR reliability . . . *reliability in no uncertain terms!*

For example, every VAMISTOR is actually proof-tested six-and-a-quarter times its own rating for 10 seconds! And random production units, subjected to a 10,000 hr life test under full load, changed less than .5% — tangible evidence of tight Quality Control. Many users themselves attest to this kind of performance.

Quality Control also makes for minimum thermal and static noise, makes sure VAMISTOR is entirely corona-free . . . can handle higher maximum continuous voltage than wire-wound types . . . higher wattages, too, up to 16 full watts at 40 C.

The exclusive Weston process of fusing the special-alloy element to the resistor's inner surface of steatite assures long shelf and service life . . . more reliability, greater mean-time-to-failure . . . improved resistance to all adverse environments . . . peak performance even under radioactive conditions.

VAMISTOR conforms to MIL-R 10509 CHAR. C SPECS.
Includes RN-65, RN-70, RN-75 and RN-80 styles.

For full information, contact your local Weston representative . . . or write to Daystrom-Weston Sales Division, Newark 12, N. J.
In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont.
Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.

WESTON

Metal-film Resistors

WORLD LEADERS IN MEASUREMENT AND CONTROL
CIRCLE 24 ON READER-SERVICE CARD

The cathode potential must be:

$$e_{RK} = E_f - E_{co} = 20 - (-7) = 27 \text{ v.}$$

Step 2. Values of bias and current are chosen that are compatible with the tube's characteristics:

$$i_{b2} = 5.0 \text{ ma}$$

$$e_{gk2} = -2 \text{ v (Point 1 on Fig. 2)}$$

Step 3. A load line can be drawn for R_{L2} and R_k . The extended load line yields a maximum tube current of 8.3 ma. (Line 1, Fig. 2)

$$R_{L2} + R_k = \frac{200 \text{ v}}{8.3 \text{ ma}} = 24 \text{ K}$$

R_k may be determined:

$$R_k = \frac{e_{RK2}}{i_{b2}} = \frac{E_f - E_{co}}{i_{b2}} = \frac{27 \text{ v}}{5 \text{ ma}} = 5.4 \text{ K}$$

R_{L2} may now be determined:

$$R_{L2} = 24 \text{ K} - 5.4 \text{ K} = 18.6 \text{ K}$$

Step 4. Since R_{k2} is at a potential of 27 v and the bias on T_2 has been chosen as -2 v, the grid potential of T_2 , e_{c2} , is known.

$$e_{c2} = e_{RK2} + e_{gk2} = 27 - 2 = 25 \text{ v}$$

The ratio of $\frac{R_1}{R_1 + R_2}$, A , may now be calculated.

$$A = \frac{e_{c2}}{E_{bb}} = \frac{25}{200} = 1/8$$

Where $R_1 + R_2 \gg R_L$.

Step 5. When the grid voltage of T_1 reaches the potential of E_f (20 v), the transition should take place. A value of bias is chosen for T_1 so that T_1 goes into heavy conduction. Choose $e_{gk1} = -1 \text{ v}$. The current through T_1 is immediately known.

$$e_{Rk1} = E_f - e_{gk1} = 20 - (-1) = 21 \text{ v}$$

$$i_{b1} = \frac{e_{Rk1}}{R_k} = \frac{21 \text{ v}}{5.4 \text{ K}} = 3.9 \text{ ma}$$

Step 6. Since the bias and plate current are known, the voltage across the tube is known. Plot $i_{b1} = 3.9 \text{ ma}$ and $e_{gk1} = -1 \text{ v}$ on the curves (Point 2 of Fig. 2) and draw the load line as in Step 3. The maximum tube current (T_1) is 5 ma.

$$R_{L1} + R_k = \frac{200 \text{ v}}{5 \text{ ma}} = 40 \text{ K}$$

$$R_{L1} = 40 \text{ K} - 5.4 \text{ K} = 34.6 \text{ K}$$

All components in the circuit are now known. The remaining calculation is to check and determine if T_2 is off.

$$e_{c2} = (e_{Rk1} + e_n) A = \frac{(21 \text{ v} + 42 \text{ v})}{8} = 7.9 \text{ v}$$

$$e_{gk2} = 7.9 \text{ v} - 21.0 \text{ v} = -13.1 \text{ v}$$

This establishes that T_2 is cut off.

To bring T_2 into conduction, the grid of T_1 must be brought below 20 v, a condition termed hysteresis. In some applications this effect is not detrimental, while in others it is of paramount importance that the circuit switch both ways at E_f .

Modification to Avoid Hysteresis

Fig. 3 illustrates a Schmitt trigger circuit in which hysteresis is avoided. The design technique is slightly different as the following steps will point out.

Step 1. Assume that T_1 is conducting and T_2 is cut-off, and that the bias on T_1 is -1 v. Assume further that the tube current i_{b1} is 5 ma. (Point 1 in Fig. 4). Draw the load line (line 1 on Fig. 4). The maximum tube current is 6.6 ma

$$R_{L1} + R_k = \frac{200 \text{ v}}{6.6 \text{ ma}} = 30 \text{ K}$$

$$R_k = \frac{e_{Rk1}}{i_{b1}} = \frac{21 \text{ v}}{5 \text{ ma}} = 4.2 \text{ K}$$

$$R_{L1} = 30 \text{ K} - 4.2 \text{ K} = 25.8 \text{ K}$$

Step 2. The potential of the plate of T_1 is 49 v + 21 v = 70 v.

The 49 v is obtained from the characteristic curves. "A" may be solved for since the grid of T_2 must be at 21 v - 7 v, or 14 v in order that T_2 must be just at cut-off.

$$A = \frac{14}{70} = 0.2$$

Step 3. When T_1 is cutoff, the voltage on the grid of T_2 is 40 v.

$$e_{c2} = E_{tb} A = 200 (0.2) = 40 \text{ v}$$

Step 4. In order that T_1 just be at cut-off when $E_f = 20$ v, the voltage across R_k must be 27 v. The current flowing in T_2 must be:

$$i_{b2} = \frac{e_{Rk2}}{R_k} = \frac{27 \text{ v}}{4.2 \text{ K}} = 6.4 \text{ ma}$$

Step 5. Solve for R_z . Since the grid of T_2 is at 40 v, a bias on T_2 can be specified such that the tube current is 6.4 ma. Choose $e_{gk2} = -0.5$ v. The cathode of T_2 must be at 40 v + 0.5 v, or 40.5 v. The value of R_z is equal to:

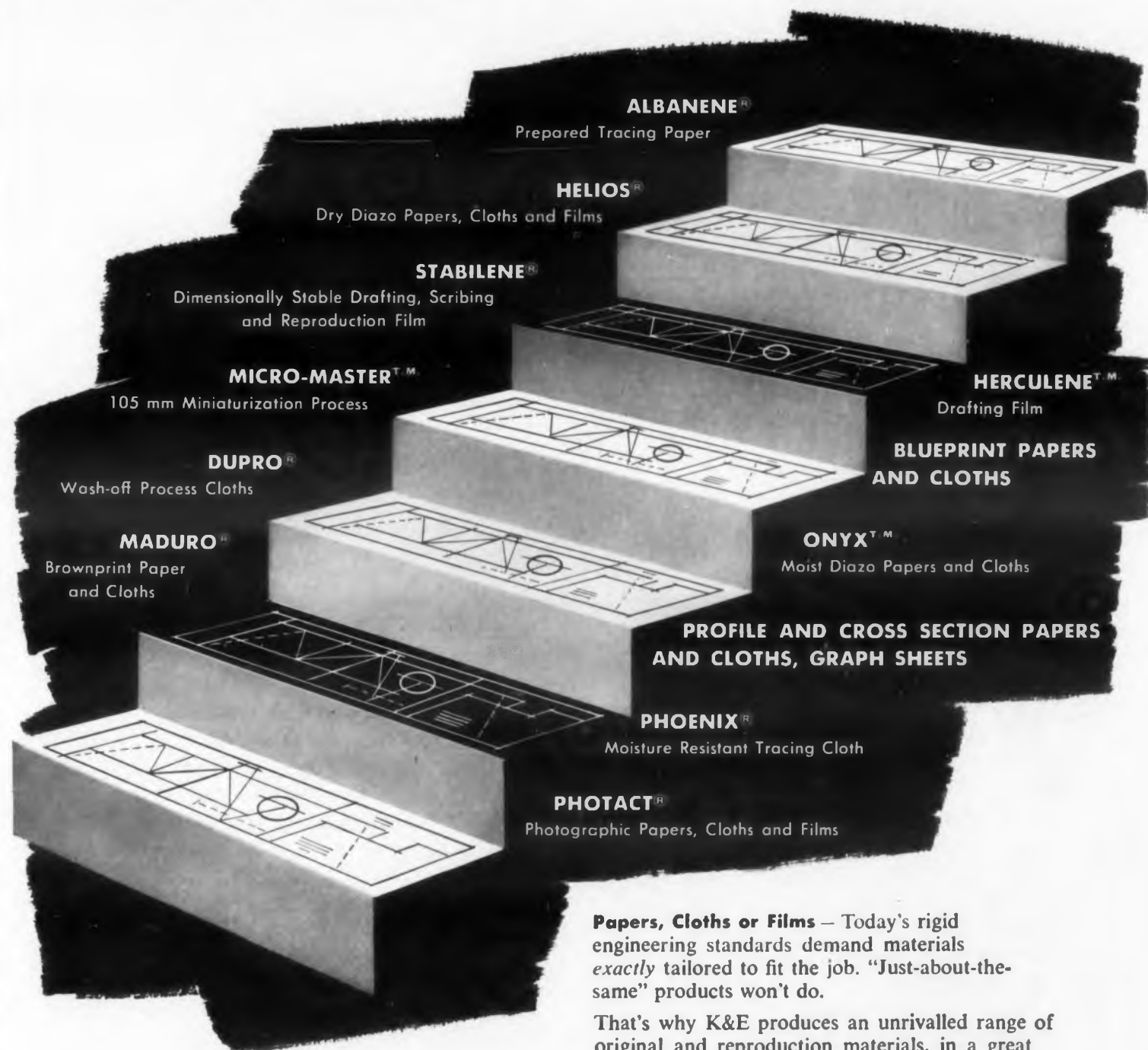
$$R_z = \frac{40.5 \text{ v} - 27 \text{ v}}{6.4 \text{ ma}} = \frac{13.5 \text{ v}}{6.4 \text{ ma}} = 2.1 \text{ K}$$

Step 6. The final step yields the value of R_{L2} and completes the circuit design. Plot $e_{gk2} = -0.5$ v and $i_{b2} = 6.4$ ma and draw the load line. The maximum current is 8.0 ma.

$$R_{L2} + R_k + R_z = \frac{200 \text{ v}}{8.0 \text{ ma}} = 25 \text{ K}$$

$$R_{L2} = 25 \text{ K} - 4.2 \text{ K} - 2.1 \text{ K} = 18.7 \text{ K} \quad \blacksquare$$

Use the right material every step of the way



Papers, Cloths or Films — Today's rigid engineering standards demand materials *exactly* tailored to fit the job. "Just-about-the-same" products won't do.

That's why K&E produces an unrivalled range of original and reproduction materials, in a great variety of sizes, shapes, surface characteristics and working properties to choose from.

Whatever your need, K&E can give you the *right* material to do the job. Write for details and samples (please specify the particular products which interest you) to Keuffel & Esser Co., Hoboken, New Jersey.

1620



The COMPLETE Line

for originals and reproductions

KEUFFEL & ESSER CO.

NEW YORK • HOBOKEN, N. J. • DETROIT • CHICAGO • MILWAUKEE • ST. LOUIS • DALLAS • DENVER • SAN FRANCISCO • LOS ANGELES • SEATTLE • MONTREAL

CIRCLE 25 ON READER-SERVICE CARD

Waveguide Flange Design For Better Microwave Performance

Lou Virgile

Sperry Gyroscope Co.
Great Neck, N. Y.



Lou Virgile feels that something is lacking in existing flange designs. There are too many slightly different designs serving a single purpose. The various drawings (including the "standards") show very little consistent overall thought.

Mr. Virgile's first reaction to microwaves was "This is something for the EE's." After considerable experience as a senior product engineer responsible for mechanical development, design, shop and test follow-up of microwave components and subsystems, he has revised his estimate.

He now sees electronics responsible for a key 20 per cent of microwave performance, with 80 per cent represented by factors like structural design, heat transfer, mechanism development, materials selection, and packaging.

WAVEGUIDE flange design seldom receives the consideration it deserves. The factors presented here can help the designer minimize vswr and maximize power handling capabilities. These factors can aid in new designs and can serve as a guide in evaluating proposed standards.

Unless otherwise specified, the term "flange" is here construed as the opening of the finished waveguide component, or as the detail part that will have no further machining after assembly to a waveguide.

It is common practice to call parts "flanges" though they are actually flange blanks. Flange blanks are machined after attachment to the waveguide.

Good Alignment Is Most Significant

Perhaps the most significant factor in proper flange design is alignment. In connecting one waveguide to another, it is necessary to minimize the step that occurs at the junction due to tolerances and other factors.

High Power Breakdown. The effect of this misalignment on high power breakdown is shown in Fig. 1. The tests described by Fig. 1 were performed in X-band, but the chart is plotted as percentage misalignment. The results apply to any size waveguide. The percentages refer to dimensions of the waveguide opening.

Standing Waves. Similar misalignment in WR112

waveguide produced the vswr's shown in Fig. 2. Here, readings were taken at a 3.5 cm wavelength. This graph also represents all sizes of waveguide. It agrees with values calculated¹ for cover-to-cover flange conditions up to about 15 per cent of center frequency. Vswr increases over greater ranges.

Fig. 2 shows that it is not advisable to use chokes to reduce vswr where the misalignments are small. The choked joints have greater microwave mismatch than the cover-to-cover connections.

Angular Twist. The effects on vswr of angular

twist of the connection are shown in Fig. 3. This graph shows that the choke flange is undesirable as a vswr suppressor in correcting for the small (less than 7 deg) angular twists that are normally encountered.

A more sophisticated approach to the vswr-misalignment question is available², wherein the offset is compared to an appropriate iris.

The amount of physical mismatch is tremendously important in determining microwave performance. This mismatch depends on the alignment of the mating flanges. It is a function of:

- Tolerances of the waveguide inside dimensions.

Table 1. Maximum Misalignment of Perfectly Centered Waveguide.

| Waveguide | Inner Dimensions | | | Maximum Misalignment | |
|-----------|------------------|-------|-----------|----------------------|------|
| | a | b | Tolerance | %a | %b |
| WR650 | 6.500 | 3.250 | ±0.015 | 0.2% | 0.5% |
| WR430 | 4.300 | 2.150 | ±0.008 | 0.2% | 0.4% |
| WR187 | 1.872 | 0.872 | ±0.005 | 0.3% | 0.6% |
| WR112 | 1.122 | 0.497 | ±0.004 | 0.4% | 0.8% |
| WR75 | 0.750 | 0.375 | ±0.003 | 0.4% | 0.8% |
| WR34 | 0.340 | 0.170 | ±0.002 | 0.6% | 1.2% |
| WR15 | 0.148 | 0.074 | ±0.001 | 0.7% | 1.4% |

■ Tolerances of the distances of the flange bolt holes from the waveguide centerline and from each other.

The first of these factors may be described as an inherent flaw. It cannot be improved through better flange design. It is the amount of misalignment that can result from perfectly centered mating of two waveguides, one of maximum positive tolerance, and one of maximum negative tolerance. Its effects are shown in Table 1.

This table was set up for worst conditions. The tolerances are those of commercial standard waveguide, and the waveguide sizes were selected to show maximum percentage misalignment. It is obvious that even the largest error (1.4 per cent) is of little microwave significance.

Thus, it is realistic and convenient to eliminate "inherent flaw" from the discussion and to consider mislocation of the bolt holes as the only source of error.

There are several sources of misalignment due to flange design. They include:

1. Error in determining centerline of flange openings for each of a pair of flanges.

2. Error in locating the first bolt hole from these centerlines for each flange of the pair.

3. Difference in size between maximum hole diameter and minimum bolt diameter. If one flange is tapped, this difference must be averaged with the difference between maximum tap pitch diameter and minimum thread pitch diameter.

4. Difference between minimum waveguide outside dimension and maximum flange opening where the waveguide goes completely through the flange. Where one flange is finished (choke) and the other is not (cover), as in most choke-to-cover junctions, this figure should be halved.

These four factors are shown in Table 2 for various military standard flanges.

Misalignments can be quite large, according to Table 2, particularly in the smaller sizes of waveguide. The chances of maximum misalignment are quite remote, so the vswr per joint is usually less than the maximum figure. But the high power breakdown values, which can be read directly from Fig. 1, are serious. One bad connection per system can hurt the power carrying capacity. A single case of high vswr is less important.

Alignment Techniques

There are several techniques which can help minimize misalignment.

■ Where the waveguide goes entirely through the flange, do not drill the holes until after attaching the flange to the waveguide. This eliminates the slop between flange and waveguide since the bolt holes are located from the finished opening. The error eliminated represents an average (for the cases in Table 2) of more than 20

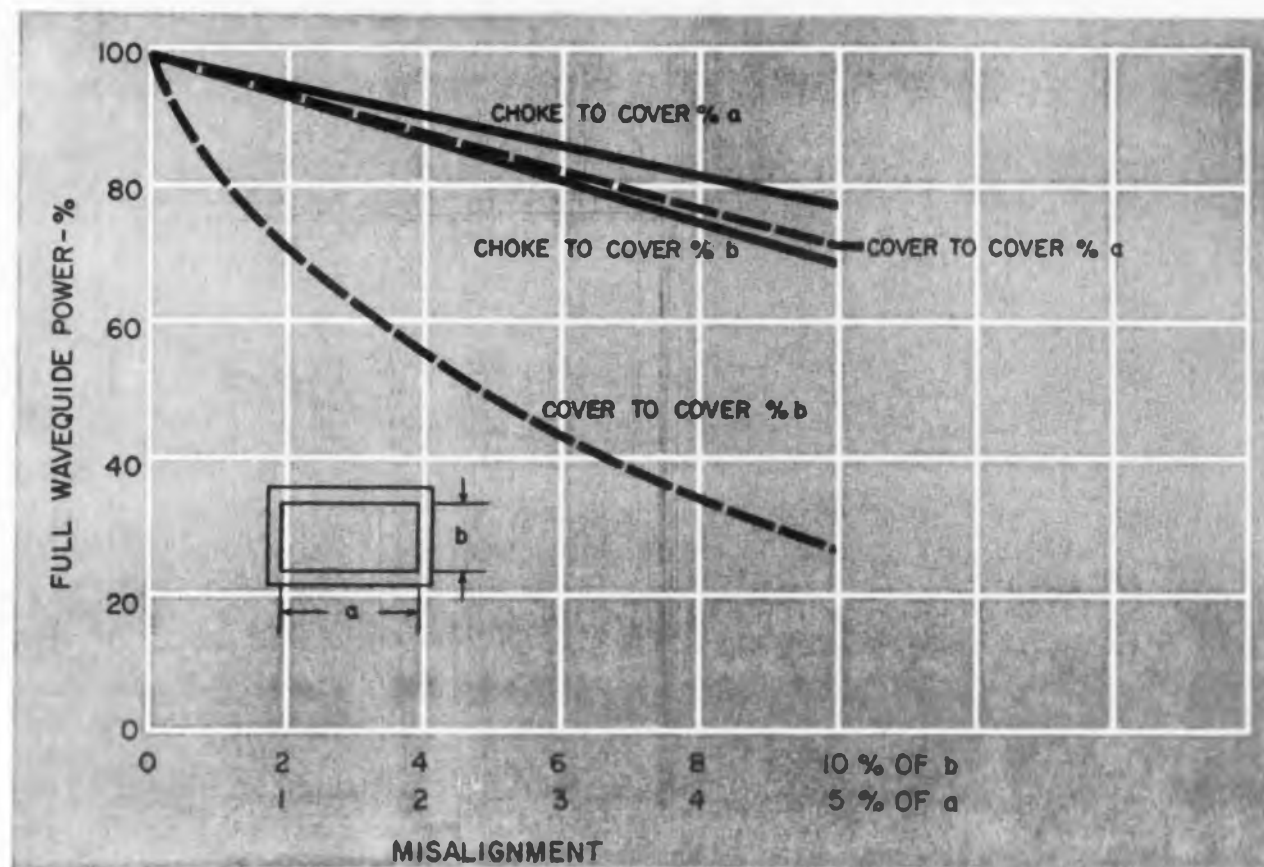


Fig. 1. The breakdown power of a waveguide decreases with increased misalignment of the flanges.

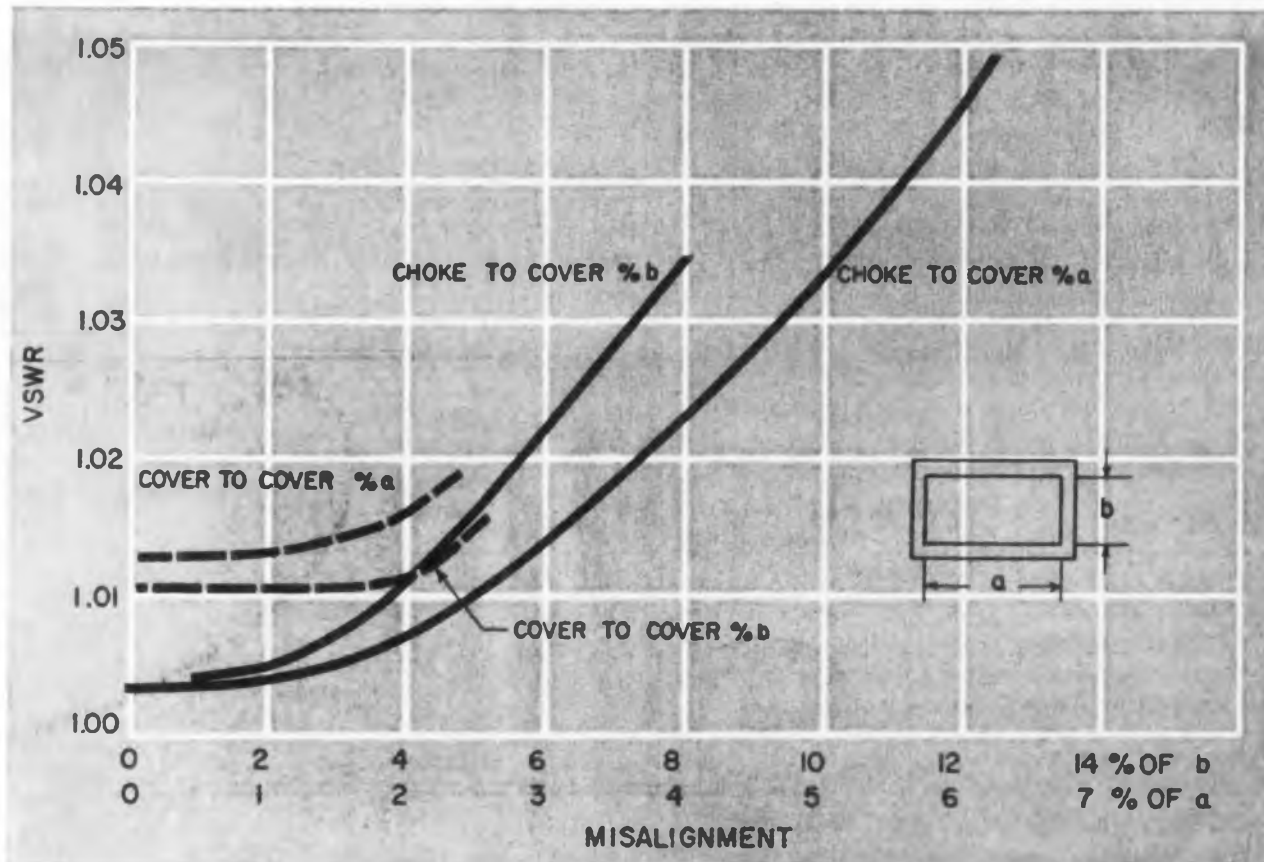


Fig. 2. Waveguide vswr gets worse as flange misalignment increases.

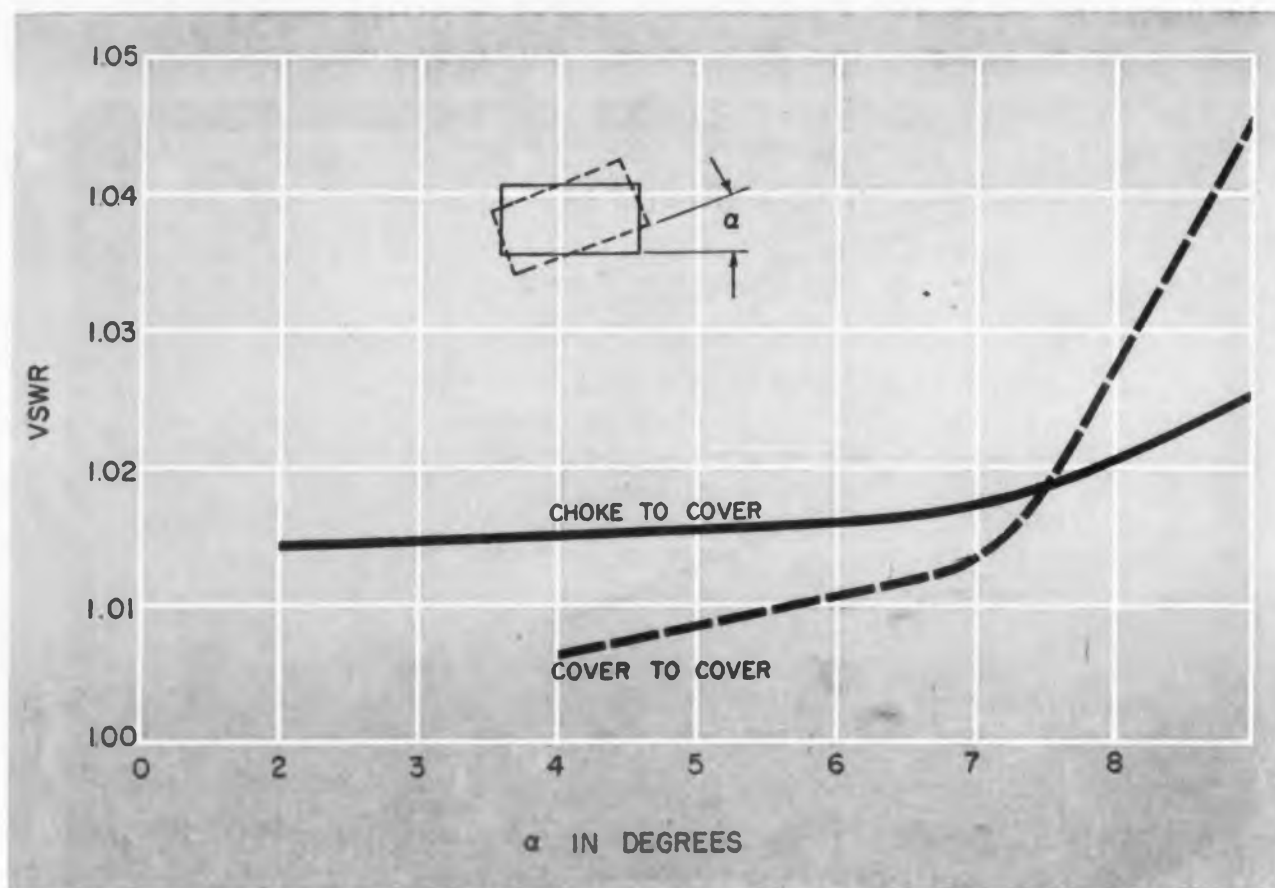


Fig. 3. Vswr increases as the angular twist of the connection increases.

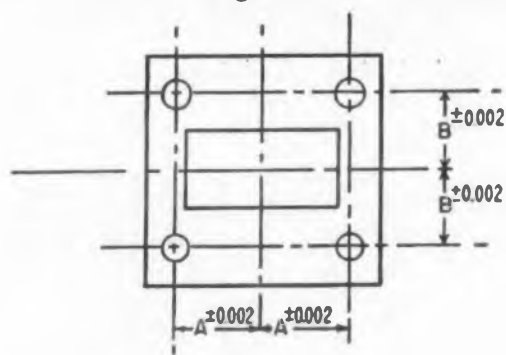


Fig. 4. Distances between bolt holes can be 0.004 in. off when all dimensions are taken from a hard-to-find centerline.

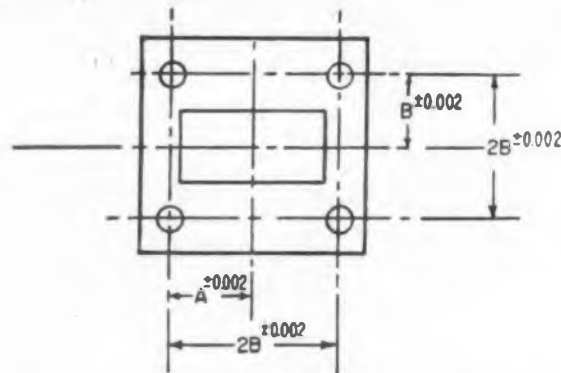


Fig. 5. Improved tolerances result when position of one bolt hole is measured from another.

Table 2. Misalignment Error Due to Four Separate Factors.

| Waveguide | Flange | 1. c/l Error | 2. First Hole Error | Minimum Bolt Diam. | Hole Diam. | 3. Max. Hole Less Min. Bolt | 3. Max. Diff. in Pitch Diam. | 4. Max. Slop | Max. Total Mis-Alignment |
|-----------|---------|--------------|---------------------|--------------------|--------------|-----------------------------|------------------------------|--------------|--------------------------|
| WR650 | MS90052 | 0.0025 | 0.0025 | 0.3042 | 0.330 ± .005 | 0.0308 | — | 0.025 | 0.066 (2.0%b) |
| WR187 | MS90046 | 0.004 | 0.005 | — | — | — | 0.008 | — | 0.044 (5.1%b) |
| | MS90047 | 0.0015 | 0.005 | 0.1831 | 0.219 ± .003 | 0.0389 | — | 0.010 | |
| WR90 | MS90058 | 0.003 | 0.002 | — | — | — | 0.007 | — | 0.025 (6.3%b) |
| | MS90059 | 0.0015 | 0.002 | 0.1571 | 0.169 ± .005 | 0.0169 | — | 0.009 | |
| WR28 | MS90055 | 0.0015 | 0.001 | — | — | — | 0.006 | — | 0.017 (12.1%b) |
| | MS90057 | 0.001 | 0.001 | 0.1061 | 0.116 ± .003 | 0.0129 | — | 0.006 | |

(1) Centerline error. (2) First hole error. (3) Error due to differences in hole and bolt sizes. (4) Error due to slop between flange and waveguide.

per cent of the maximum total misalignment, a substantial improvement.

■ Use smaller clearance holes and evaluate tolerances on a statistical rather than a 100 per cent basis. "Degree of interchangeability" considerations are an important source of misalignment. Theoretically, 100 per cent interchangeability is obtained when the clearance holes are large enough to permit assembly of two flanges though the tolerances on the various parts may be completely unfavorable.

From this viewpoint, most of the flange combinations in the smaller sizes should show many instances of failure to assemble. However, examination of the tolerances on a statistical basis, assuming normal distribution and specification limits of 3.5 times standard deviation of each parameter, shows that the unsuccessful trials would be less than five in ten thousand³.

Actual experience at the Sperry Gyroscope Company has borne this out. In making thousands of X-band assemblies, no complaints of inability to bolt flanges together have been received to the author's knowledge.

■ Dimension parts functionally. Poor dimensioning is best illustrated by an X-band flange which is partially dimensioned in Fig. 4. Here, the bolt holes are 2A (or 2B) inches apart ±0.004 in. More functional dimensioning, at no increase in manufacturing cost, is illustrated in Fig. 5.

Dimensioning as in Fig. 5 reduces the tolerances between holes from ±0.004 in. to ±0.002 in. This reduces the difference (for 100 per cent interchangeability) between maximum bolt diameter and minimum clearance hole diameter from 0.016 in. to 0.008 in. Thus a smaller clearance hole can be used.

More Expensive Alignment Techniques

There are other techniques which can be used to reduce misalignment. But they represent considerably higher cost, so they should be used sparingly.

■ Use tighter tolerances. Obviously, tighter tolerances can reduce misalignment. By and large, existing flange and waveguide design represent a satisfactory compromise between precision and cost. Closer tolerances generally result in costly secondary manufacturing operations.

■ Use pre-doweling. Provide each flange with an accurately located dowel pin and a reamed hole. These serve to register the flanges. The bolts serve only to make a tight connection. This technique is extremely expensive.

■ Use post-doweling. The most accurate (and most costly) method involves centering the inside walls of matching waveguides at assembly and then post-doweling to maintain this alignment. This technique should be restricted to the most critical applications.

Other Flange Considerations

Degree of Contact. Of extreme importance in waveguide connections is the degree of contact. This is primarily a function of the flatness of the mating surfaces. Screwing the flanges tightly together can correct for minor deformations.

While insufficient contact can cause high vswr, the major objections are to the arcing and breakdown that occur in high power applications. Remedies include use of chokes and special gaskets to improve the contact.

Quick Disconnects. It is often desirable to use quick disconnects, in place of bolts, for frequently removed parts. They generally apply pressure to the flange joint at a maximum of four points (replacing eight or more bolts in larger flanges), and thus increase the likelihood of high power breakdown. They should be used only with extreme care.

Gaskets. Requirements for pressurizing waveguides make it necessary to use gaskets at the flange connections. Sometimes the seal is a combination rf and pressure gasket, but more often, it is a simple rubber (or similar material) seal, which fits into a machined groove in one flange. Good design allows a 10 to 30 per cent gasket compression, considering both tolerance extremes.

Materials and Finishes. The choice of materials for flanges is dictated by the material used for the waveguide itself. However, the application of finishes to flanges (as part of the waveguide assembly) is an important factor in their design.

Care must be taken to apply coatings which will withstand both erosion and galvanic corrosion. In general, anodic coatings (Anodize, Alodine, Iridite, etc.) are applied to aluminum units, and electroplates (gold, rhodium, etc.) to brass. Special requirements, such as mating of dissimilar metals, sometimes require the use of other finishes that do not react unfavorably with either base metal.

Objections to the use of Anodize as a finish have been raised because it is dielectric in character, and prevents dc contact between flanges. To the author's knowledge, this insulating coating does not degrade microwave performance, except in items like crystal mounts, where dc contact is necessary.

References

1. Final Engineering Report on Broadband Microwave Components, Sperry Gyroscope Co., Oct. 1948.
2. U. von Kienlin and A. Kierzl, Reflexionen an Hohlleiter-Flanschverbindungen, *Nachrichtentechnische Zeitschrift*, Nov. 1958, pp 561-564.
3. E. L. Grant, Statistical Quality Control, McGraw-Hill Book Co., 1946, pp. 323-327.

CAN A SYNCHRO MAINTAIN ACCURACY



OVER A WIDE RANGE OF TEMPERATURE?

Synchros have to take punishment. They are often exposed to blistering heat and stratospheric cold . . . and they still must operate accurately.

Naturally, Ketay synchros meet and surpass the new MIL-S-20708A ambient temperature requirement of -55° to 85° C. (or to 75° C. for size 23). Even more important, they give you a remarkable 6 minute accuracy over this whole temperature range.

Ketay is the only source currently manufacturing and shipping a complete line of the new Mil-type synchros. They are available in production quantities in sizes from 8 to 23, with 60 cps units as small as size 15. Because of their superior accuracy, with some units offering 3' accuracy at room temperature, Ketay synchros one or more sizes smaller than previously required may often be used.

Ketay engineers are working on many advanced environmental and accuracy problems in developing prototype systems, and have an unusual degree of experience in high temperature work. Why not call or write for help in solving your special problems?

Ketay precision components:
SYNCHROS
RESOLVERS
POTENTIOMETERS
SERVO MOTORS
TACHOMETERS
SERVO AMPLIFIERS
GYROSCOPES
Catalogues available



Division of United Aircraft Corporation

KETAY DEPARTMENT, Commack, Long Island, N.Y.

CIRCLE 26 ON READER-SERVICE CARD

Automatic Circuit Tolerance Tester

for checking reliability and failure trends

K. S. Packard, M. Goldstein, N. Stone, J. Cavallari
 Airborne Instruments Laboratory
 A Division of Cutler-Hammer, Inc.
 Mineola, N. Y.

Automatic switching of extreme limit values of components in electronic circuits permit rapid evaluation of reliability and failure.

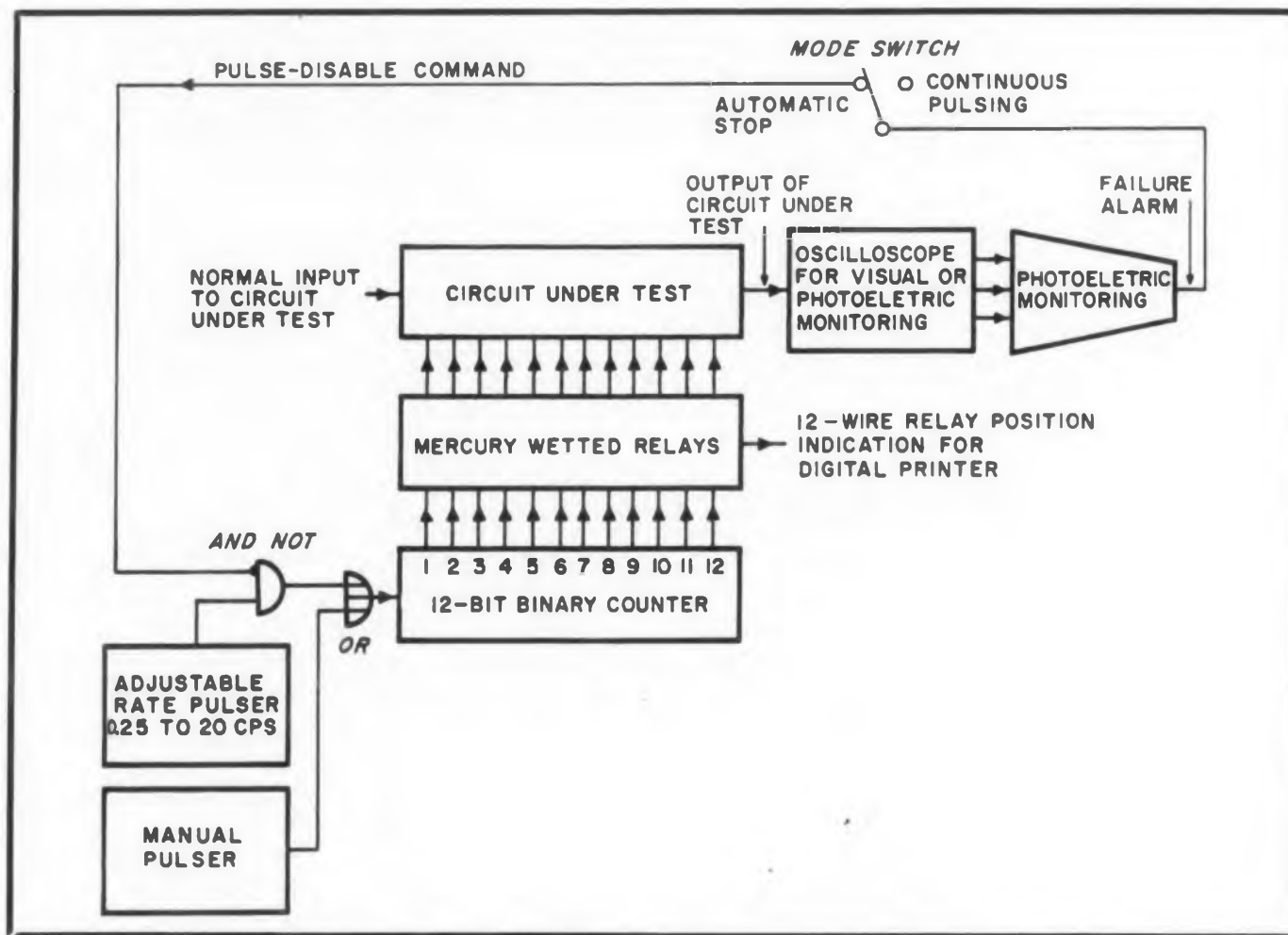


Fig. 1. Block diagrams of automatic circuit tolerance tester.



RELIABILITY and failure trends of electronic circuits can be rapidly and accurately determined by automatic insertion of extreme limit values of component parts. If satisfactory operation is achieved under these conditions, a high degree of reliability can then be assumed for the circuit under test.

It would be possible to test the reliability of a circuit by successively wiring into it all the desired combinations of the high and low "end point" limit values. Proper operation of the circuit under all these combinations of parts limits would indicate a reliable circuit.

The use of this method in testing 16 parameters would require that 2^{16} or approx. 70,000 combinations be investigated. Using the normal methods of soldering or plugging this number of combinations into the circuit would take far too much time for the method to be practical.

A device called an "Automatic Circuit Tolerance Tester" has been developed to make this search rapidly and automatically. Fig. 1 is a block diagram of the instrument, and it illustrates the principle on which it operates.

Binary Counter Operates Relay

In the tester, a binary counter is triggered at a rate that is variable between 0.25 and 20 cps. Each stage of the counter controls a relay which switches the value of one component part in the circuit under test. One characteristic of a binary counter is that it will run through all possible combinations of its high and low states; this is the requirement of the test procedure.

The prototype tester, shown in Fig. 2, uses a 16-stage counter, each stage of which controls one part-switching relay. If any stage of the counter contains a "one," the relay controlled by that

Karle S. Packard has been engaged in research and development of cathode ray stereoscopy, magnetic survey equipment, and microwave relay links, systems, and components during his 13 years at AIL. In his present capacity as Reliability Group Manager for Project STAR, he has been instrumental in the development of the automatic tester described.

stage is energized. The relay contacts are wired so that if the relay is not energized, the low-limit part value is in the circuit; when the relay is energized, a short circuit is removed, producing the high-limit part value. The use of a low-limit part plus a part corresponding to the range reduces the transient effects of switching, since removal or insertion of a short circuit across the range part is the only actual switching done.

The 16 relays are mounted about one inch from the components being switched and are mercury-wetted relays of low contact-capacitance (less than 5 μf) and low contact-resistance. Thus, the instrument can be used at any frequency for

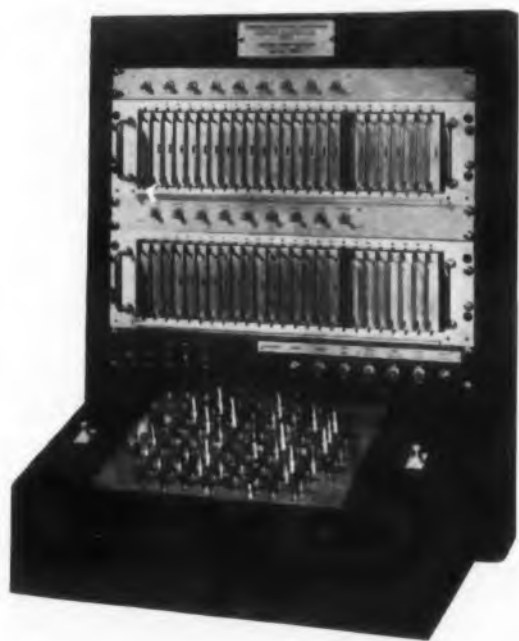
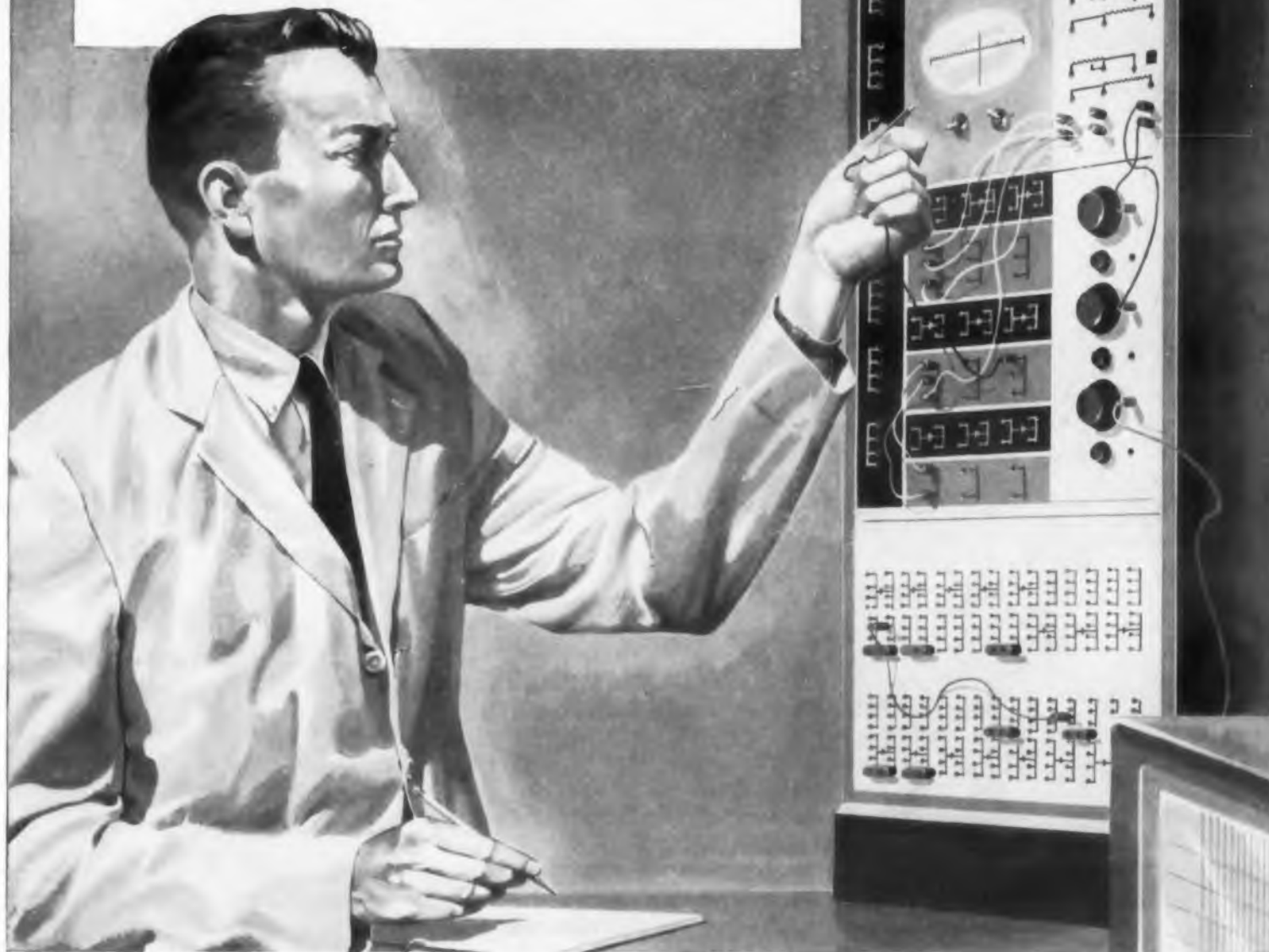


Fig. 2. Automatic circuit tolerance tester with circuit in position.

Helping to keep computers compact...

The space and weight saving characteristics of Gamewell Sinusoidal Potentiometers make them a popular choice for equipment employing sine-cosine operations. Far lighter and more compact than gears, cams, and other complicated mechanisms, they're widely used in analog computers, data converters, Tacan systems, and radar components. Wire wound card and double brushes produce sine-cosine functions with a smoothness and precision unobtainable by other resistive methods... ideal for low frequency sine wave generation.

Solve your prototype problems with Gamewell Precision Potentiometers. A wide range of linear and non-linear models including servo, precision, and trimmer types. Emphasis on "specials." Engineering assistance upon request. Write THE GAMEWELL COMPANY, Dept. 13E, Newton Upper Falls 64, Mass.



CONDENSED SPEC OF RVG-30XS-4POT

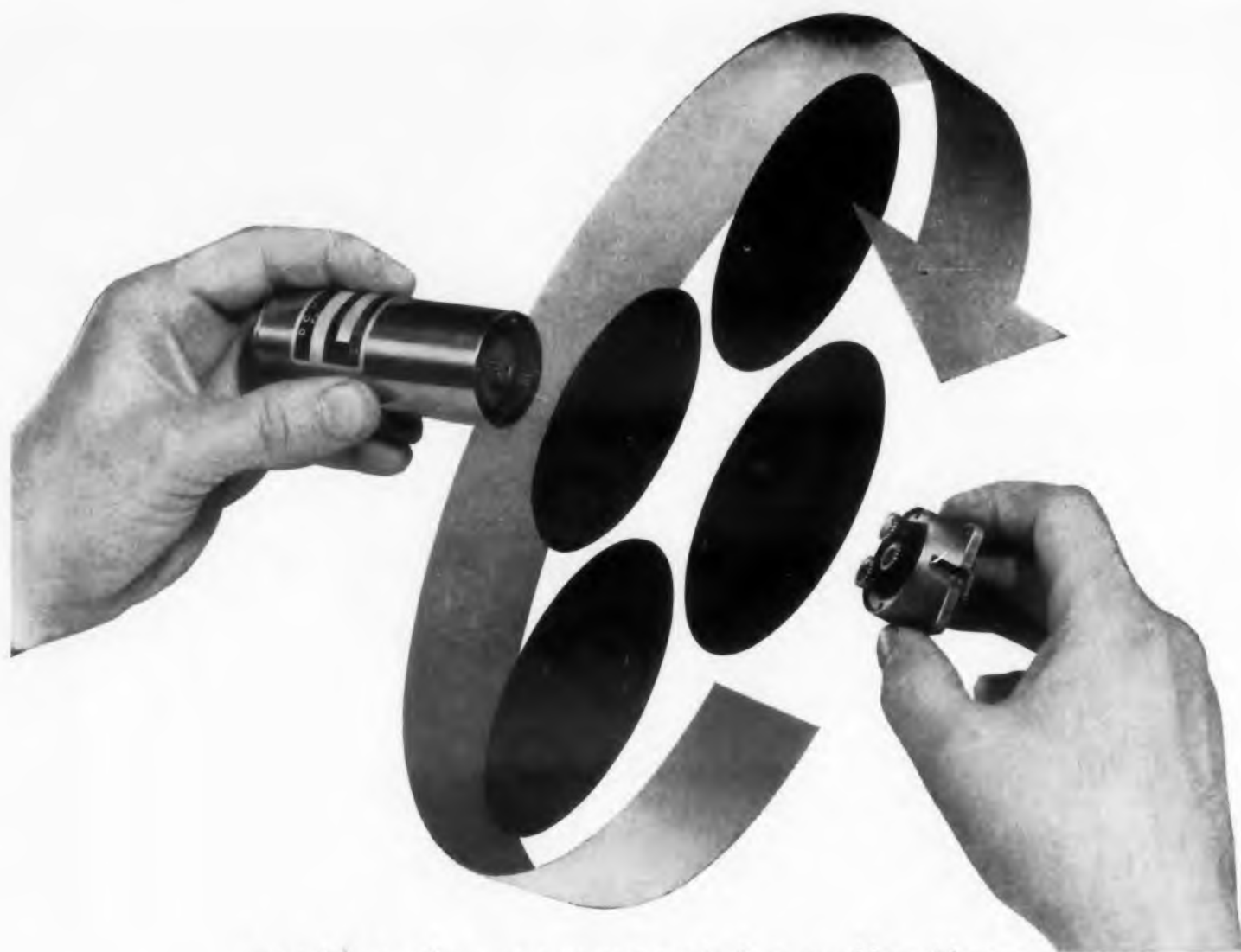
Resistance..... 16,000 ohms $\pm 5\%$
 Conformity..... 1.0% peak to peak
 Starting Torque..... 0.5 oz. in. max.
 Angular Accuracy..... $\pm 0.7^\circ$
 Weight..... 2 oz. max.
 Mechanical Rotation..... Continuous
 Electrical Rotation..... 360°
 Nominal Life..... 350,000 cycles



Gamewell[®]

PRECISION POTENTIOMETERS
 INTEGRALS OF
 HIGH PERFORMANCE

CIRCLE 27 ON READER-SERVICE CARD



motors for commercial applications

HIGHEST TORQUE FOR SMALLEST SPACES

Missile designers are well acquainted with the extremely high torque available from a planetary geared precision miniature Globe motor. Units similar to the one pictured can produce up to 150 inch pounds of torque!

And more and more designers are finding that these motors offer outstanding advantages for commercial applications as well. Universal, a.c., or d.c. types are available from $\frac{7}{8}$ " to $2\frac{1}{4}$ " in diameter. They can replace larger, ordinary motors at competitive cost, and deliver important bonuses too. They perform reliably under conditions that would soon ruin ordinary motors—high humidity and temperature, jarring shock and vibration, dust and fume-laden atmospheres.

Globe speed reduced motors are engineered to fit your specific application as no "off the shelf" motor can. Standard component design is the secret; for example, 83 even ratio planetary reducers are available to give the speed and torque you need. Many parts are inventoried. Design and production efficiency will save you money. If you have a commercial application that demands a smaller, more powerful, more reliable and competitively priced motor, then consult Globe first. Write for Bulletin ACG. Globe Industries, Inc., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE INDUSTRIES, INC.

PRECISION MINIATURE A.C. & D.C. MOTORS, ACTUATORS,
TIMERS, GYROS, STEPPERS, BLOWERS, MOTORIZED DEVICES

GLOBE

CIRCLE 28 ON READER-SERVICE CARD

which these capacitances can be regarded as very small. The relays have a life of at least 10^8 operations, which is important in a circuit being operated at a high switching rate.

To obtain optimum relay life, the relays, which are an octal plug-in type, are each occasionally advanced one position in the counter, except for the number 1 stage relay, which is shifted to number 16 stage. Because the first stage relay operates at about 4000 times the rate of the 12th stage relay, this occasional change prevents uneven wearing out of relays.

Precision Parts Used

The circuit to be tested is wired into a plug board that is on the top of the instrument. Switched component parts can include resistors, capacitors, transistors of different betas, etc. Precision parts are used for building the test circuit. Resistors are metal-film type and capacitors are ceramic or glass. They have the stability necessary to prevent changes in value with age, humidity, and other performance degrading factors. Such instability could invalidate the test.

Because the circuits under tests are largely transistorized digital types, transistor beta variations and excessive I_{CBO} are important contributors to circuit unreliability. "Libraries" of transistors have been accumulated with high- and low-limit values of beta by selection from incoming units and special orders from manufacturers. These are treated as high- and low-limit parts and are also switched in and out of the circuit under test. Transistor I_{CBO} is permanently maintained at its maximum predicted value during the test by adjustment of a variable potentiometer between the collector and base of each transistor.

Three Operating Modes

Controls on the front of the instrument provide for either one-step-at-a-time manual advance of the count, continuously variable automatic advance at rates from 0.25 to 20 cps, or manual setting of any combination without going through a complete counting cycle. A switch provides for automatic "stop" in case of failure of the tested circuit, or, if a digital printer is used to automatically record failures, the switch can be set to a "no-stop" position.

A unijunction transistor relaxation oscillator provides a variable-rate trigger for the 16 standard flip-flops that make up the relay-drive counter. The normal signal-input is applied to the circuit under test.

The output of the circuit under test is viewed on an oscilloscope; since the normal circuit-output waveshape is known, failures are easily detected by observation. When a particular combination of part values causes circuit failure, stepping of the counter can be stopped manually and the

combination that caused failure is read as a binary number from lamp indicators on the fronts of the flip-flops. A lighted lamp or "one" in a stage indicates that the component controlled by that stage is at its high-limit value. A zero or unlit lamp indicates low-limit value.

Automatic Failure Indicator

An automatic failure indication device has also been developed. The allowable circuit output is premarked on the face of an oscilloscope as an opaque trace whose line width represents allowable output voltage and time tolerances. The normal output will thus always be hidden behind the opaque line (black masking tape is used). A failure will appear as a visible trace on the face of the oscilloscope and is detected by a photocell mounted in a hood. The photocell signal disables the part-switching pulse drive line and the part switching stops. Faster switching rates can be used with this automatic system than with manual operation. A digital printer can be commanded to print on paper tape the number of each failure step without stopping the switching. This provides rapid, unattended testing. Any failure trend can be noted by observing the tape and comparing the status of the various parts on the failed steps.

It is also possible to make a less sophisticated automatic failure indicator without the use of an oscilloscope. One way is to compare the output of the circuit under test with that of an identical circuit containing the nominal values. The two circuits are triggered or otherwise fed inputs in parallel and the difference in outputs is detected. The system can be designed so that a difference in output waveforms of more than a certain amount will cause failure indication.

Another method is to integrate the output of the tested circuit in such a way that a dc voltage is maintained as long as the circuit output is active. The absence, increase, or decrease of this dc voltage would be an indication of circuit failure and would produce a failure alarm. Both these methods have been tried with moderate success.

Design Application

Perhaps of as great significance as the use of the instrument in determining reliability of previously designed circuits is its use as an aid to the circuit designer during the development of new circuits. Several new circuits have been optimized by placing the preliminary design in the tolerance tester, noting failure trends, and then changing nominal part values in the indicated direction. This procedure has not yet become routine, but has been sufficiently useful to gain significant acceptance among design engineers. In this manner, the circuit is designed and tested at the same stage of development. ■ ■



MCDONNELL VOODOO

Above 1200 mph, it isn't enough to put just mechanical "muscle" at the pilot's command; he needs an assist with "mental" aerobatics, too.

Teaming-up with McDonnell engineers, the specialists of the Aeronautical Division at Minneapolis-Honeywell Regulator Company turned out a mechanical co-pilot specifically for the F-101B. For nerves and sinews in this M-H Autopilot, they specified Hitemp Teflon* coated wire and cable.

As the leading specialist in high temperature insulated wires and cables, Hitemp Wires, Inc. is proud to stand among those devoted to safeguarding our country.

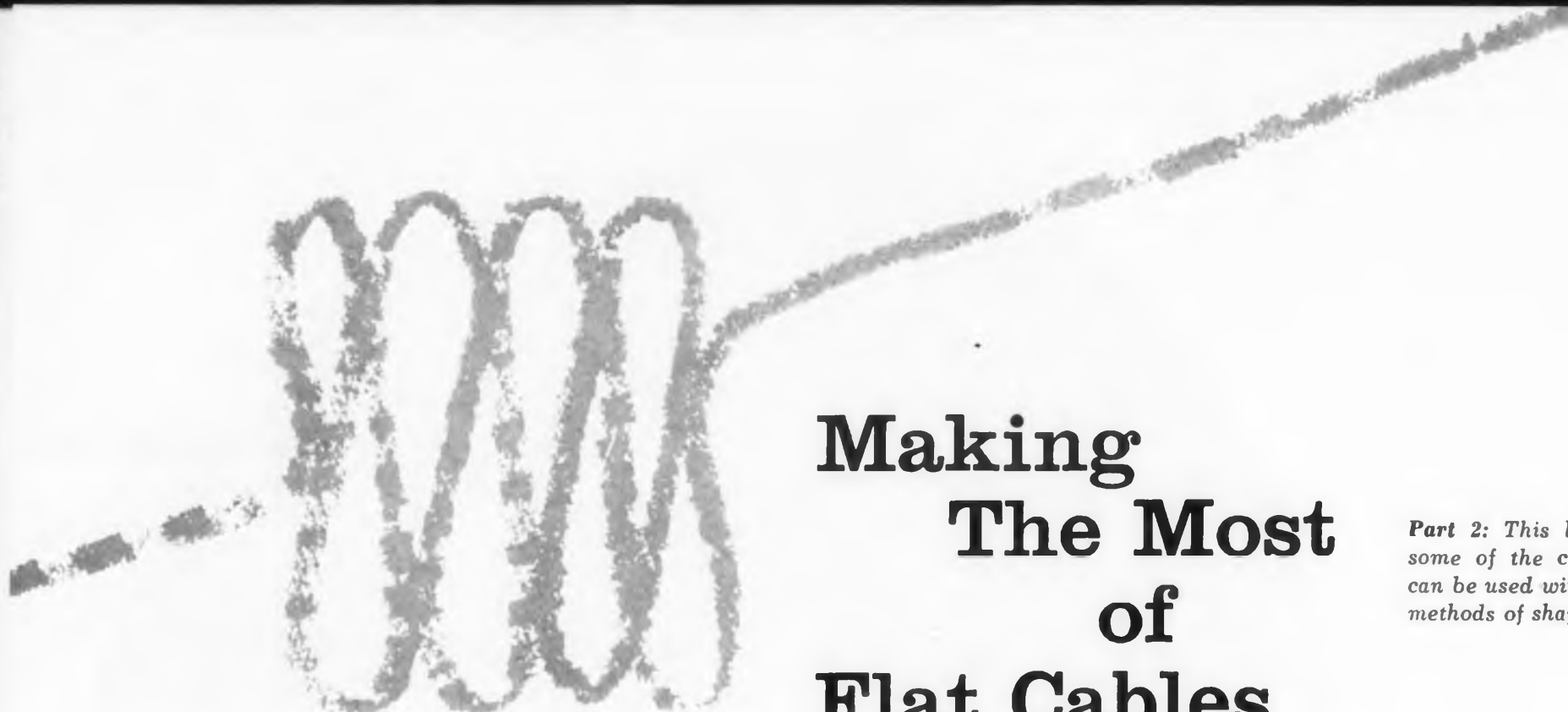
HITEMP WIRES, INC.

1200 SHAMES DRIVE, WESTBURY, NEW YORK

*Registered trademark for DuPont fluorocarbon resins.

CIRCLE 29 ON READER-SERVICE CARD





Making The Most of Flat Cables

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

Part 2: This last of two articles describes some of the connectors and terminals that can be used with flat cables. Also covered are methods of shaping flat cables.

FLAT CABLES can be shaped for a variety of purposes. And they can be terminated to many of the standard terminals and connectors now available.

When some AMP terminals are connected to some flat cables, the conductors are separated by a punch and die that removes U-shaped pieces of insulation from between the conductors. It leaves a radius at the end of the slot in the insulation to absorb large stresses that might tear the insulation. Conductors are stripped at the end either before or after slotting. A double crimp holds both the insulation and the stripped conductor end. (See Fig. 1.)

Some terminals can be attached at any position along the conductor without the need for stripping. (Fig. 2.)

Conventional connectors are attached easily by stripping, soldering and encapsulating the flat cable. (Figs. 3, 4 and 5.) Scotchcast #4 (Minnesota Mining & Mfg. Co.) is a convenient resin to use for encapsulating.

Some connectors have been especially designed for flat conductor cables. Like the cable, they are thin, flat and light. When used with an Industrial Hardware connector, the cable's conductors are first stripped simultaneously, then folded around the ends of the terminals and dip-soldered. A mechanical strain relief is applied. Variations are available for bulkhead mounting, for printed wiring, wire wrap and for soldering conventional wires. (Figs. 6 and 7.)

Elco's Varicon terminals may be staked into a board after a flat cable's stripped conductors have been "combed" through the terminal holes. The staked side of the board is then dip-soldered, adding to the reliability of the pressure connection. Molded receptacles for the Elco plug are available for wire wrap, taper tab, printed wiring and soldered wires. These are illustrated in Figs. 8a and 8b.

AMP's printed wiring connector is designed to accept flat conductor cable or conventional wire. Terminals are crimped on stripped conductors and inserted as a group in the connector block. Individual terminals may be removed as desired for circuit checking. (Fig. 9.)

The Advantages of Book Packaging

Printed wiring can be hinged for serviceability while the circuits are energized. "Book packaging" permits greater packaging density, reduces package weight and cost, eliminates board connectors and increases the reliability of the system by eliminating half of the series terminations required for a board connector system. (See Fig. 10.) Most of the advantages of a pluggable package may be retained by equipping each book of many pages with a single connector.

How Retractable Cables Are Made

Flat cables with thermoplastic insulations may be formed by the use of heat and stresses. An S-shaped retractile cable is shown in Fig. 11.

Retractable cables used for connecting sliding chassis to a rack are formed by winding standard cables on a suitable fixture that holds the cable in a final desired shape. Bend radii should be kept as large as practicable to maintain the high flex life characteristics of the cable. The forming fixture should be made of a material having low thermal inertia. A heat forming fixture for retractile cable is shown in Fig. 12.

The recommended forming temperature for insulation material made of Polyester, type M, is 130 C.

Processing time need be only long enough to raise all parts of the cable to processing temperature. A circulating air oven is preferred, although almost any other type of oven is suitable.

The need for an S-shaped retractile cable, such as described above, may be eliminated in some applications by the use of flat cables laid out in the shape of a U. This eliminates the necessity for heat-forming the cable, and it may be used in its natural, straight form.

In some application it is desirable to capture the cable in a channel or raceway approximately a half-inch deep and a little wider than the cable. The channel may be lined with pressure-sensitive Teflon tape to minimize abrasion damage to the cable under severe conditions. The cable loop is driven back and forth by the motion of the chassis to which it is attached, and no spring retractile is necessary.

(Continued on page 39)



Fig. 1. (left) Some AMP terminals can be crimped to a flat cable.



Fig. 2. (above) Some terminals, like these, made by AMP Inc., can be attached at any position along the conductor without the need for stripping.

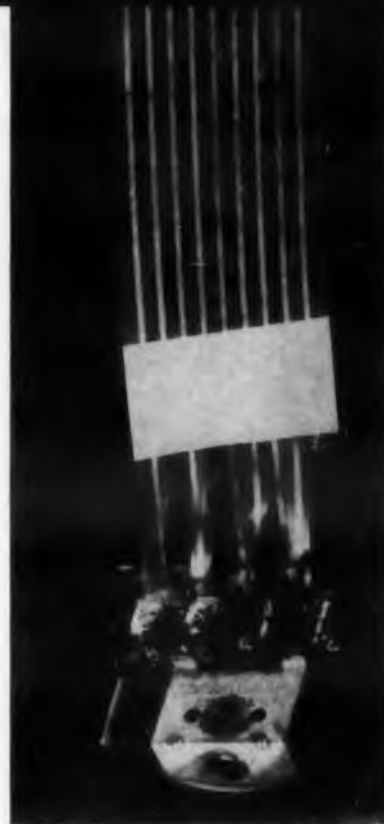


Fig. 3. (above) Many familiar connectors may be connected by encapsulation. Conductors are first stripped, then the cable is slit between conductors and soldered in place as with conventional cable.



Fig. 4. (above) Encapsulating resin acts as a strain relief.

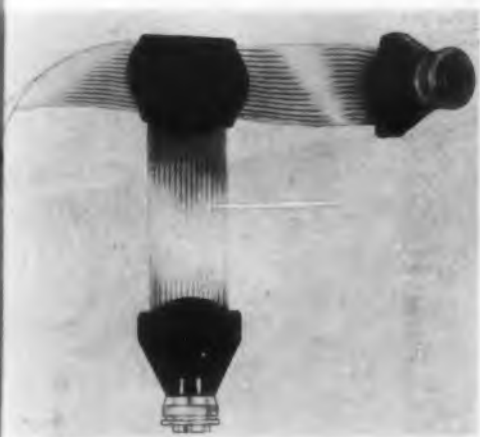


Fig. 5. This Bendix-Scintilla harness has Pygmy connectors attached by encapsulation.



Fig. 6. (left) This Industrial Hardware connector is connected by dip soldering and can be stacked in multiple.



Fig. 7. This Bendix-Scintilla connector is designed for environmental extremes.



Figs. 8a (left) and b (below). An Elco Vari-con can connect a flat cable to conventional wires or printed wiring.



Fig. 9. (left) AMP printed wiring connector.

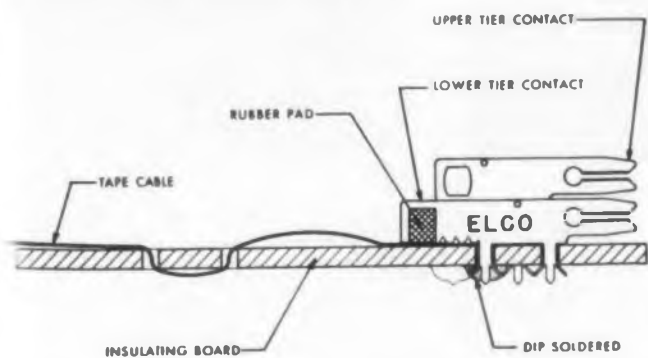


Fig. 10. (right) "Book Packaging" in Stromberg-Carlson airborne equipment uses hinged printed wiring boards interconnected by a flat cable.

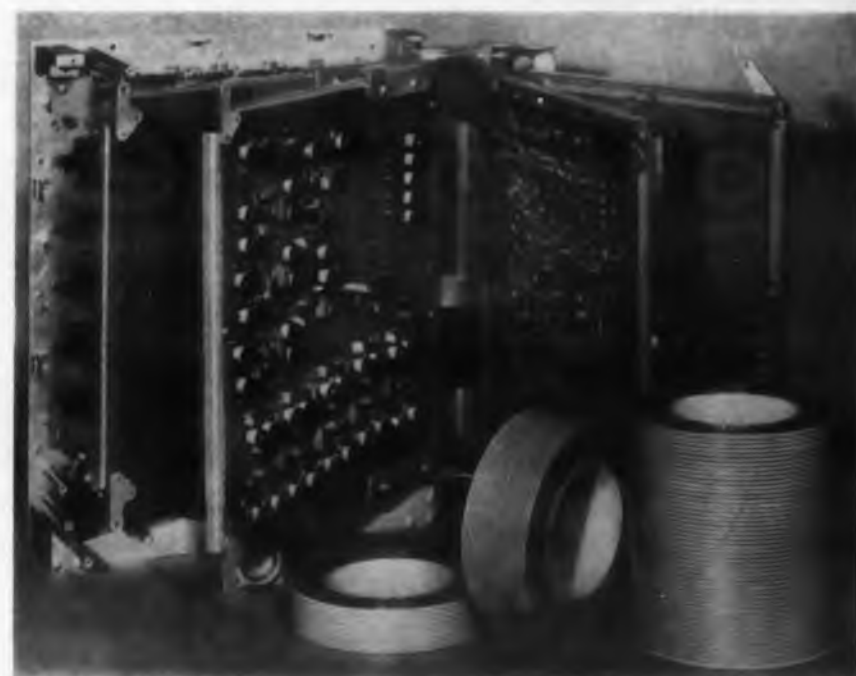




Fig. 12. (above) Heat forming fixture for retractor cable.

Fig. 11. (left) An "S" shaped retractor cable can be used for connecting a sliding chassis to a rack.

Fig. 13. (right) A curved cross-section makes a flat cable self-supporting.

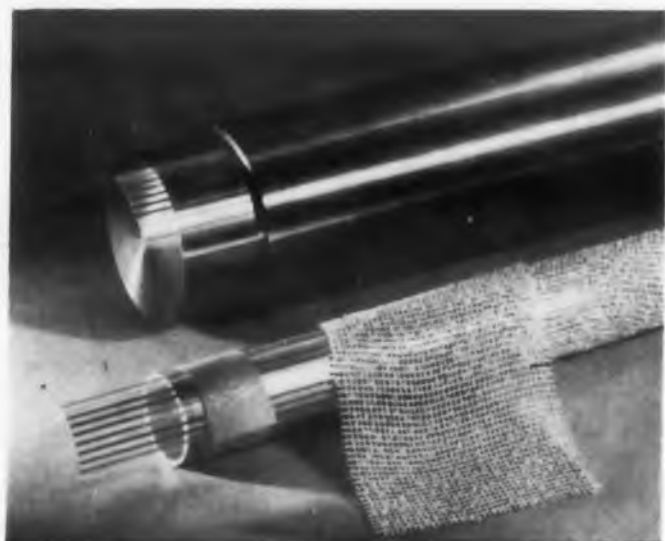


Fig. 14. Simple heat forming tools used for making a curved cross-section.

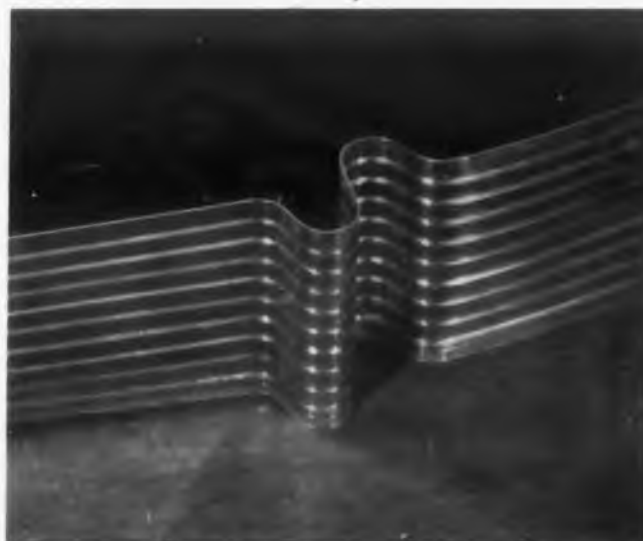


Fig. 15. A corrugation compensates for the variation in dimensions between fixed points and absorbs longitudinal stresses.

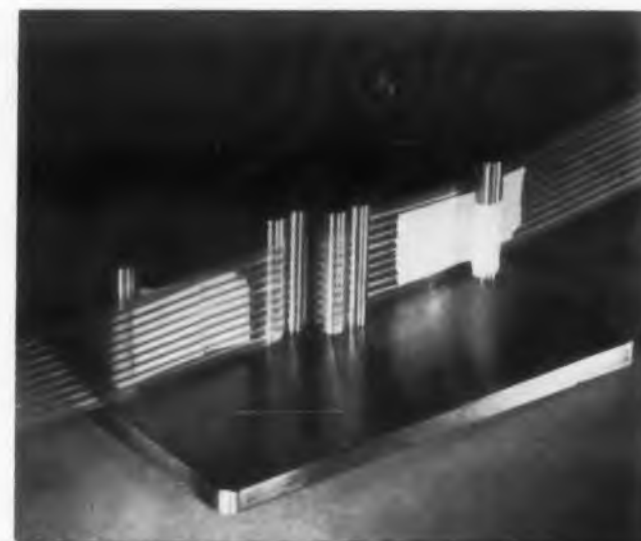


Fig. 16. The fixture for heat forming a corrugation.

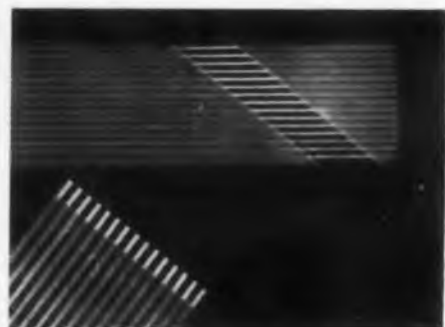


Fig. 17. Narrower cable is stripped at an angle when changing conductor centers.

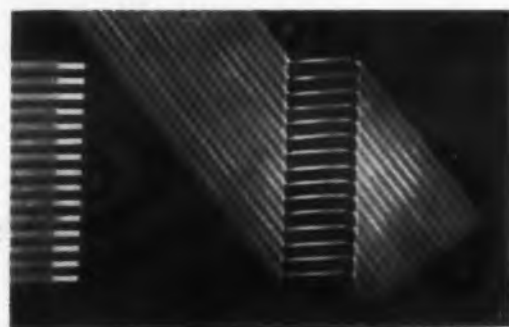


Fig. 18. Narrower cable conductors are staggered to make conductor centers match larger cable.



Fig. 19. Conductors are held in position with masking tape and dip soldered.

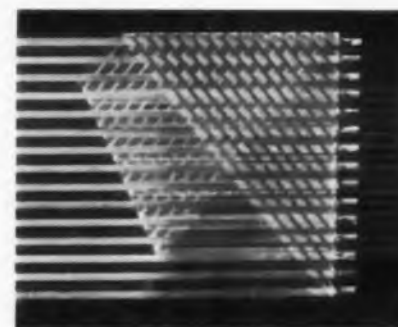


Fig. 20. The cable is folded to restore in-line configuration. Insulation may then be replaced with electrical tape or encapsulation.



Fig. 21. Changing conductor centers with grid wiring technique.

Uses of Curved Cross-Section Cable

Applications requiring extremely low mass for interconnecting multiple-conductor cable, such as oscillating or high-speed recording or reading heads, are ideally suited for a flat cable formed with a curved cross-section. (See Fig. 13.)

Acting much like a doubled-up steel tape rule, this cable shape is used where minimum mass and friction are desired. In some applications it can be completely self-supporting, with no channel or raceway necessary.

In the application, the ends of the cable should be mounted or potted in such a way that the cross-section curve of the cable is maintained to prevent buckling of the cable at the terminal ends. U-shaped cables have the advantage of less length, resulting in lower cable cost and lower voltage drop. However, they are not self-retracting, and space requirements are usually quite different. Mechanical resonant frequency problems are usually easier to solve with the U configuration. Simple heat-forming tools for flat cables with a curved cross section are shown in Fig. 14.

Corrugated Cable Helps

When it is desirable to have the cable follow a straight line between two fixed points, it is often difficult to cut the cable to the exact dimensions required, since cutting and stripping tolerances are usually necessary. Sometimes it is necessary to allow for minor variations in the mounting of a termination, or longitudinal vibrations must be absorbed. Such variations can be compensated by the use of an adjustment corrugation. (See Fig. 15.)

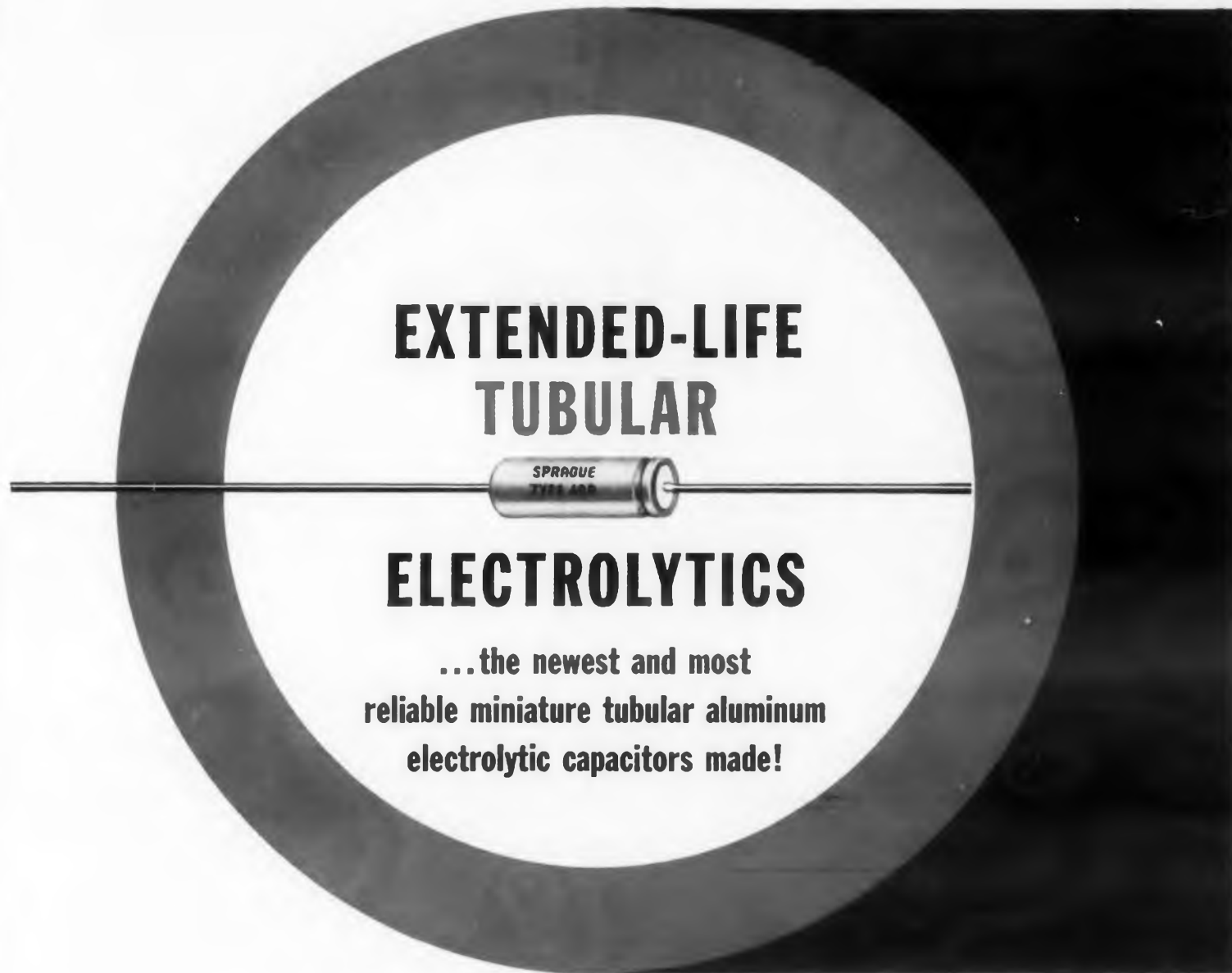
Corrugations may be formed on a fixture in an oven (Fig. 16). It is desirable to control forming temperature within a few degrees to produce uniform controlled corrugations. Care should be taken to prevent heavy compression or other high stresses on the cable during the forming operation.

Changing Conductor Centers

Angle splicing may be used to change conductor centers. (See Figs. 17 through 20.)

The Selectacon grid-wiring technique is a versatile method for changing conductor centers. A cable with any given conductor spacing is laid at a right angle on top of a cable with any other conductor spacing, and selected conductor intersections are simply soldered through the insulation (ED, Oct. 15, 1958). This method is shown in Fig. 21.

Separating the conductors, by slitting at the end of the cable, makes it possible to connect the cable to a connector or cable with any spacing between terminals or conductors. ■ ■



**EXTENDED-LIFE
TUBULAR
ELECTROLYTICS**

...the newest and most
reliable miniature tubular aluminum
electrolytic capacitors made!

Now . . . for the first time . . . an extended-life electrolytic in miniature tubular case styles. Sprague's New Type 40D Extended-Life Electrolytics are designed to give more than 10 years of service under normal operating conditions in actual circuit applications.

○ Broader Application

Though similar in many respects to Sprague's famous extended-life electrolytics for telephone and communications systems, these capacitors have the added advantage of low temperature characteristics previously unavailable in an aluminum electrolytic. As a result, Type 40D offers much broader industrial and military application.

○ Special Construction

Type 40D capacitors are specially constructed to assure freedom from open circuits even after extended periods of operation in the millivolt signal range. Ultra-low leakage currents are the result of special design and processing techniques based on the use of the highest purity anode and cathode foils.

○ Hand or Machine Assembly

For applications which require an insulated case, Sprague furnishes an outer insulation of either flexible plastic for hand assembly or rigid phenolic for machine insertion on printed wiring boards.

Get details on Type 40D Extended-Life Electrolytics by writing for Bulletin 3205 to Technical Literature Section, Sprague Electric Co., 347 Marshall St., North Adams, Mass.

SPRAGUE COMPONENTS:

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

CIRCLE 30 ON READER-SERVICE CARD

SPRAGUE[®]
THE MARK OF RELIABILITY

Get Higher Torque from Multipole Hysteresis Motor

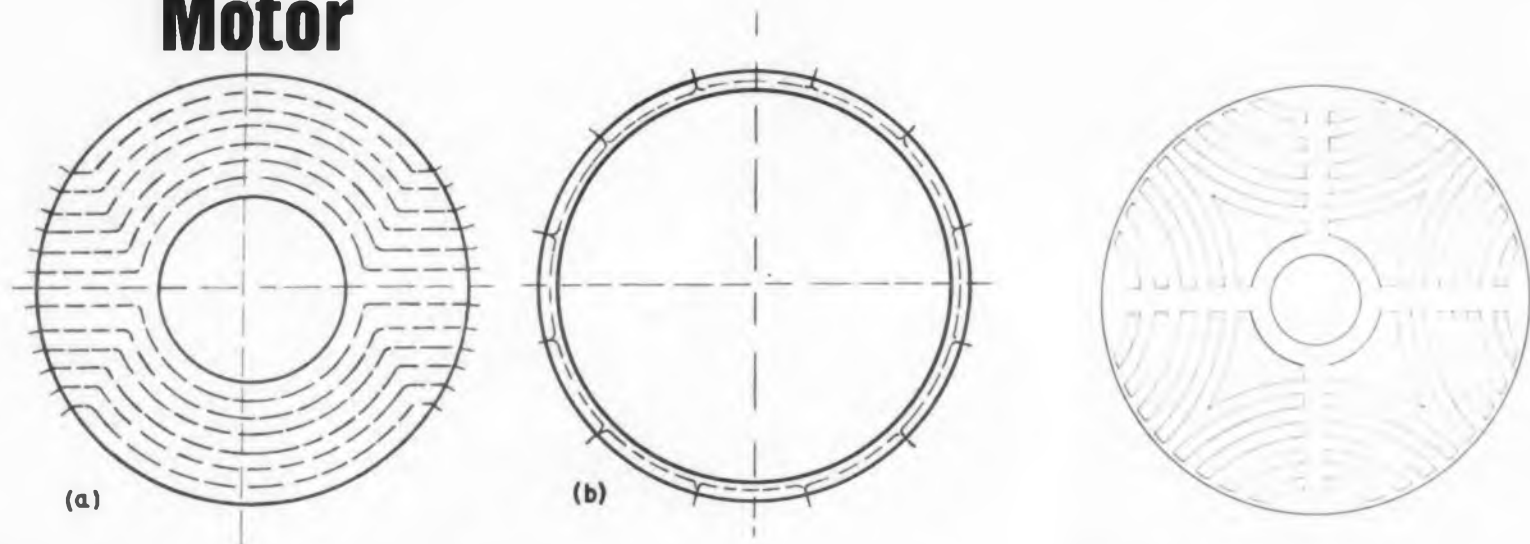


Fig. 1. Density of magnetic lines in rotor must remain constant; (a) shows a two-pole rotor and (b) a 12-pole rotor. In both cases density is the same, but useable volume of magnetic material is greatly reduced with 12 poles.

Fig. 2. Supersyn rotor design. This four pole rotor has the optimum magnetic density, but many times the effective volume of conventional rotors. Magnetic lines of force traverse several long, narrow paths.

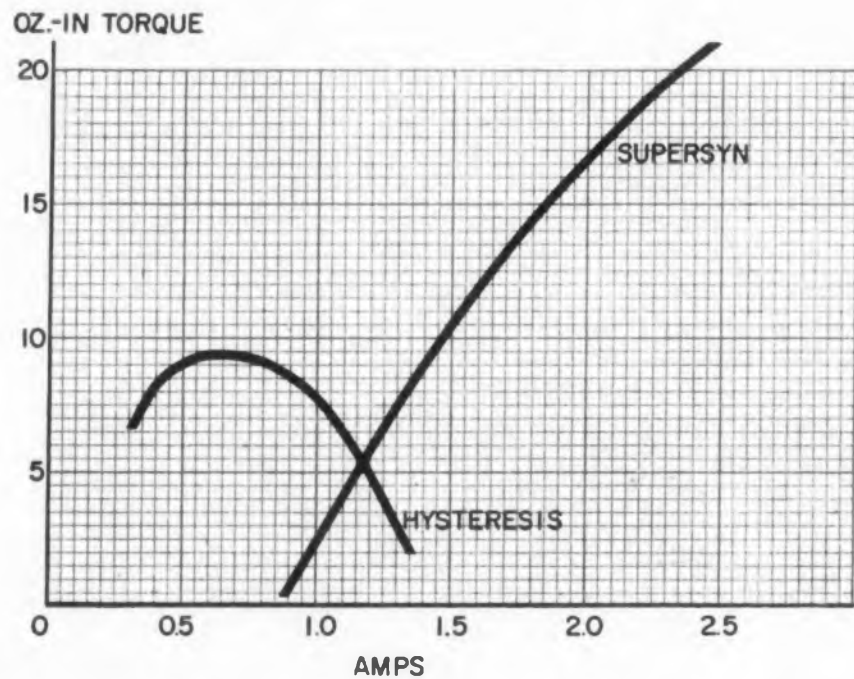


Fig. 3. Torque (in-oz) per ampere relationship of conventional hysteresis synchronous motors and new Supersyn. Both motors the same size.

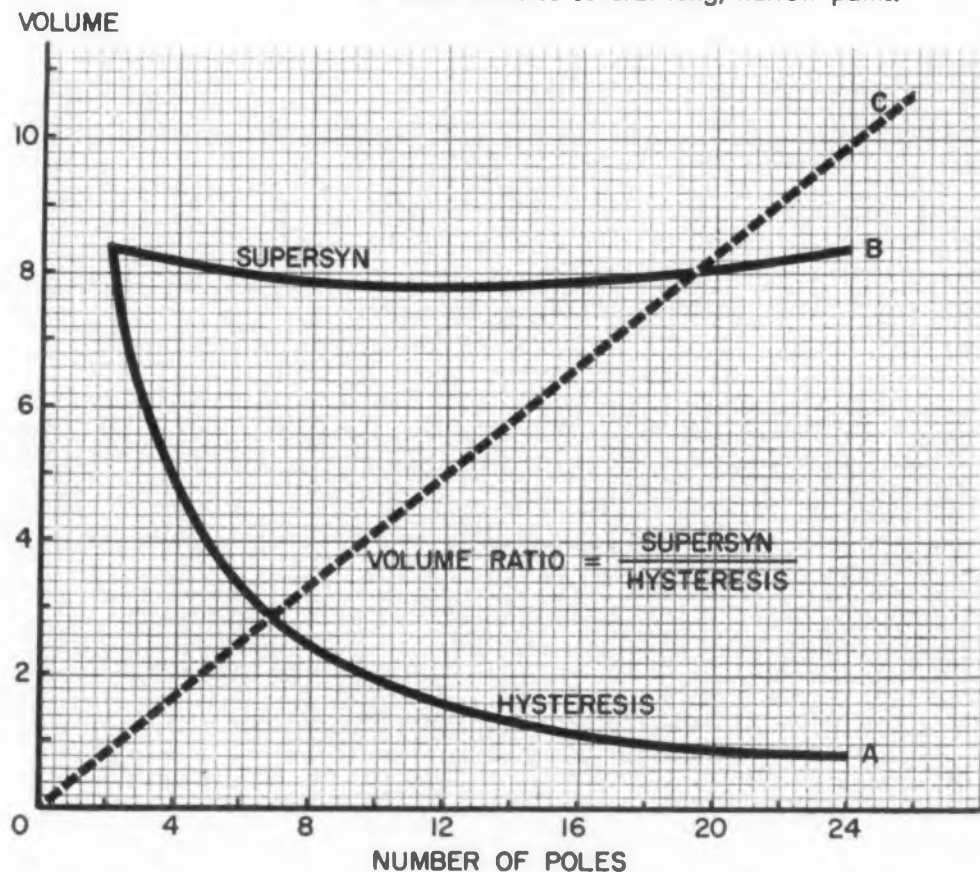


Fig. 4. Active (effective) rotor volume (normalized) as a function of number of poles for conventional and Supersyn motors. As both volume and poles increase, torque increases.

TEN TIMES smaller than conventional multiple pole hysteresis synchronous motors, a new design eliminates wasted rotor volume without sacrificing optimum flux density.

Designed by Andrew Bekey of Bekey Electric Div. of Genisco, 2233 Federal Ave., Los Angeles 44, Calif., the Supersyn will find application in electronic and aircraft power supplies.

Its fast acceleration and good damping along with high power in a small package will make it particularly valuable in applications where size and weight are at a premium.

Design

A new rotor design is the heart of the Supersyn—the stator and package are similar to standard motors. Conventional hysteresis synchronous motors contain a cylindrical rotor built of permanent magnetic material. Since the motor's torque is proportional to a constant (representing the quality of the hysteresis material) times the usable volume of material times the number of poles, it seems reasonable to expect the torque to increase with number of poles.

But since the total magnetic flux through the rotor is divided in as many parts as there are poles, and since to achieve best rotor operation an optimum density of magnetic lines is needed, the rotor volume must be decreased as poles are added. See Fig. 1. As magnetic flux is divided into more parts the rotor section must be decreased to keep the magnetic density constant.

With the usable rotor volume reduced in the same ratio as the increase in poles, the torque is virtually constant. Horsepower output varies with speed.

If a rotor is designed as in Fig. 2, so that the lines of force traverse several long paths, the usable rotor volume is enormously increased. Each path being individually narrow, the magnetic density remains optimum.

Result of this design is shown in the curves of Figs. 3 and 4. A Supersyn with 24 poles has ten times the usable rotor volume of the conventional hysteresis synchronous motor. Practically, this means that for the same horsepower a Supersyn is one tenth the size of a conventional motor. A 12-pole Supersyn of the same size as a conventional motor would have five times more power.

For hysteresis synchronous motors with more than 24 poles, the Supersyn is virtually a necessity; and in terms of torque per ampere (Fig. 4) Supersyn's almost linear increase makes it a sure bet—it becomes a constant horsepower device, rather than a conventional constant torque device.

For further information on this new high power hysteresis synchronous motor turn to the Reader-Service Card and circle 101.



BELDEN

MAGNET WIRE HANDBOOK 14

1960 Edition

Now Available

Over 90 pages . . . handy desk and pocket size (4¾" x 7½")
A special feature dealing with "Factors Involved in Selection of Magnet Wire"
A discussion of "Winding Tensions"
Performance data on all types of magnet wires
Dimensional tables on all types of magnet wires . . . including bare aluminum, bare copper, and tinned copper
Ask for no-charge copy of Belden Magnet Wire Handbook 14

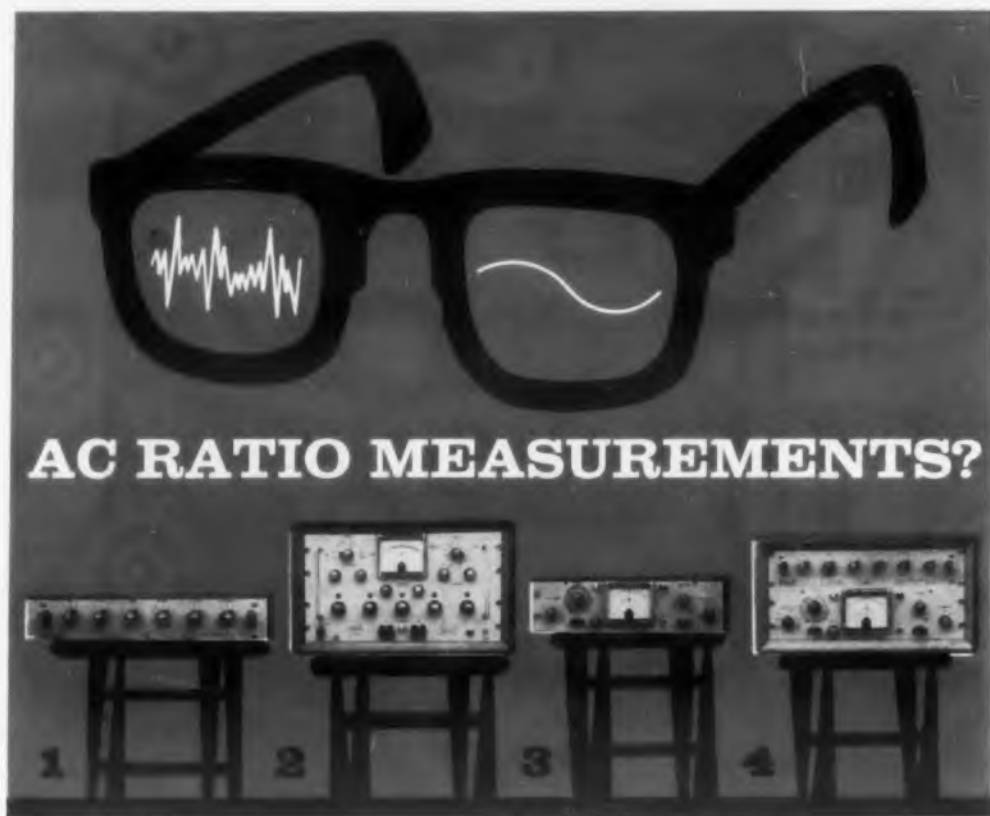
BELDEN MANUFACTURING COMPANY
P. O. Box 5070-A, Department 11
Chicago 80, Illinois

one wire source for everything electrical and electronic



lead wire • magnet wire • power supply cords •
cord sets • portable cordage • electronic wire •
automotive replacement wire and cable •
aircraft wire • electrical household replacement cords

1-1-9



THERE'S A NORTH ATLANTIC INSTRUMENT TO MEET YOUR REQUIREMENTS, TOO...

Now — from North Atlantic — you get the complete answer to AC ratio instrumentation problems — in the laboratory, on the production line, in the field.

Specialists in ratiometry, North Atlantic offers the only complete line of precision instruments to handle any ratio measurement task. All are designed to meet the most demanding requirements of missile age electronics — provide high accuracy, flexibility, component compatibility and service-proven performance. Some are shown above.

If your project demands total solution to ratio measurement problems, write for Date File No. 10B. It provides complete specifications and application data and shows how North Atlantic's unparalleled experience in ratiometry can help you.



1. RATIO BOXES:
Both laboratory standards and general duty models. Ratio accuracies to 0.0001%. Operation from 25 cps to 10 kc.

2. COMPLEX VOLTAGE RATIOMETERS
Integrated, single-unit system for applications where phase relations are critical. Accuracy to 0.0001%, unaffected by quadrature. Three frequency operation. Direct reading of phase shift in milliradians or degrees.

3. PHASE ANGLE VOLTMETERS*
Versatile readout system for all ratiometry applications, providing direct reading of phase, null, quadrature, in-phase and total voltage. Broad-band, single-, or multiple-frequency operation.

4. RATIO TEST SETS
Ratio reference and readout in one convenient package for production line and similar applications. Can be supplied with any desired combination of ratio box and phase angle voltmeter.

NORTH ATLANTIC INDUSTRIES, INC.
603 MAIN STREET, WESTBURY, N. Y. • EDGEWOOD 4-1122

CIRCLE 31 ON READER-SERVICE CARD



Specially Designed Components Cut Transformer-Rectifier's Size, Weight

TRANSFORMER-RECTIFIERS that are more compact and lighter than others on the market are now being made available for airborne applications. They were trimmed in size and weight by specially designed circular components.

The most distinctive component in the T-R's is a three-phase transformer constructed with a symmetrical Y configuration—claimed to be a first. The transformer consists of three single-phase structures mounted into the Y configuration. It is symmetrical magnetically, electrically and physically. The structures consist of a coil assembly and core.

Each core is made from wedge-shaped sections of wound, grain-oriented steel tape. Three of these sections are placed adjacent to each other so that each occupies one-third of the circular configuration. They are then cut at the periphery so that the three-coil assemblies can be placed over the three adjacent and mat-

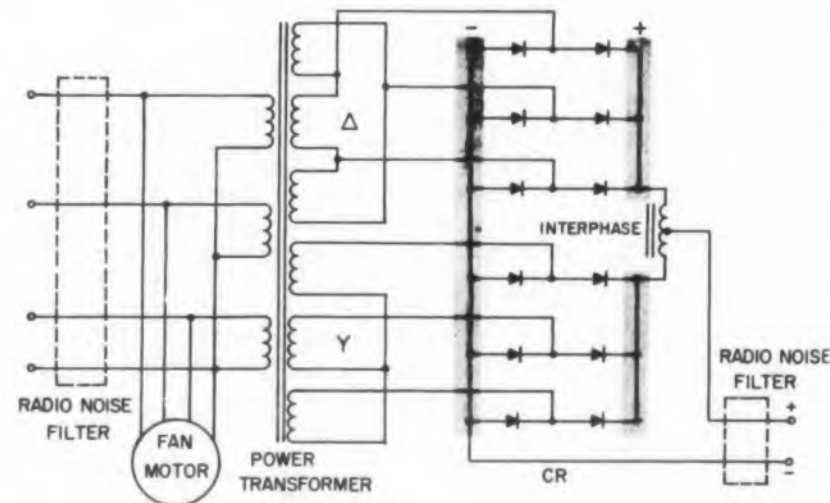
ing parts of the sections. A tension band clamps the cut sections together to provide uniformity of flux patterns.

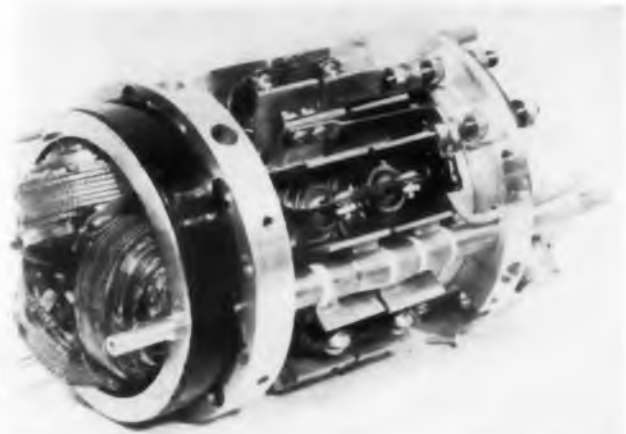
The secondary of each coil is made of two separate wires that are connected in wye and delta, respectively, to the other coils. The three-phase, wye-connected primary is thus split into a six-phase output at the secondary with a nominal output of about 20 v. The wye and delta outputs are 30 electrical degrees out of phase with each other and each is tied to its own rectification circuit.

The wye-delta secondary doubles the fundamental ripple frequency and cuts the magnitude of the ripple voltage in half—to about 2.5%. And the interphase transformer cuts this in half again—to about 1.5%, and eliminates the need for any further ripple refinement.

Made by Chatham Electronics, a division of Tung-Sol Inc., 630 W. Mt. Pleasant Ave., Livingston, N. J., all four

The wye-delta secondary of the transformer doubles the fundamental ripple frequency and cuts the magnitude of the ripple voltage in half—to about 2.5%.





Visible, from left to right, are the transformer, and the silicon diodes mounted in heat sinks.

T-R's in the "Y" series work off 200 v ac and deliver 28 v dc. The output of models 28VS20Y, 28VS50Y, 28VS100Y and 28VS200Y, is, respectively, 20, 50, 100 and 200 amp. The 200-amp unit weighs under 17 lb (compared to about 30 lb for other units with comparable ratings) and measures 11 in. in length. By comparison, the same unit occupies about one quarter of the volume of competitive units.

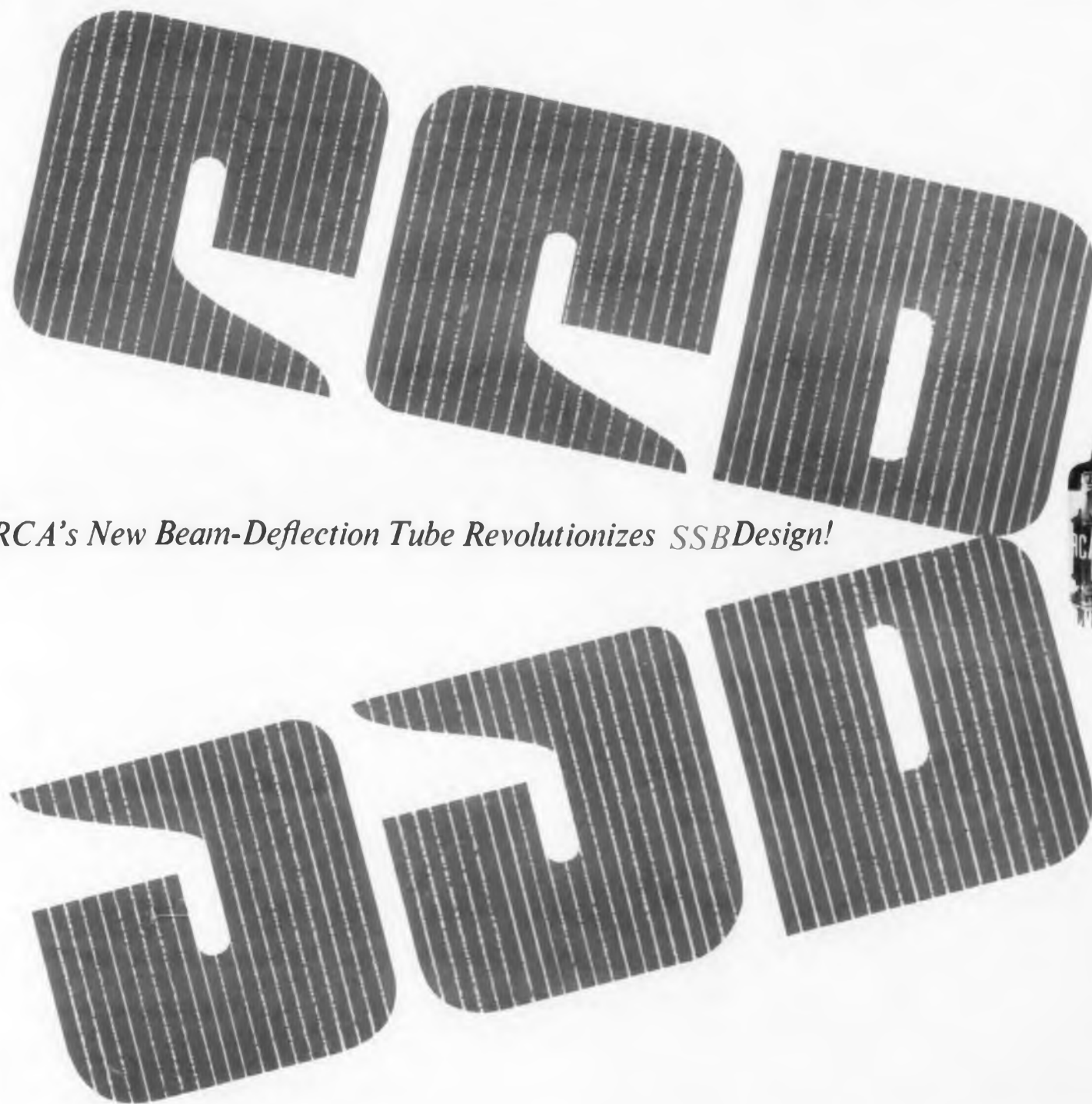
Twelve silicon diodes are in the rectification system—six for each full-wave bridge. They are also specially designed and are claimed to have higher current ratings than competitive units in this application.

Each delta and wye section is fed into its own bridge network. The bridges rectify independently of each other and their outputs are combined electrically with an interphase transformer.

The diodes are mounted on extruded aluminum heat sinks which are arranged in semi-circular sections with recesses to accommodate the diodes and radial fins to dissipate heat. Two of the semi-circular sections are electrically tied together to form the negative bus for the diodes. The other two sections are isolated from the first ring and each other. Between these two rings lies the interphase transformer, which equalizes any difference between the two bridges, limits peak current in the diodes, and reduces ripple in the dc output by about 50%.

The fan, an axial flow type, has a three-phase induction motor. It operates at 6500 rpm at sea level and at 18,000 rpm at 60,000 ft. thus displacing a nearly-constant volume of air.

For more information on these units, turn to the Reader-Service Card and circle number 102.



RCA's New Beam-Deflection Tube Revolutionizes SSB Design!

RCA-7360 First tube specifically developed for single-sideband applications...reduces tube and component requirements...its inherent long-term stability assures top performance of balanced circuits

Now you can design low-cost balanced SSB circuits around a single tube...RCA-7360. This unique tube makes possible one-tube balanced-modulator, balanced-mixer, and product-detector circuits. As a balanced modulator, it will deliver push-pull output from single-ended input...and can provide stable 60-db carrier suppression. When used as a self-excited balanced mixer, it can provide oscillator-signal suppression of at least 40-db. Other features include large signal-handling capability (up to 8 volts peak-to-peak mixer input), high transconductance, high input impedance, high deflection sensitivity, and extremely effective isolation between inputs. All these features make the 7360 the most significant electron-tube development for SSB design.

RCA-7360 contains two plates and two deflecting electrodes together with a cathode, a control grid, and a screen grid. Its inherent long-term stability is the result of electron flow to both plates from a single beam of electrons. Total beam current is determined by the voltages on grid No. 1 and grid No. 2 as in conventional pentode tubes, while the portion of the total beam current collected by each plate is determined by the voltage difference between the deflecting electrodes. Thus the output is a product of two input voltages.

The unique features of RCA-7360 enable you to design simpler, less-costly balanced SSB circuits with excellent long-term stability. Get full details now from the RCA Field Office nearest you.

EAST: 744 Broad Street, Newark 2, New Jersey
HUmboldt 5-3900

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

WEST: 6355 E. Washington Boulevard
Los Angeles 22, Calif., RAymond 3-8361



RADIO CORPORATION OF AMERICA
Electron Tube Division

Harrison, N. J.

ANOTHER WAY RCA SERVES YOU THROUGH ELECTRONICS

NEW PRODUCTS

Covering all new products that might generally be specified by an electronics engineer engaged in the design of original equipment.



Servomotor Has 1 in. Length

This size 5 servomotor has a 1-in. overall length and delivers a no load speed of 9500 rpm. The unit has a stall torque of 0.09 oz-in. and a theoretical acceleration of 45,000 rad per sec². Total power input is 3.5 w. Operating in a temperature range of -55 to +150 C, it is a 400 cycle unit. Completely encapsulated in epoxy, the servomotor weighs 0.68 oz and has a diameter of 0.5 in.

IMC Magnetics Corp., Dept. ED, 570 Main St., Westbury, N. Y.

CIRCLE 33 ON READER-SERVICE CARD

Center Screwlock Connector Contains 152 Contacts

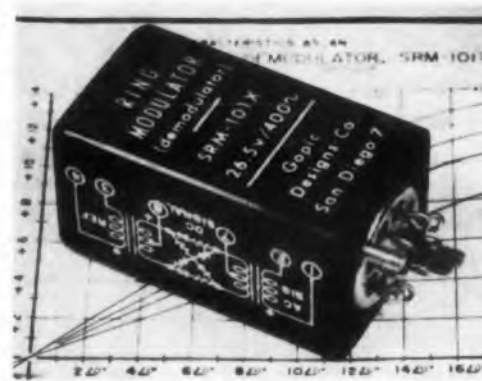


The series 1900 miniature rectangular power connectors come with a center screwlock, closed entry contacts, and up to 152 contacts. These pin and socket connectors can be had with terminals for solderless wire wrap, solderless taper pin or solder cup. The series can also be supplied with 104, 78 and 34 contacts. Body dimensions are 1.72 x 3.59 in. Current rating is 10 amp continuous, 13 amp max. Voltage breakdown at sea level is 1800 v rms and 2500 v dc.

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

CIRCLE 34 ON READER-SERVICE CARD

Ring Modulator-Demodulator Stable from -54 to +85 C



Type SRM-101X ring modulator-demodulator is stable between -54 and +85 C when operating as a phase-sensitive demodulator. No adjustment or external circuit compensation is required to maintain a 60-db dynamic range, a maximum phase error of 20 min, and a gain variation of less than 0.03% per deg C. The two transistors, four silicon diodes, and four wirewound resistors are preassembled on an etched circuit board which is potted and sealed in a steel case. The unit is suitable for both industrial and military applications.

Gopic Designs Co., Dept. ED, P.O. Box 7534, San Diego 7, Calif.

CIRCLE 35 ON READER-SERVICE CARD



Transistorized Generator Provides Simulated and Flexible Pulse Pattern

This transistorized pulse pattern generator provides a simulated and flexible time division pulse pattern and can be used for testing both slow and high speed electronic systems such as: guidance systems, computers, communication systems, and telemetry systems. It is especially useful working with equipment having a time division multiplex principle. The unit generates a pulse pattern any length from 1 to 100 pulses. The pulse rate is continuously variable from 10 to 100,000 pulses per sec using an internal oscillator, and it can be driven by an external oscillator at a pulse rate as low as desired. Each pulse can assume either a mark or space condition and is controlled by an individual switch.

Data Products Company, Inc., Dept. ED, 7320 Westmore Rd., Rockville, Md.

CIRCLE 36 ON READER-SERVICE CARD

Tunnel Diode Samples Available

The ZJ56, an experimental germanium semiconductor tunnel diode, is designed for low level switching and small signal applications with frequency capabilities extending to 1000 mc. Its operating temperature range is -55 to $+100$ C. The unit has a rated dissipation of 50 mw and is derated 0.66 mw per deg C in the ambient temperature range of $+25$ to $+100$ C. Peak tunnel current is: 0.9 ma, min; 1 ma, typical; 1.1 ma, max. There is a waiting list for these units which are available in sample quantities.

General Electric Co., Semiconductor Products Dept., Dept. ED, Liverpool, N. Y.

CIRCLE 37 ON READER-SERVICE CARD

CIRCLE 38 ON READER-SERVICE CARD

Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 1, No. 8

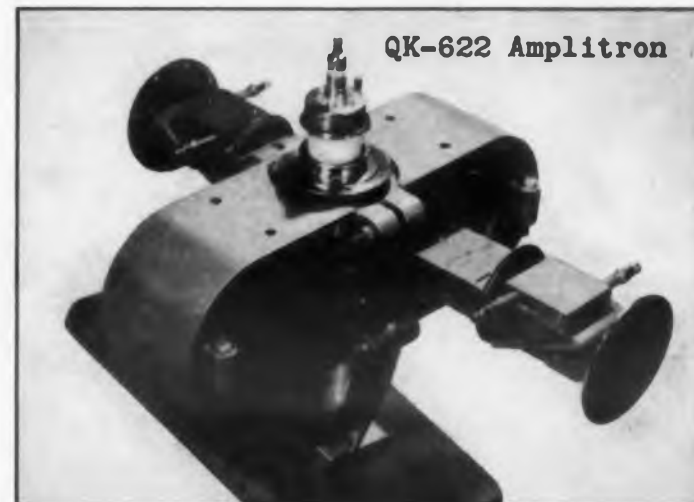
NEW RAYTHEON HEATERLESS AMPLITRONS EXCEED 1,000 HOURS AT RATED POWER OUTPUT

Two new 3-megawatt, S-band Amplitrons have demonstrated an operating life of more than 1,000 hours at rated power output. The QK-622 covers the 2,900 to 3,100 Mc band; the QK-783, the 2,700 to 2,900 Mc band. Both tubes supply full power with low phase pushing characteristics over their entire operating bands at efficiencies greater than 70%—making them unquestionably the most highly efficient microwave tubes thus far developed.

Tubes may be operated at reduced peak power levels to serve as driver stages. High efficiencies are retained at peak power of 600 Kw and gain of 10 db.

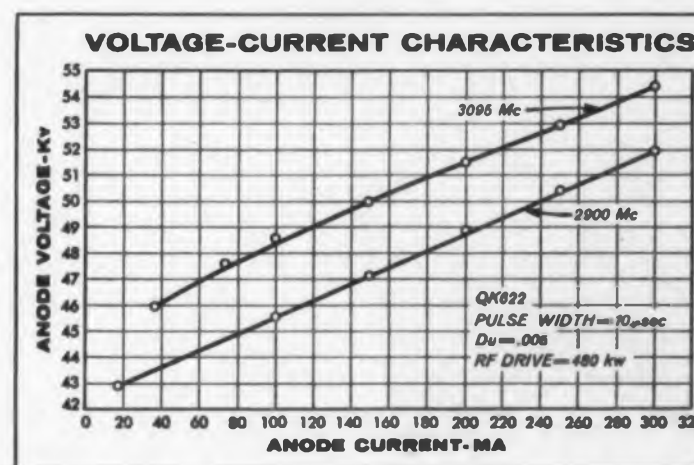
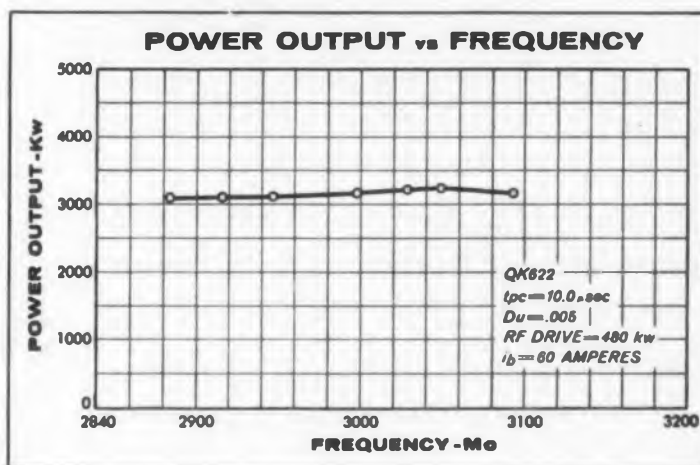
Exceptionally long tube life is made possible by the fact that no cathode warmup is required. Starting takes place whenever RF input is present prior to application of modulating pulse. Heater supplies may be omitted entirely from the equipment.

Applications include power-amplifier stages for long-range radars. The tube has been used successfully as an RF power source for linear accelerators.



Typical Operating Characteristics (QK622 and QK783 Amplitrons)

| | |
|--------------------------------|--------------|
| Peak Power Output (min.) | 3 Mw |
| Average Power Output | 15 Kw |
| Pulse Duration | 10 μ sec |
| Band Width | 200 Mc |
| Duty Cycle | .005 |
| Pulse Voltage | 50-55 Kv |
| Peak Anode Current | 65 amps |
| Efficiency | 70% |
| RF Input | 475 Kw |
| Weight (with permanent magnet) | 125 lbs. |



Excellence in Electronics



You can obtain detailed application information and special development services by contacting: Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts

A LEADER IN CREATIVE MICROWAVE TECHNOLOGY

*Twist It 'til It Snaps
and It Still*

**WON'T
LEAK**



The new improved Fusite V-24 Glass is so solidly fused to the stainless pins that 180° twisting won't break the bond between glass and metal.

Here is the line of hermetic terminals that is so resistant to both mechanical and thermal shock that terminals require no special nursing in application. Weld them, solder them, treat 'em rough—your assembly will remain hermetic, free of cracks under Statiflux testing.

Only V-24 Glass developed and smelted here in our own plant can produce terminals that give you such latitude in your production operation.

Wide variety of combinations of size, flange treatments, pin types and placement.

Write Dept. B-1 today stating your application and we'll send appropriate samples for your own testing.



THE FUSITE CORPORATION

6000 FERNVIEW AVE., CINCINNATI 13, OHIO

In Europe: FUSITE N. V. Kōrligsweg 16, Amelo, Holland

CIRCLE 39 ON READER-SERVICE CARD

NEW PRODUCTS

Interval Timer

Resolving time is 20 μ sec



Having a resolving time of 20 μ sec, the designated model LFQ-20 quantizer is accurate to one part in 10^7 per day. Compatible with a variety of digital data handling equipment, the unit accepts time-varying input signals and reads out the time of each interval in digital code. The unit is transistorized and meets Mil specs. It is designed to fit a standard relay rack.

Computer Equipment Corp., Dept. ED, 1931 Pontius Ave., Los Angeles 25, Calif.

CIRCLE 40 ON READER-SERVICE CARD



Zener Diodes

Are rated at 13.2, 22, and 29.7 v

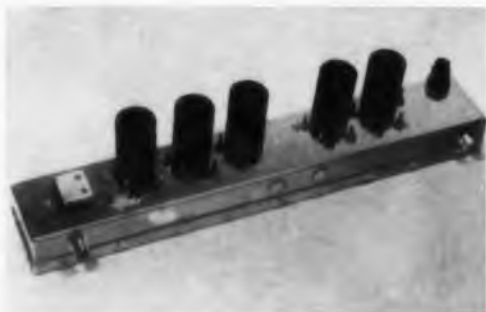
Designed to meet MIL-E-1/1236, these three 10-w Zener diodes have the following ratings: type 1N1353, 13.2 v; type 1N1358, 22 v, and 1N1361, 29.7 v. Their uses include the regulation of vacuum tube filaments, protection of transistors against voltage surges, and to provide voltage regulation despite variations in input voltage. For use in both ac and dc circuits, these Zener diodes are compact in design and are suitable for miniature equipment.

Motorola, Inc., Semiconductor Products Div., Dept. ED, 5005 E. McDowell, Phoenix, Ariz.

CIRCLE 41 ON READER-SERVICE CARD

IF Amplifier

Center frequency is 200 mc



Type 39 if amplifier has a center frequency of 200 mc, a gain of 120 db, and a 3 mc bandwidth. The unit provides detector output and gain control. A matched input noise figure of 6.5 db is standard; lower noise figure input circuitry can be supplied when required.

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

CIRCLE 42 ON READER-SERVICE CARD

Binary Decade Counter

Transistorized

Model BD-101 binary decade counter consists of four transistor flip-flops that may be externally connected as a binary counter, as a binary coded decimal counter, or as any multistage counter that requires feedback. The power required is +20 v at 20 ma and -90 v at 1 ma. The maximum input rate is 100 kc.

Computer Control Co., Inc., Dept. ED, 983 Concord St., Framingham, Mass.

CIRCLE 43 ON READER-SERVICE CARD

Circuit Modules

Perform varied functions



Types 24 through 27 flip-flops and binary dividers come in speeds to 1.2 mc. They are epoxy resin filled and can be furnished with either soft wire in-line leads or soft hook terminals. All units operate to 60 C and meet the requirements of MIL-T-21038, grade 5, class Q, life expectancy X.

MF Electronics Co., Dept. ED, 122 E. 25th St., New York 10, N.Y.

CIRCLE 44 ON READER-SERVICE CARD

NOW...selenium rectifiers with an unlimited life span!

RADIO RECEPTOR



Tri-Amp

the only selenium rectifier with

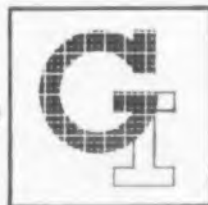
NO ARTIFICIAL BARRIER LAYER

plus /

superior overload characteristics • higher current ratings
• lower forward voltage drop • no sudden failures • no special protective devices required • smaller size • operate in parallel or in series without special precautions

Tri-Amp is a new and completely different concept in selenium. No artificial barrier layer of any kind is used, thus eliminating the cause of aging and high voltage drop. Result is the finest rectifier ever made.

Rectification in the Radio Receptor Tri-Amp is accomplished through a P-N junction formed by a closely controlled diffusion process involving the use of cadmium-selenide and tellurium. We'll be glad to send you more complete information on this important development. Write today to Section ED-2.



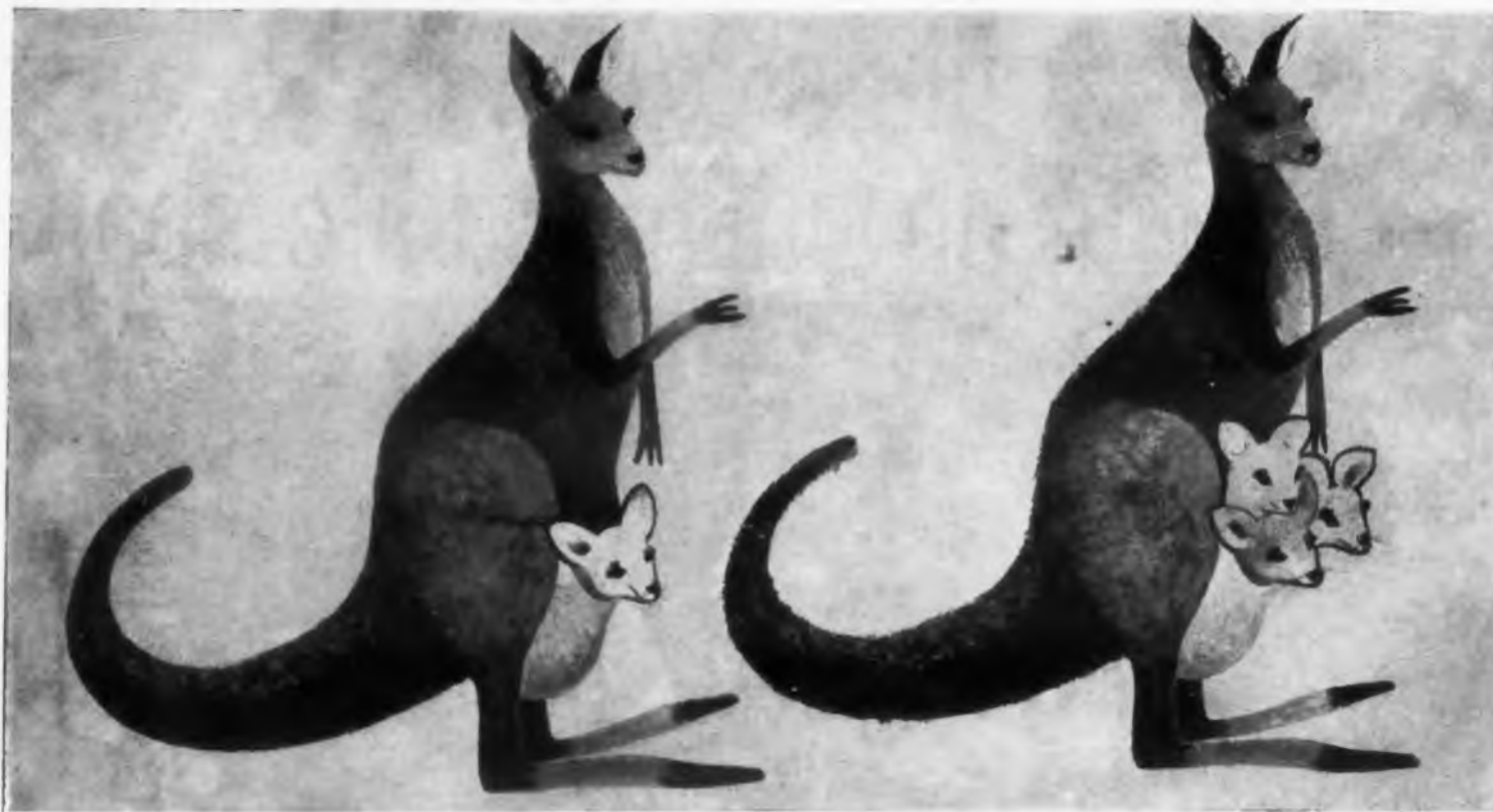
RADIO RECEPTOR COMPANY, INC.

Subsidiary of General Instrument Corporation

240 Wythe Avenue, Brooklyn 11, N. Y., EVergreen 8-6000

GENERAL INSTRUMENT CORPORATION INCLUDES F. W. SICKLES DIVISION, AUTOMATIC MANUFACTURING DIVISION, RADIO RECEPTOR CO., INC., MICAMOLD ELECTRONICS MANUFACTURING CORPORATION AND HARRIS TRANSDUCER CORPORATION (SUBSIDIARIES)

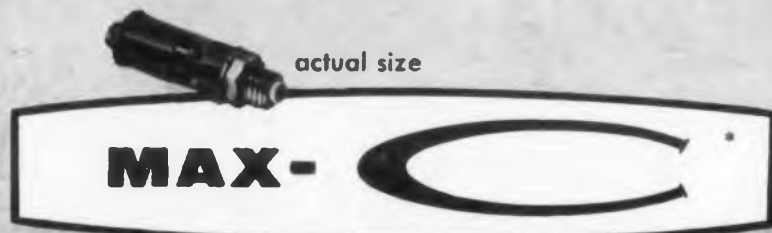
CIRCLE 45 ON READER-SERVICE CARD



TRIPLE THE CAPACITY
AT NO INCREASE IN SIZE

NEW FROM

JFD



MINIATURE
TRIMMER
SEALCAP®

From JFD, pioneer in precision electronic components, comes the most important new miniature trimmer development in years!

Now you can have *triple* the range previously attainable in a miniature trimmer capacitor — at no sacrifice in volume — with new MAX-C Sealcaps.

Imagine the possibilities in your circuitry!

This new series incorporates revolutionary new advances in trimmer production which combine the advantages of a thin dielectric gap with the structural strength and ruggedness of a heavy wall glass tube. The result is a broad capacitance tuning range

at a 300 per cent saving in volume over other presently available piston trimmer caps.

Also, MAX-C Sealcaps feature a new sealed interior construction that locks out all atmospheric effects, locks in stable performance under critical extremes of altitude, vibration, shock, temperature and other rigorous environmental conditions.

These new trimmers along with the complete JFD line of miniature and subminiature trimmers, and LC tuners offer you new dimensions in design. For complete data, write today for bulletin #221.

MINIATURE PANEL MOUNT MAX-C SEALCAP SERIES

| Model | Min. Max. (Pf) | DISTANCE BEYOND PANEL | MAXIMUM DIAMETER |
|-------|----------------|-----------------------|------------------|
| MC601 | 1.0 14.0 | 2 3/4" | 5/16" |
| MC603 | 1.0 28.0 | 1 1/4" | 5/16" |
| MC604 | 1.0 42.0 | 2 3/4" | 5/16" |
| MC606 | 1.0 60.0 | 1 3/4" | 5/16" |
| MC609 | 1.0 90.0 | 1 3/4" | 5/16" |

Also available in printed circuit lug and lead, and 4 wire lead type.

JFD

Pioneers in electronics since 1929
ELECTRONICS CORPORATION

1462 62nd Street, Brooklyn, New York

JFD International, 15 Moore Street, New York, New York

JFD Canada Ltd., 51 McCormack Street, Toronto, Ont., Canada

•TRADEMARK

CIRCLE 46 ON READER-SERVICE CARD

NEW PRODUCTS



Synchro Data Switch

For two-speed systems

Model DS-3 synchro data switch operates automatically between fine and coarse synchros in two-speed systems. For use with all common synchro ratios and sensitivities, it operates on 60 or 400 cps or any other synchro excitation frequency. For small errors, it sums the fine and coarse synchro signals so that the coarse signal is blocked. For large errors, the coarse signal overrides the fine to prevent false nulls. The unit consists of solid state components, potted and hermetically-sealed in a metal case.

Feedback Controls, Inc., Dept. ED, 8 Erie Drive, Natick, Mass.

CIRCLE 47 ON READER-SERVICE CARD

Pressure Transducers


Have ranges of 0 to 50 through 0 to 5000 psig



The SP2-518 series of pressure transducers come in pressure ranges of 0 to 50 through 0 to 5000 psig. Bridge impedances can be specified from 50 to 2000 ohms. The sensitivity is ± 0.015 mv per v with total errors of less than 1% of full scale. Nonlinearity and hysteresis errors combined are less than $\pm 0.5\%$ of full scale. The thermal zero shift is less than $\pm 0.01\%$ full scale per deg F; the thermal coefficient of sensitivity is $\pm 0.005\%$ of full scale per deg F over the range of -65 to $+275$ F. The unit has an easily accessible recalibrating terminal board with bobbin wound resistors.

Standard Controls, Inc., Dept. ED, 1130 Poplar Place, Seattle 44, Wash.

CIRCLE 48 ON READER-SERVICE CARD

 **SEALED RELAYS—unmatched for reliability**



**All the dust in this room
could hide under this dot**



This is General Electric's "white room," where special, ultra-reliable miniaturized relays are painstakingly adjusted, inspected, and tested. On certain supercritical applications, particularly those involving dry-circuit switching, a tiny speck of dust could cause a sealed relay to malfunction, possibly resulting in failure of an entire electronic system.

To prevent such costly failures, General Electric has installed this special "white room" where elaborate precautions are taken to maintain a dust-free atmosphere for assembly of ultra-reliable sealed relays. Regular checks

insure that dust in the air does not exceed 20,000 particles per cubic foot. Compare this with well over a million particles per cubic foot in the average home or office.

But this dust-free assembly room is only part of General Electric's reliability story. Design leadership, such as produced the Unimite—world's smallest one-amp relay—and advanced manufacturing techniques—including a new inert-arc welding process to eliminate contact-contaminating solder and flux—consistently produce superior relays. Then, General Electric conducts ex-

haustive operational and environmental tests to prove extreme reliability.

Relay applications differ widely in performance requirements. Whatever your application, General Electric can offer sealed relays designed, built and tested to comply with your requirements. Call your G-E Apparatus Sales Engineer today or mail the coupon at right. General Electric Co., Specialty Control Dept., Waynesboro, Va.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



**There's a G-E sealed
relay for every
circuit need—every
reliability requirement**

G-E miniature, sub-miniature, micro-miniature and Unimite relays combine small size with unusual reliability under severe temperature, shock and vibration conditions to make them ideal for electronic jobs, both military and commercial. G-E's complete line of sealed relays includes these basic types:



MINIATURE: Long-life type; rated 5 amps. at 28 volts d-c; in 2- or 4-pole double throw and 6PNO forms. Ideal for ground applications.



SUB-MINIATURE: 2 amps at 28 volts d-c, 115 volts a-c, double-pole double-throw. Excellent thermal life.



MICRO-MINIATURE: Crystal-can type, double-pole and new welded 4-pole units. Rated 2 amps, 28 v d-c or 115 v a-c. Grid-space terminals available.



UNIMITE: The world's smallest 1-amp sealed relay; single-pole type. Isolated contact chamber, high speed 1.5 millisecond operation.

General Electric Co.
Section C792-14
Schenectady 5, N. Y.

Please send me a free copy of the
1959-60 Sealed Relay Catalog.

Name _____

Address _____

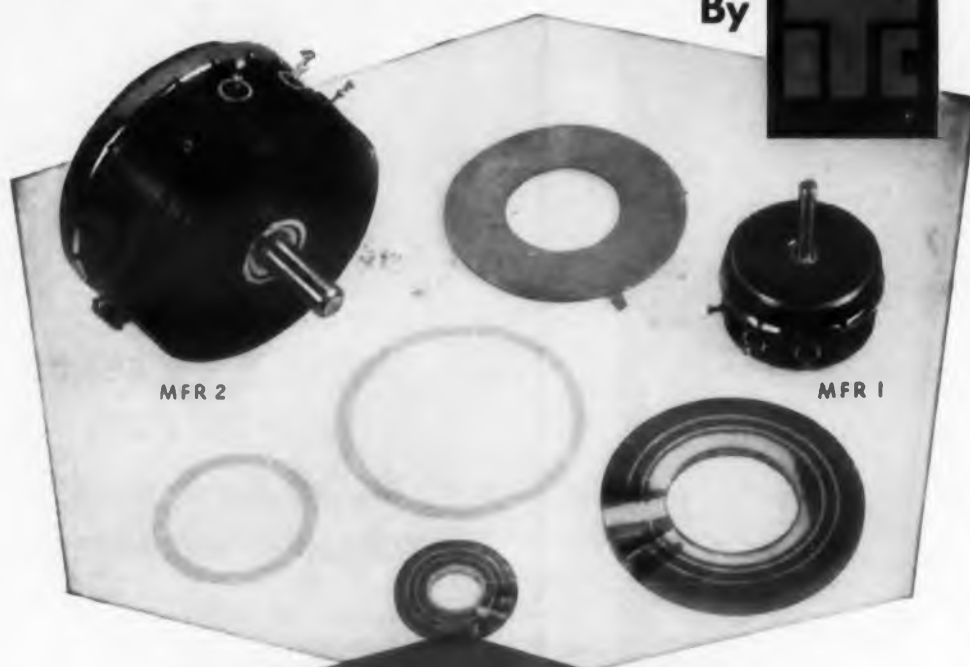
City _____ State _____

GENERAL  ELECTRIC

CIRCLE 49 ON READER-SERVICE CARD

NEW PRECISION VARIABLE RESISTOR with no sliding wiper

By



These Rotary Metallic Film Potentiometers are the perfection of years of research and development

Super reliability is inherent through unique manufacturing techniques

FEATURES:

- Complete Hermetic Seal
- Infinite Resolution
- High Temperature Operation
- Long Life
- Low Torque
- Exceptionally High Accuracy
- Extremely Low Noise

NEW CATALOG

of the most complete line of potentiometers — available upon request



A patented compression contact eliminates the wear or friction caused by usual wiper contacts. A precious metal capsule contact provides dependable long life operation. The deposited metal film resistance element is encased and hermetically sealed. The ultimate in craftsmanship is employed in the manufacture to produce a potentiometer unparalleled for performance. This new concept of design makes possible super reliability under the most severe environmental conditions such as those encountered in airborne, missile and satellite applications.

TECHNOLOGY INSTRUMENT CORP.

569 Main St.
Acton, Mass.
COlonial 3-7711

P. O. Box 3941
No. Hollywood, Calif.
POplar 5-8620

Visit us at Booth 134-135 at NEC
CIRCLE 50 ON READER-SERVICE CARD

NEW PRODUCTS

Signal Generator

Range is 100 cps to 100 kc



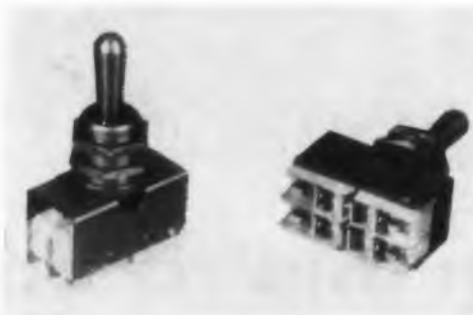
Designed for use with fm telemetry discriminator systems, model 320 signal generator has a frequency range of 100 cps to 100 kc with 0.02% accuracy at all frequencies. Maximum settling time to stabilize to a new preset frequency is 1 sec. The unit is crystal referenced. Suitable for standard rack or instrument case mounting, the chassis with power supplies is 8-3/4 in. high. Other applications are as a laboratory frequency standard and as an accurate frequency source for use in calibrating complex electronic systems.

Digital Instrument Labs., Dept. ED, 5115 Via Corona, Los Angeles, Calif.

CIRCLE 51 ON READER-SERVICE CARD

Toggle Switch

Has four poles



Made for aircraft and military use as well as for compact control panels on electrical and electronic equipment, this four-pole toggle switch occupies less than 1 cu in. The bat handle of the switch is kept in one of three positions with the center position off. Each pole is rated at 6 amp from 125 to 250 v ac, 30 v dc resistive, and 3 amp at 30 v dc inductive. All exposed metal parts are either stainless steel or are treated to resist corrosion. The operating force required to move the bat handle is set above the point where vibration or accidental jarring will actuate the switches. The weight is about 1 oz.

Electrosnap Corp., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.

CIRCLE 52 ON READER-SERVICE CARD



TODAY-
he can escape

Rheumatic Heart Disease

Tommy had an attack of rheumatic fever, frequent forerunner of rheumatic heart disease. Fortunately for him, his heart was not damaged.

Rheumatic fever, usually preceded by a "strep" infection, often strikes the same victim more than once. With each attack comes a new danger of heart damage.

Tommy's parents no longer live in fear of rheumatic heart disease, however. Through research, medical science has developed new methods of controlling "strep" infection and preventing recurrences of rheumatic fever.

For more facts about prevention, see your physician or ask your Heart Association.

For more research progress against the heart diseases . . .

Give  HEART FUND

Transformers

Isolation type

These three hermetically-sealed, isolation type transformers use an electrostatic shield brought out to a terminal to eliminate noise. Made to exceed MIL-T-27A, they operate from a 115 or 230 v, 60 cps, single-phase line to a 105, 115, or 125-v line. Model HSM-270 is Mil type TF4RXO1JB and has a 50-va rating, model HSM-271 is Mil type TF1RXO1KA and has a 125-va rating, and model HSM-272 is Mil type TF1RXO1NB and has a 250-va rating.

Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE 53 ON READER-SERVICE CARD

Miniature Connectors

Provide 25 lb retention

These miniature electrical connectors have insertable contacts which provide a minimum retention of 25 lb. The contact retention spring, is designed to accurately fit into the retaining angle of the hard insert and hold under compression. The connectors have hard plastic center inserts.

The Deutch Co., Electronic Components Div., Dept. ED, Municipal Airport, Banning, Calif.

CIRCLE 54 ON READER-SERVICE CARD

DC Power Supply

Delivers 60 v at 1000 amp

Made to produce a high magnetic field inside a high compression molding dye for manufacturing magnetic ceramics, this power supply delivers 60 v dc at 1000 amp. Ripple is less than 5%. Sequence timers and reversing switches, located internally, make the output positive or negative as required. The output is varied over a wide range by a saturable core reactor. The intensities of the magnetizing and demagnetizing fields are controlled independently by manual adjustments.

Nothelfer Winding Labs., Inc., Dept. ED, P.O. Box 455, Trenton, N.J.

CIRCLE 55 ON READER-SERVICE CARD

If your career interests are in electronics and missile sciences



and you possess creative foresight



you will logically investigate Martin Orlando

Many engineers and scientists who make continuing appraisals of their futures are investigating new professional engineering positions with the Orlando, Florida, Division of The Martin Company. Our unusual growth record has opened many ground-floor opportunities for creative engineers who can manage and staff ambitious new programs.

Because Martin Orlando has prime responsibility for 5 major weapon systems, you are offered many channels for growth. Engineers find professional development is faster in the creative climate of Martin Orlando's new \$20 million plant.

To help you make a realistic evaluation of what your part can be in the engineering success story at Martin Orlando, send for the free bulletin which gives you facts you need to reach a rewarding conclusion. Use the handy coupon.

MARTIN
O R L A N D O

John F. Wallace, Dir. of Employment, The Martin Co., Orlando 6, Fla.

PLEASE SEND MY FREE COPY OF "280 SECONDS."

NAME _____

STREET _____

CITY _____

ZONE _____

STATE _____

CIRCLE 922 ON CAREER INQUIRY FORM ON PG 129 >

Electronic Daily

IES.

PUBLISHED DAILY DURING THE RADIO ENGINEERING SHOW AND WESCON

Copyrighted 1959 Hayden Publishing Co., Inc.

Tuesday, August 18, 1959

8, No. 1

NEW SHOCKLEY DIODE APPROACHES IDEAL

Few Delays Due To Strike

Page 4

Page 2



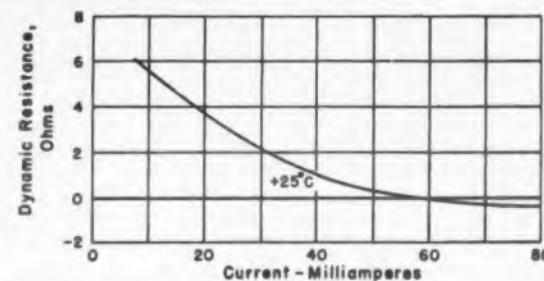
Drs. Horsley (l.) and Shockley (r.) check out new compensated avalanche diode which approaches concept of ideal di

THE SHOCKLEY COMPENSATED AVALANCHE DIODE...

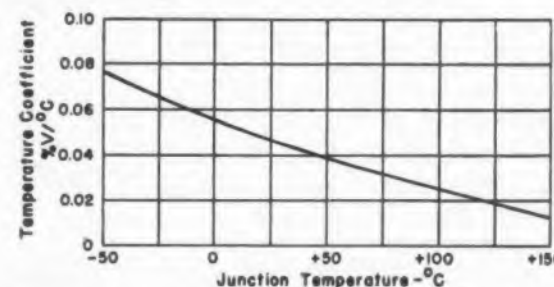
A new silicon voltage regulator for more precise voltage control under varying loads and changing temperature.



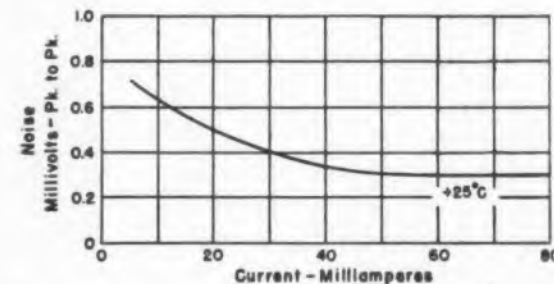
Reproduced at the left is the first issue of the ELECTRONIC DAILY distributed at the recent WESCON Show. The lead story describes the new Shockley Compensated Avalanche Diode which had just been announced. The immediate interest that followed was due to a major breakthrough in Zener design, enabling us to approach the ideal in operating characteristics. The result has been significant improvement in three areas:



1. Dynamic resistance—Drops to zero and is actually slightly negative at the higher currents of the operating range. Therefore, changes in the current flowing in the diode cause less shift in regulated voltage.



2. Temperature coefficient—Reduced to half that of conventional Zener regulator diodes. (Note: This is still somewhat greater than that of Zener reference diodes.)



3. Noise—Reduced to less than half that of conventional Zeners.

The curves shown are typical of those in our Data Sheet ADC-1. A copy is available from your Shockley representative or from our Palo Alto headquarters. But "the proof is in the pudding"—try one in a circuit and be convinced.

Shockley TRANSISTOR CORPORATION
A SUBSIDIARY OF BECKMAN INSTRUMENTS, INC.

STANFORD INDUSTRIAL PARK, PALO ALTO, CALIFORNIA

NEW PRODUCTS

Differentials

Shaft sizes are 5/64, 3/32, 1/8 in.



Designed to meet Mil specs, type V15 miniature differentials have shaft sizes of 5/64, 3/32, and 1/8 in., and are available in ball and oilless bearing units. A variety of stainless steel and aluminum end gears can be supplied in 96, 120, and 200 pitches with 100 to 600 teeth. Static friction under load is not more than 5%, lost motion between any two end gears is not more than 10 min of arc, and load rating is 10 oz-in. The ball bearing units have a maximum operating speed of 1000 rpm.

PIC Design Corp., Dept. ED, 477 Atlantic Ave., E. Rockaway, L.I., N.Y.

CIRCLE 57 ON READER-SERVICE CARD

Ohmmeter

For automatic production testing



Model 8516 ohmmeter, for automatic production testing of components and assemblies, covers a range of 3.75 to 4 ohms and may be supplied to cover any specified resistance range between 0.1 and 1,000,000 ohms. Accuracy of the standard instrument is better than 0.05 ohms. Three pilot lights are used to indicate if the resistance is below the lower limit, within limits, or above the upper limit. The unit operates from a 115 v, 50 to 60 cps line, and has a very low voltage at test terminals.

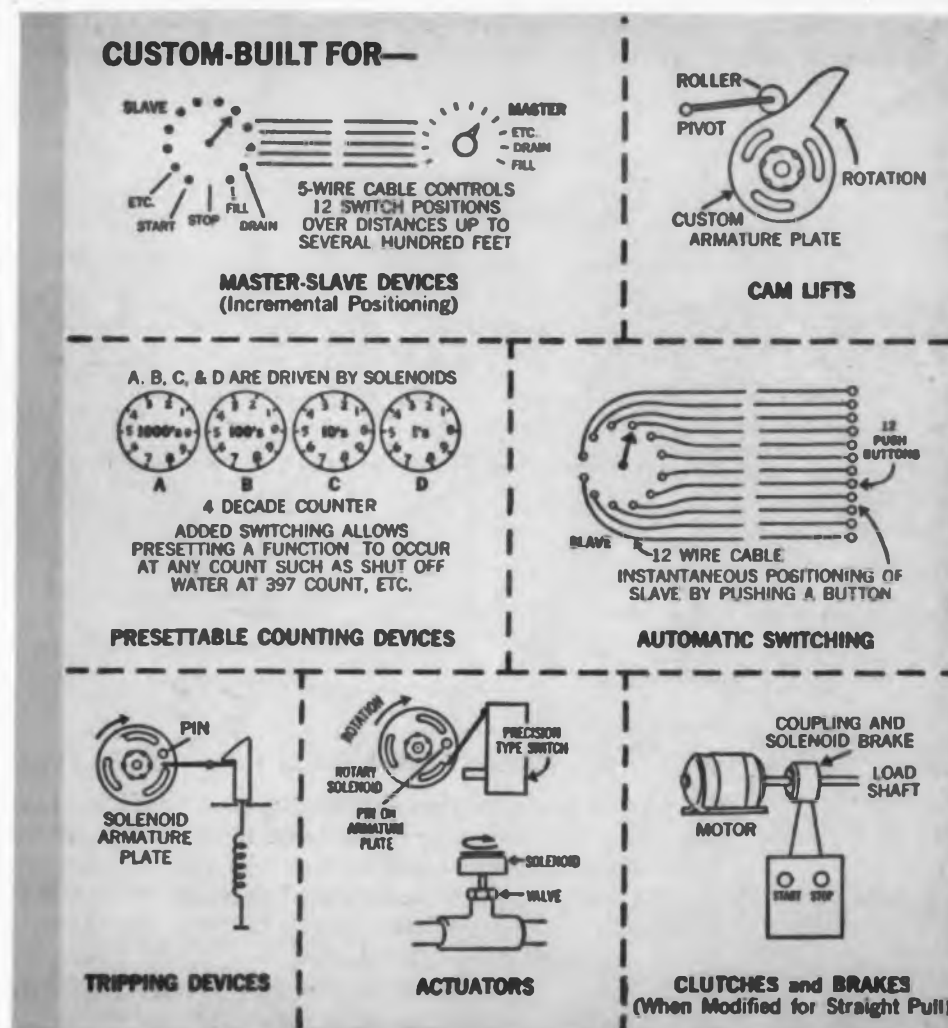
Associated Research, Inc., Dept. ED, 3777 W. Belmont Ave., Chicago 18, Ill.

CIRCLE 58 ON READER-SERVICE CARD

have you checked this
*Remote Actuator for jobs
under Shock and Vibration?*

...OAK ROTARY SOLENOIDS

(Mfd. under license from G. H. LELAND, INC.)



stepping torques from 6.4 to 64 inch-ounces

If you've been searching for an actuator that meets such specs as MIL-S-4040A, and is remarkably small for the amount of work it can do, investigate Oak Rotary Solenoids. They operate on DC and are designed for intermittent service. Standard models give steps of 25°, 35°, 45°, 67.5°, or 95° in either a left or right-hand direction. Self-stepping or externally pulsed units are also built. Oak Rotary Solenoids find wide use in both commercial and military equipment. Why not evaluate their unusual capabilities for your next project. We will be glad to help you engineer the job. Just send us a short description and sketch.

CIRCLE 59 ON READER-SERVICE CARD

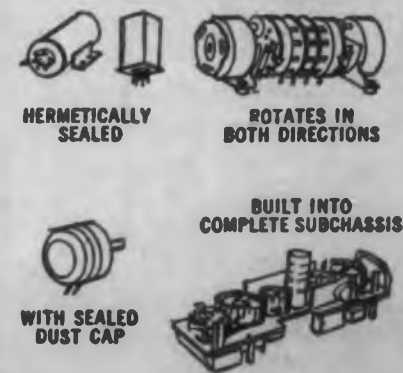
MODEL 5E
SHOWN ACTUAL SIZE



OPERATES IN ANY POSITION

Body remains stationary
Snap-action torque in steps
Ratchet mechanism is added to provide stepped progression of an "output" shaft.
"Solenoid" shaft oscillates with armature... can be supplied at front or rear... other power take-off arrangements also possible.
Armature plate rotates through predetermined angle then springs back to original position.

EXTREMELY ADAPTABLE



OAK MFG. CO.

1260 Clyburn Ave., Dept. D, Chicago 10, Illinois
Phone: MOhawk 4-2222

SWITCHES • ROTARY SOLENOIDS • CHOPPERS
VIBRATORS • TUNERS
SUBASSEMBLIES



ARE YOU MAKING THE SAME MISTAKE IN DEPOSITED CARBON RESISTORS?

Switch to IRC Molded Deposited Carbon Resistors—"PRE-SHRUNK" for miniaturization.

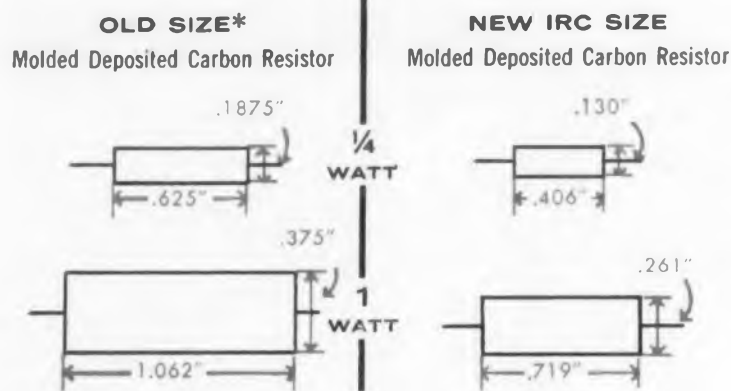
If you have anything to do with miniaturizing components, be prepared for a pleasant surprise.

IRC has reduced the size of Molded Deposited Carbon Resistors in the 3 most popular wattage ratings at the same ambient, an improvement made possible through the use of a unique IRC alloy film and a new high-temperature coating.



This means that you can now choose a smaller unit with wattage equivalent to the one you formerly specified. Weight and space savings, as it happens, are especially significant in the most-used sizes.

COMPARE



These SIZE REDUCTIONS also result in nearly corresponding weight reductions.

| MIL Type | IRC Type | Length Nominal | Diam. Nominal | Min. Ohms | Max. Ohms | Max. Volts Continuous | WATTAGE | | |
|----------|----------|----------------|---------------|-----------|-----------|-----------------------|----------|----------|-----------|
| | | | | | | | MIL 70°C | IRC 70°C | IRC 125°C |
| RN60 | MDA | .406 | .130 | 10 | 5M | 300 | 1/8 | 1/4 | 1/8 |
| RN65 | MDB | .594 | .203 | 10 | 5M | 350 | 1/4 | 1/2 | 1/4 |
| RN70 | MDC | .719 | .261 | 5 | 25M | 500 | 1/2 | 1 | 1/2 |

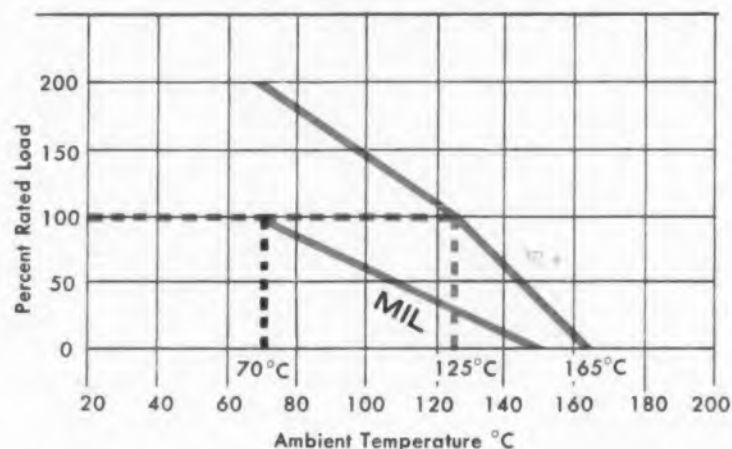
IRC EXCEEDS MIL SPECIFICATIONS

IRC Resistors are designed for MIL-R-10509C Characteristic B requirements.

INTERNATIONAL RESISTANCE CO., Dept. 3310, 401 N. Broad St., Phila. 8, Pa. • In Canada: International Resistance Co., Ltd., Toronto, Licensee

CIRCLE 60 ON READER-SERVICE CARD

DERATING CURVE FOR IRC MOLDED RESISTORS



IRC HAS GREATER LOAD LIFE RESERVE

IRC Molded Deposited Carbon Resistors exhibit excellent heat dissipating characteristics. Size for size, IRC Resistors will run cooler under any load condition and take sudden overloads with very low permanent change. Load life is superior to that of hermetically sealed resistors which cost three times as much!

IRC HAS DOUBLE-BARRIER INSULATION

Resistance element is coated with a moisture-resisting material, then encased in a molded, break-resistant dielectric case which, though heavy-duty, is well within MIL size.

Write
for
Bulletin B-9C



NEW PRODUCTS

Magnetic Tape Transport

Transfer rate is 400,000 characters per sec



The model 908, Mark II, Magnetic tape transport has a transfer rate of 400,000 characters per sec. It has complete program freedom at 120 in. per sec with 10-1/2 in. reels of tape 1 in. wide and a 16-channel system. The transport has a redundant guide system, fully interchangeable head mounting, and loading with almost instant reel hub release. Solid state electronics supported by logically arranged plug-in boards provide the servo drive and control.

Potter Instrument Co., Inc., Dept. ED, Plainview, L.I., N.Y.

CIRCLE 61 ON READER-SERVICE CARD

Environmental Chamber

Measures 7 x 3 x 3 ft



Measuring 7 x 3 x 3 ft, model FH-63-705-705 environmental chamber provides temperatures from -100 to +300 F and simulates altitudes to 200,000 ft. The temperature recording controller provides for programming and automatic proportioning of heating and cooling. Temperature and altitude changes are rapid. The unit includes a manometer and a radiation gauge. Designed for testing complete assemblies of electronic equipment, the chamber will accommodate an entire relay rack assembly at one time.

Conrad, Inc., Dept. ED, 141 Jefferson St., Holland, Mich.

CIRCLE 62 ON READER-SERVICE CARD



We are pleased to announce that

Schweber
ELECTRONICS
60 HERRICKS ROAD, MINEOLA, L. I., N. Y.
TWX G-CY-NY 380 PIONEER 6-6520

has been selected as the first direct factory source for Fairchild transistors and devices. A complete inventory is now available at Schweber's facilities with same day shipment. Factory price protection up to 1000 pieces per type.



NEW HIGH-VOLTAGE SILICON MESA TRANSISTORS

FAIRCHILD'S 2N699 OFFERS ANOTHER UNIQUE COMBINATION

120 VOLTS collector to base voltage, permits greater voltage swings in amplifier and oscillator circuits and more protection in inductive switching circuits. Maximum base-emitter turn-on voltage is only 1.3 volts for $I_C=150$ mA and $I_B=15$ mA.

120 MEGACYCLES typical gain-bandwidth product means excellent broad-band video performance. In addition the units will provide typically 18 db neutralized gain at 30 mc and 30% efficiency in a 70 mc oscillator circuit.

300° C SURVIVAL has been assured. Every transistor produced at Fairchild has been preaged a minimum of 60 hours at 300° C before test. This provides extra reliability at their recommended maximum operating junction temperature of 175° C.

2 WATTS dissipation at 25° C—the combination of power with high frequency that is available only in double diffused silicon transistors.

In Fairchild's recent succession of new transistor announcements, each has offered some exceptional combination of characteristics previously unattainable. The 2N699 combines high collector voltage rating with high-frequency performance, medium power capabilities and low saturation resistance. Its applications range from low-current high-frequency I-F circuits to high-current, low-frequency relay drivers. Other products nearing production at Fairchild promise even greater advances in the state of the art.

2N699 — ELECTRICAL CHARACTERISTICS (25° C)

| Symbol | Characteristic | Min. | Typ. | Max. | Test Conditions |
|---------------|--|------|-------------------|--------------------------------------|---|
| h_{FE} | D.C. pulse current gain | 40 | | 120 | $I_C = 150\text{ma}$ $V_C = 10\text{v}$ |
| $V_{BE(sat)}$ | Base saturation voltage | | 1.0 | 1.3 | $I_C = 150\text{ma}$ $I_B = 15\text{ma}$ |
| $V_{CE(sat)}$ | Collector saturation voltage | | | 5v | $I_C = 150\text{ma}$ $I_B = 15\text{ma}$ |
| h_{fe} | Small signal current gain at $f = 20$ mc | 2.5 | 5.0 | | $I_C = 50\text{ma}$ $V_C = 10\text{v}$ |
| C_{ob} | Collector capacitance | | 14 μmf | 20 μmf | $I_E = 10\text{ma}$ $V_C = 10\text{v}$ |
| I_{CBO} | Collector cutoff current | | | 2 μa 200 μa | $V_C = 60\text{v}$ $T = 25^\circ\text{C}$ $V_C = 60\text{v}$ $T = 150^\circ\text{C}$ |

A new plant of nearly ten-times increased capacity opened in June 1959 to fill demand created by new products introduced in less than a 12-month period.



For full information, write Dept. B-10-28.



545 WHISMAN ROAD • MOUNTAIN VIEW, CALIF. • YORKSHIRE 8-8161
Regional sales offices in Los Angeles and Philadelphia



INFINITE RESOLUTION

pressure transducers
equipped with
homogeneous conductive
plastic potentiometers

RAHM INSTRUMENTS
DIV. OF AMERICAN MACHINE AND METALS, INC.
11973 San Vicente Blvd. Los Angeles 49, Calif. GRanite 2-9584
65 Rushmore St. Westbury, N. Y. EDgewood 3-4840

See us at Booth 430 AES Show
CIRCLE 65 ON READER-SERVICE CARD

NEW PRODUCTS

Silicon Rectifiers

Have piv range of 700 to 1600 v



Type BR/1N2772-2781 silicon rectifiers, called the Siamese series, have a piv range of 700 to 1600 v with a maximum dc output of 750 ma at 25 C. Maximum forward voltage drop is 1.8, reverse leakage factor is 4 μ a, and recovery time is 5 μ sec. All units are hermetically-sealed to meet Mil specs. Dimensions are 19/32 in. in length and 3/8 in. in diameter.

Bradley Semiconductor Corp., Dept. ED, 275 Welton St., New Haven 11, Conn.

CIRCLE 66 ON READER-SERVICE CARD

Time Delay Relay

Uses miniature potentiometer



Incorporating a miniature potentiometer, this time delay relay has a time range of 50 msec to 2 sec or of 2 to 50 sec. The delay times are set by means of an external screw adjustment. The units may be delayed pull-in type or delayed drop-out. The control circuit is transistorized and a relay contact is the only moving part. The relays are hermetically sealed, use printed circuit construction and weighs 5-1/2 oz. Mil specs for ground support equipment are met.

Master Specialties Co., Dept. ED, 956 108th St., Los Angeles 59, Calif.

CIRCLE 67 ON READER-SERVICE CARD



connections
are easy
with...
Automatic
connectors

Manufacturers of:

- COAXIAL CONNECTORS AND FITTINGS
- COAXIAL RELAYS AND SWITCHES
- BAYONET, PUSH-ON AND THREADED SUB-MINIATURE CONNECTORS
- MICRO-MINIATURE CONNECTORS
- DIRECTIONAL COUPLERS
- AUDIO AND POWER PLUGS

Write, wire or phone for further information.

FOR POSITIVE CONNECTIONS EVERY TIME, SPECIFY ...

Automatic

METAL PRODUCTS CORP.

317 Berry St., B'klyn, N.Y. • Evergreen 8-6057

CIRCLE 68 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Insulating Felts

Have wide range of densities

This line of insulating felts that come in rigid or semi-rigid boards are composed of inorganic mineral fibers mill-formed to specific densities and thicknesses with a durable, thermo-setting resin. Thermal conductivity range is from 0.27 for low density felts to 0.24 for the high density felts, based on a test mean temperature of 70 F. Densities range from 3 lb per cubic foot to 12 lb per cubic ft.

United States Mineral Wool Co.,
Dept. ED, Stanhope, N.J.

CIRCLE 69 ON READER-SERVICE CARD

DC Power Supply

Has two regulated outputs

Operating from a source of 105 to 125 v, 60 cps, single-phase, model P36-20 power supply provides two dc outputs which are regulated to within 0.25% for line and load changes. The unit is transistorized and has an output current cutoff which provides external circuit protection. The outputs are completely floating with either positive or negative ground. Recovery time is less than 50 μ sec, ripple is 0.01%, and overshoot is less than 1% of voltage setting. The unit is portable and measures 11-1/4 x 13-9/16 x 10 in.

Mid-Eastern Electronics, Inc.,
Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 70 ON READER-SERVICE CARD

Cathode Ray Tube

Frequency range is 2 to 10 kmc

Capable of presenting microwave frequency information directly on its screen this cathode ray tube, called Wamoscope, operates over the range of 2 to 10 kmc. The spot size is 160 lines per in. at the center of the 10-in. screen. Made for use in advanced electronic systems, the tube does not require a solenoid. It is particularly suitable for high-resolution radar applications.

Sylvania Electric Products, Inc.,
Dept. ED, 730 Third Ave., New York 17, N.Y.

CIRCLE 71 ON READER-SERVICE CARD

CIRCLE 72 ON READER-SERVICE CARD

2N1069 2N1070

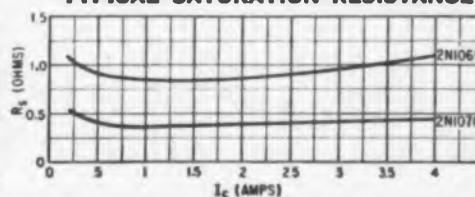
HIGH POWER — LOW SATURATION RESISTANCE NPN SILICON TRANSISTORS

Silicon Transistor Corporation is now delivering diffused-junction, NPN silicon mesa transistors. These new high power—low saturation resistance transistors operate in the temperature range of -65°C to $+175^{\circ}\text{C}$ for a wide variety of military and industrial applications where peak reliability and high temperature characteristics are required. Maximum saturation resistance for the 2N1070 is 0.67 ohms at a collector current of 1.5 amps., the 2N1069 is 2 ohms maximum at the same current.

Applications: Since these STC transistors feature low saturation resistance they are ideally suited for switching applications as well as relay replacements and controls, solenoid actuators, power converters, power switches, high level D.C. amplifiers, power supply regulators, and Class A and B power amplifiers.

For complete specifications, request STC Form 1953. Write also for engineering bulletins on STC's full line of silicon glass diodes.

TYPICAL SATURATION RESISTANCE



| RATINGS | |
|------------------------|-----------|
| Power Dissipation..... | 50 watts |
| VCBO..... | 60 volts |
| VEBO..... | 9 volts |
| VCEO..... | 45 volts |
| IC..... | 4 amperes |



SILICON TRANSISTOR CORPORATION, Carle Place, L. I., New York, Pioneer 2-4100

POWER

handling capacity
of the new
Westinghouse
Silicon

POWER

transistor!

Greater than 99% efficiency when used to handle 1.5 kw of power in a low-frequency DC switch! Power loss is only 10-15 watts when handling 1.5 kw. That's just one of the impressive specifications established by a remarkable new semiconductor device—the Westinghouse Silicon Power Transistor.

This Power Transistor is remarkable in other ways, too . . .

- It is the first power transistor available in voltage ranges above 100 volts.
- It has power dissipation capability of 150 watts made possible by the low thermal resistance of $.7^{\circ}\text{C}/\text{watt}$.
- It can operate at higher temperatures than germanium (150°C ., compared to 85°C).

- It has astonishingly low saturation resistance—less than $.5$ ohms at 5 amperes and $.75$ ohms at 2 amperes, an achievement made possible through extensive research and development of hyper-pure Siemens-Westinghouse Silicon.

- It is 100% power-tested under actual maximum rated specifications before leaving the plant.

- It is encapsulated in a rugged, all-welded case.

HERE ARE A FEW OF THE APPLICATIONS . . .

- Inverters and converters • Data processing circuits • Servo output circuits • Series regulated power supplies • As a low frequency switch • In class A amplifiers.

Available in 2 and 5 ampere collector ratings in production quantities now. For complete specifications and details, contact your local Westinghouse representative.

YOU CAN BE SURE...IF IT'S **Westinghouse**
Westinghouse Electric Corporation, Semiconductor Department, Youngwood, Pa.

CIRCLE 73 ON READER-SERVICE CARD

NEW PRODUCTS



**Subcarrier
Discriminator**
Output is ± 10 v

Made for telemetry used, type GFD-3 subcarrier discriminator has an output of ± 10 v max at 500 ma, continuously adjustable. The dynamic input range is 10 mv to 10 v. The unit has phase-lock circuitry and replaceable plugboard features. The power drain is less than 27 w. The unit is completely solid state, weighs 12 lb, and measures 8 x 16-1/2 x 3-1/2 in.

Data-Control Systems, Inc., Dept. ED, Danbury, Conn.

CIRCLE 74 ON READER-SERVICE CARD



Voltmeter
Peak responding type

Model 305A voltmeter measures peak or peak-to-peak values of any repetitive wave forms. The operating mode can be selected to respond to peak-to-peak and positive or negative peak of the waveform. The dc component of the waveform is not measured by the instrument. The frequency range for sine waves is 5 cps to 500 kc; distorted waveforms with harmonics to 2 mc, and pulses with duration from 0.5 μsec to 5 msec having repetition rates from 5 pps to 500,000 pps can also be measured. The 5-in. mirror scale is a suppressed-zero indication type. The accuracy of the meter is 2% to 5% and the precision of the reading is better than 0.5% at any part of the scale. The instrument can be used as a wideband amplifier with a gain of 86 db and a source of impedance of about 3 ohms in series with 0.22 μf .

Ballantine Labs., Dept. ED, Boonton, N.J.

CIRCLE 75 ON READER-SERVICE CARD



RCA SILICON RECTIFIERS

DIFFUSED-JUNCTION
TYPES

Another Way
RCA
Serves You
Through
Electronics

RCA TYPES FOR INDUSTRIAL and MILITARY POWER SUPPLIES

| RCA TYPE NUMBERS | MAXIMUM RATINGS Absolute-maximum values: For supply frequency of 60 cycles and with resistive or inductive load. | | | | | | | CHARACTERISTICS | | | | |
|------------------|---|----------------------------|----------------------------|---------------------|--------------------|--------------------|-----------------------|---------------------|--------------|--|---|---|
| | Peak Inverse Voltage (VOLTS) | RMS Supply Voltage (VOLTS) | DC Reverse Voltage (VOLTS) | FORWARD CURRENT, DC | | | | AMBIENT TEMPERATURE | | At Ambient Temp. of 25°C | | At Ambient Temp. of 150°C |
| | | | | 50°C Ambient (MA) | 100°C Ambient (MA) | 150°C Ambient (MA) | Surge One-Cycle (AMP) | Operating (°C) | Storage (°C) | Max. Forward Voltage Drop (DC) at indicated DC Forward Current (VOLTS) | Max. Reverse Current (DC) at Max. Peak Inverse Voltage (μA) | Max. Reverse Current (averaged over one complete cycle) at Max. Peak Inverse Voltage (μA) |
| IN536 | 50 | 35 | 50 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.1 at 500 ma | 5 | 400 |
| IN537 | 100 | 70 | 100 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.1 at 500 ma | 5 | 400 |
| IN538 | 200 | 140 | 200 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.1 at 500 ma | 5 | 300 |
| IN539 | 300 | 210 | 300 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.1 at 500 ma | 5 | 300 |
| IN540 | 400 | 280 | 400 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.1 at 500 ma | 5 | 300 |
| IN1095 | 500 | 350 | 500 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.2 at 500 ma | 5 | 300 |
| IN547 | 600 | 420 | 600 | 750 | 500 | 250 | 15 | -65 to +165 | -65 to +175 | 1.2 at 500 ma | 5 | 350 |

RCA TYPES FOR MAGNETIC AMPLIFIERS and BLOCKING CIRCUITS

| RCA TYPE | Peak Inverse Voltage (VOLTS) | RMS Supply Voltage (VOLTS) | DC Reverse Voltage (VOLTS) | 50°C Ambient (MA) | 100°C Ambient (MA) | 150°C Ambient (MA) | Surge One-Cycle (AMP) | Operating (°C) | Storage (°C) | At Ambient Temp. of 25°C Max. Forward Voltage Drop (DC) at indicated DC Forward Current (VOLTS) | At Ambient Temp. of 25°C Max. Reverse Current (DC) at Max. Peak Inverse Voltage (μA) | At Ambient Temp. of 150°C Max. Reverse Current (averaged over one complete cycle) at Max. Peak Inverse Voltage (μA) |
|----------|------------------------------|----------------------------|----------------------------|-------------------|--------------------|--------------------|-----------------------|----------------|--------------|--|---|--|
| IN440-B | 100 | 70 | 100 | 750 | 500 | 250 | 15 | 165 | -65 to +175 | 1.5 at 750 ma | 0.3 | 100 |
| IN441-B | 200 | 140 | 200 | 750 | 500 | 250 | 15 | 165 | -65 to +175 | 1.5 at 750 ma | 0.75 | 100 |
| IN442-B | 300 | 210 | 300 | 750 | 500 | 250 | 15 | 165 | -65 to +175 | 1.5 at 750 ma | 1.0 | 200 |
| IN443-B | 400 | 280 | 400 | 750 | 500 | 250 | 15 | 165 | -65 to +175 | 1.5 at 750 ma | 1.5 | 200 |
| IN444-B | 500 | 350 | 500 | 650 | 425 | 0 | 15 | 150 | -65 to +175 | 1.5 at 750 ma | 1.75 | 200 |
| IN445-B | 600 | 420 | 600 | 650 | 400 | 0 | 15 | 150 | -65 to +175 | 1.5 at 750 ma | 2.0 | 200 |

RCA TYPES FOR TV and RADIO RECEIVERS and GENERAL PURPOSE

| RCA TYPE | MAXIMUM RATINGS Absolute-Maximum Values: for supply frequency of 60 cps and with capacitor input to filter | | | | | CHARACTERISTICS | | | | | | |
|----------|---|----------------------------|----------|------------------------------|--|---------------------|--------------|---|---|--------------------------|---------------------------------|--------------------------|
| | Peak Inverse Voltage (VOLTS) | RMS Supply Voltage (VOLTS) | DC (AMP) | FORWARD CURRENT (UP TO 75°C) | | AMBIENT TEMPERATURE | | At Ambient Temperature of 25°C | | | At Ambient Temperature of 100°C | |
| | | | | Peak Recurrent (AMP) | Surge for a "turn-on" transient = 2 milliseconds (AMP) | Operating (°C) | Storage (°C) | Max. Instantaneous Forward Voltage at Instantaneous Forward Current = 15 amps (VOLTS) | Max. Reverse Current (μA) Peak Inverse Volts = 400 | Peak Inverse Volts = 500 | Peak Inverse Volts = 400 | Peak Inverse Volts = 500 |
| 1N1763 | 400 | 140 | 0.5 | 5 | 35 | 100 | -65 to +150 | 3 | 100 | — | 1 | — |
| 1N1764 | 500 | 175 | 0.5 | 5 | 35 | 100 | -65 to +150 | 3 | — | 100 | — | 1 |

CHECK YOUR RCA SEMICONDUCTOR DISTRIBUTOR

For...

- ✓ A comprehensive line of superior-quality RCA Transistors and Silicon Rectifiers.
- ✓ RCA Semiconductors for special projects or preproduction-run requirements from local stock—at factory prices.
- ✓ Prompt delivery of the latest RCA types for your evaluation.
- ✓ Orders filled from factory-fresh stock.
- ✓ Up-to-date practical product information.
- ✓ Valuable RCA technical assistance when it is needed.
- ✓ "One-stop" service on your orders.
- ✓ Specialists who understand your problems and your electronic needs.

**RCA RADIO CORPORATION
OF AMERICA**

Semiconductor Products-Distributor Sales
Harrison, N. J.



...immediately available from your local RCA SEMICONDUCTOR DISTRIBUTOR!

QUALITY is the reason designers of high-reliability equipment specify RCA Silicon Rectifiers. FAST SERVICE is the reason they order through their local RCA SEMICONDUCTOR DISTRIBUTOR.

All RCA Silicon Rectifiers are Welded and Hermetically Sealed. Entertainment types are subjected to rigid quality control procedures to provide top quality and performance. In addition, RCA types for Industrial Power Supplies and Magnetic Amplifiers undergo these extensive tests to assure reliability and long life.

- 100% high-temperature dynamic test at full load current and rated voltage
- 100% reverse leakage current test
- 100% forward characteristic test
- 100% pressure-seal test
- 100% temperature cycling test

So, whatever your requirements for Silicon Rectifiers—or transistors—for fast service check with your local RCA SEMICONDUCTOR DISTRIBUTOR. For quality products, specify RCA. You benefit from this combination!



RCA RADIO CORPORATION OF AMERICA
Semiconductor Products—Distributor Sales • Harrison, New Jersey

in or out of outer space

E-I

**GLASS-TO-METAL
SEALS**

- universally specified as the reliable line!

FOR COMMERCIAL EQUIPMENT AND VITAL SPACE AGE PROJECTS - Proof of the rugged reliability of E-I glass-to-metal seals is the fact they are employed on vital missile and rocket programs... are specified for commercial equipment by leading manufacturers industry-wide. E-I offers the widest range of standard terminals for maximum design flexibility... fast service on "specials" for unusual specifications... a broad selection of miniature components... and economical custom sealing of your assemblies. Call or write for complete information today.



PLUG-IN CONNECTORS



CUSTOM SEALING



SEALED TERMINALS



TRANSISTOR CLOSURES



MINIATURE CLOSURES



MULTIPLE HEADERS



THREADED SEALS



SINGLE LEAD TERMINALS

**ELECTRICAL
INDUSTRIES**



A Division of Philips Electronics, Inc MURRAY HILL, NEW JERSEY

CIRCLE 76 ON READER-SERVICE CARD

Patented in Canada, No. 523,390; in United Kingdom, No. 734,583; licensed in U. S. under No. 2561520

NEW PRODUCTS



**Inverter
Transistorized**

This 2 kw dc-ac inverter will supply a 2-kw output or two 1-kva outputs of 120 v, 60 or 400 cps, single-phase, from a source of 11 to 14 v dc or 22 to 32 v dc. Frequency stability is $\pm 0.01\%$ and efficiency at full load is about 85%. It can be used as a replacement for rotary inverters in microwave, telemetry, and automatic control installations. The standard rack panel unit measures 24-1/2 x 19 x 12 in.

Electrodynamic Instrument Corp., Dept. ED 2508 Tangley Rd., Houston 5, Tex.

CIRCLE 77 ON READER-SERVICE CARD

Ratio Transformer

Measures deviation in per cent



For use in testing transformers, transducers and resolvers, type PDR 1100 ratio transformer measures ratio deviation in per cent. The unit consists of seven-decade ratio transformer combined with a four-place, per cent deviation ratio transformer. Ratio settings to 3.1111 are possible, measuring deviations to 9.999%. The maximum input voltage is 350 v at 0.35 cps or 140 v at 400 cps. Also available, type PDR 1101 has a maximum input voltage of 350 v at 2.5 cps or 150 v at 60 cps. Per cent deviation ratio transformers can be obtained alone for use with standard ratio transformers. Type PDR 1102 accepts the same input voltage as the PDR 1100; input to the PDR 1103 is the same as to the PDR 1101. All units have built-in switching transient suppression and an accuracy of 0.001%.

Gertsch Products, Inc., Dept. ED, 3211 S. La Cienega Blvd., Los Angeles 15, Calif.

CIRCLE 78 ON READER-SERVICE CARD

CIRCLE 825 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Wirewound Potentiometer

Non-contaminative type



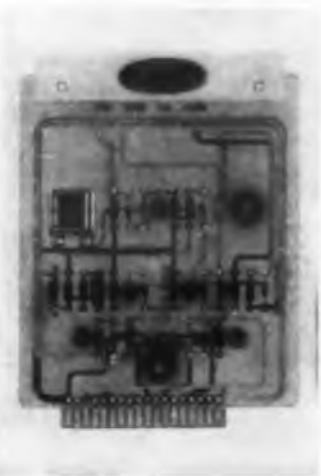
Encased in phenolic housing, series 61 wirewound potentiometer is for use in chemical production, laboratory testing, and other applications where safeguarding from foreign factors is important. The terminal lug spacing on the rear plate of the casing provides for a 10,000-v dc rating, or a safety factor in dust filled atmospheres. Rated at 2.5 w, the unit measures 2 in. in diam and 5/8 in. in depth.

Clarostat Manufacturing Co., Inc., Dept. ED, Dover, N.H.

CIRCLE 88 ON READER-SERVICE CARD

Pulse Generator

Transistorized



Model 300X transistorized pulse generator provides accurately timed clock pulses at crystal-controlled frequencies. A standardized 2.5-v pulse of both polarities is generated by the oscillator. The output stage is transformer-coupled and has a constant voltage. The pulse remains undeteriorated when loaded at an output current between 0 and 100 ma. Mounted on a 5 x 6-in. glass-epoxy printed circuit card 1/16 in. thick, the unit is for use with an 18-pin PC receptacle. Accuracy is to 0.01% of crystal frequency and the operating temperature is from 0 to 135 F. Available models and operating frequencies are: 300X-1, 100 kc; 300X-2, 200 kc; and 300X-3, at 300 kc.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.

CIRCLE 89 ON READER-SERVICE CARD

CIRCLE 825 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Specify "ARNOLD"

for your MAGNETIC CORE requirements



Top to bottom: Tape wound cores, Silectron C, E and O cores, and bobbin cores.



Top to bottom: Mo-Permalloy powder cores, iron powder cores, and Sendust cores.

SILECTRON C-CORES, E-CORES and TOROIDS Arnold C and E cores are made from precision-rolled Silectron strip in 1, 2, 4 and 12 mil thicknesses.

They are supplied in a wide variety of shapes, and in sizes from a fraction of an ounce to several hundred pounds. In addition to standard transformer applications, they may also be supplied for special applications such as saturable reactors, instrument transformers and pulse transformers.

Over 1,000 stock cores are listed in the Arnold Silectron catalog. A wide selection of preferred sizes are carried in stock for immediate shipment. For complete data on C and E cores and Silectron toroids, write for *Bulletin SC-107A*.

TAPE WOUND CORES of High Permeability Materials Arnold tape wound cores are available made of Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750 Electrical Metal, Silectron, or the new rectangular-loop material, Supermendur. All except Supermendur cores are available in standard tape thicknesses of 1, 2 and 4 mils; also in special tape thicknesses of 1/2 mil, 12 mil or other, as required or feasible. Supermendur is presently available in 4 mil cores.

Toroidal cores are made in 30 standard sizes with protective nylon or aluminum cases. Special sizes of toroidal cores are produced to individual requirements. Write for *Bulletin TC-101A*. (TC-113A for Supermendur Cores.)

BOBBIN CORES Arnold bobbin cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps to suit the ultimate use of the core in electronic computer assemblies. Magnetic materials usually employed are Deltamax and Square Permalloy in standard thicknesses of 1, 1/2, 1/4 and 1/8 mil. Bobbins are supplied in ceramic or stainless steel. Write for *Bulletin TC-108A*.

SPECIAL MATERIALS

2V PERMENDUR . . . a ferromagnetic alloy of cobalt, vanadium and iron that possesses high flux density saturation properties. Its magnetostrictive properties are useful in many transducer applications. Write for *Bulletin EM-23*.

VIBRALLOY . . . a ferromagnetic alloy of nickel, molybdenum and iron whose temperature coefficient of elastic modulus is controllable over a wide range. It has high ferromagnetic permeability, and a rather high coefficient of magnetostriction. Used in applications where a zero or controlled thermo-elastic coefficient is desired.

BARIUM TITANATE . . . A piezoelectric ceramic widely used in ac-

MO-PERMALLOY POWDER CORES Available in a wide range of sizes, from .260" OD to 5.218" OD. They are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

These powder cores are supplied in four standard permeabilities: 125, 60, 26 and 14 Mu. They provide constant permeability over a wide range of flux density, and in many cases may be furnished stabilized to provide essentially constant permeability over a specific temperature range. Large warehouse stocks of preferred sizes are carried for immediate shipment. Write for *Bulletin PC-104C*.

IRON POWDER CORES A wide selection of cores is available, from simple cylinders to special cores of complicated design. The line includes all standard types of threaded cores, cup, sleeve, slug and cylindrical insert cores: for use in antenna and RF coils, oscillator coils, IF coils, perm tuning, FM coils, television coils, noise filter coils, induction heating and bombarder coils, and other low frequency applications. Preferred sizes are carried in warehouse stock for quick shipment. A standard series of iron powder toroids is also manufactured, conforming to the standard sizes proposed by the Metal Powder Industries. Write for *Bulletin PC-109*.

SENDUST POWDER CORES Available in a wide selection of sizes, ranging from .800" OD to 3.348" OD, and in permeabilities of 10, 13, 25, 30, 50 and 80, although not all sizes are available in all permeabilities. They possess magnetic properties generally superior to iron powder cores, but inferior to Mo-Permalloy powder cores in the audio and carrier frequency range. Write for *Bulletin SDC-110*.

celerometers, phono pickups, microphones, ultrasonic grinding and cleaning devices and underwater signaling devices. For more information, write for *Bulletin CM-116*. 7807 B



ARNOLD

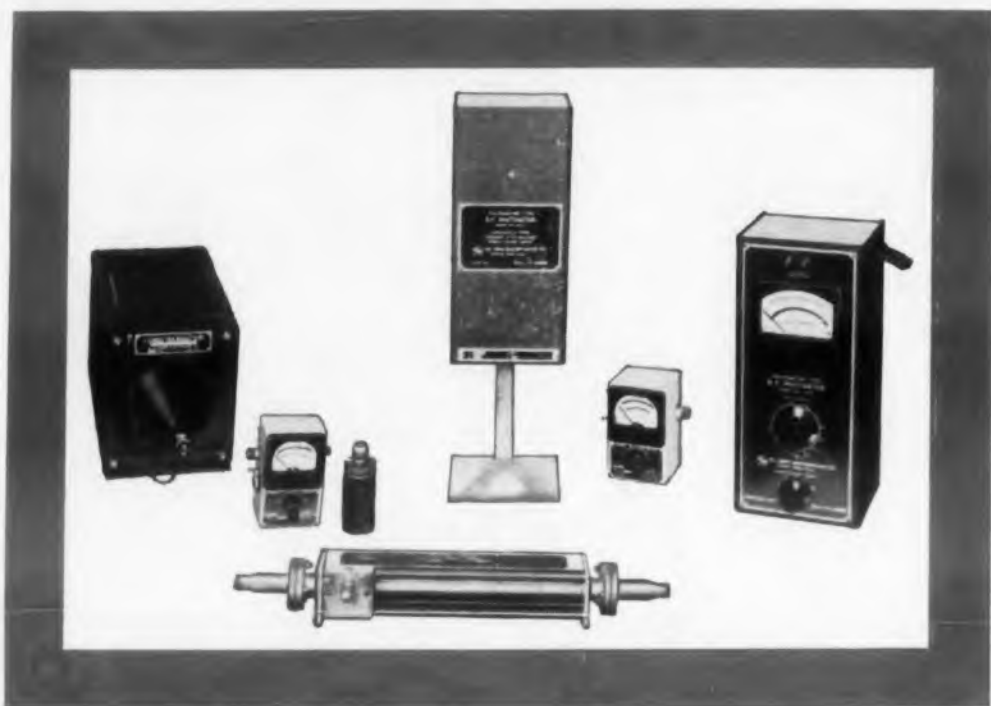
SPECIALISTS in MAGNETIC MATERIALS

THE ARNOLD ENGINEERING COMPANY, Main Office: MARENGO, ILL.
BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES

CIRCLE 90 ON READER-SERVICE CARD

MicroMatch

RF POWER STANDARDS LABORATORY



MicroMatch

equipment is used to establish a reference standard of RF power to an accuracy of better than 1% of absolute.

THE 64IN CALORIMETRIC WATTMETER establishes RF power reference of an accuracy of 1% of value read, and is used to calibrate other wattmeters. Five power scales, 0-3, 3-10, 10-30, 30-100, and 100-300 watts, are incorporated in the wattmeters for use in the 0-3000 mcs range.

711N and 712N FEED-THROUGH WATTMETERS, after comparison with the 64IN, can be used continuously as secondary standards and over the same frequency range as covered by the primary standard. The MODEL 711N is a multirange instrument covering power levels from 0 to 300 watts in three ranges, 0-30, 30-75, and 75-300 watts. MODEL 712N covers power levels of 0 to 10 watts in three switch positions, 0-2.5, 2.5-5, and 5-10 watts full scale.

636N and 603N RF LOAD RESISTORS absorb incident power during measurements. MODEL 636N is rated at 600 watts, and MODEL 603N is rated at 20 watts. Both models perform satisfactorily over the entire frequency range to 3000 mcs. These loads, in conjunction with the MODELS 711N and 712N Feed-through Wattmeters, form excellent absorption type Wattmeters.

152N COAXIAL TUNER is used to decrease to 1.000 the residual VSWR in a load. The tuner is rated at 100 watts, and its frequency range is 500-4000 mcs.

For more information on Tuners, Directional Couplers, R. F. Loads, etc., write



M. C. JONES ELECTRONICS CO., INC.

185 N. MAIN STREET, BRISTOL, CONN.

SUBSIDIARY OF



CIRCLE 91 ON READER-SERVICE CARD

NEW PRODUCTS

DC Power Supply

Regulation is 0.25%



Type 157 transistorized power supply provides three simultaneous outputs: 22.5 v dc at 1 amp, -12 v dc at 1 amp, and -6 v dc at 0.5 amp, all adjustable and all regulated to within 0.25% for line and load changes. The input power is 115 v, 400 cps, three-phase. The ripple is 0.01%, recovery time is less than 50 μ sec, and the overshoot will not exceed 1% of voltage setting. Designed for a standard 19 in. relay rack and panel, the unit measures 5-1/4 in. high.

Mid-Eastern Electronics, Inc., Dept. ED, 32 Commerce St., Springfield, N.J.

CIRCLE 92 ON READER-SERVICE CARD

Potentiometer

Has 3/4-in. diam



The series 450 10-turn potentiometer, called Multipot, is 3/4 in. in diam and 1-1/4 in. long. Units are available in resistance ranges from 1 to 250 K. They provide a 2-1/2 w power rating, operate from -65 to +100 C, and withstand 20 g shock for 11 μ sec. They exceed MIL-E-5272A, procedure II for vibration, 5 g to 2000 cps, and meet MIL-STD 202, Method 102, for temperature cycling. Designed for use in general test equipment and computers, they have rear-mounted terminals.

Daystrom Pacific, Div. of Daystrom Inc., Dept. ED, 9320 Lincoln Blvd., Los Angeles 45, Calif.

CIRCLE 93 ON READER-SERVICE CARD

NEW WAVEGUIDE FERRITE ISOLATORS



Specially designed to offer maximum isolation with minimum insertion loss, six broadband isolators cover a frequency range of 3.95 to 26.5 KMC/S.

Conservatively rated at 5 watts, these rugged units can dissipate FIVE TIMES as much power with only temporary electrical characteristic degradation.

| PRD TYPE | FREQUENCY (KMC/S) | MINIMUM ISOLATION | LENGTH (INCHES) |
|----------|-------------------|-------------------|-----------------|
| 1205 | 3.95-5.85 | 16 db | 8 1/4 |
| 1204 | 5.85-8.20 | 20 db | 6 1/8 |
| 1206 | 7.05-10.0 | 24 db | 5 |
| 1203 | 8.20-12.4 | 30 db | 6 1/4 |
| 1208 | 12.4-18.0 | 24 db | 6 |
| 1209F1 | 18.0-26.5 | 24 db | 4 1/2 |

Complete specifications on the PRD Type 1203, 1204, and 1205 are contained on page A-21 of the PRD Catalog E-8. For a copy of this 160 page designers' workbook containing data on hundreds of quality microwave instruments from PRD, the company that's FIRST IN MICROWAVES, send your request on your company letterhead please.

If you want specifications on PRD Waveguide Ferrite Isolators, simply fill out inquiry card in this magazine.



POLYTECHNIC RESEARCH & DEVELOPMENT CO., INC.

Factory & General Office:
202 Tillary St., Brooklyn 1, N. Y.
ULster 2-6800

Western Sales Office:
2639 So. La Cienega Blvd., Los Angeles 34, Calif.
UPTon 0-1940

CIRCLE 94 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Accelerometer

Gas-damped



For aircraft and missile control applications, this accelerometer is equipped with a gas-damped seismic system. The range of the instrument is ± 1 to ± 25 g, the damping is 0.65 of critical at 75 F, and the temperature range is -65 to $+250$ F. The zero and sensitivity drift from -25 to $+180$ F is less than 2% of range per 100 deg F. The linearity is less than 1% of acceleration span and the hysteresis is less than 1% of acceleration.

Wiancko Engineering Co., Dept. ED, 225 N. Halstead, Pasadena, Calif.

CIRCLE 95 ON READER-SERVICE CARD

Photoconductive Cell

Made of indium antimonide



Made of indium antimonide, this photoconductive cell, called the Mullard Orpio, has a sensitivity to 7.5 microns at room temperature. The spectral response range is from the visible to 8 microns; the peak response is 6 to 6.5 microns. The sensitivity is measured with $2 \mu\text{w}$ of radiation falling on the sensitive area and 50 ma dc applied to the cell. With this condition, the signal-to-noise ratio at 6 microns is more than 72 and the noise equivalent power is 4×10^{-9} w. The impedance of the cell is about 75 ohms. The maximum dc value is 100 ma and the maximum case temperature is 70 C. The unit is readily attached to a heat sink.

International Electronics Corp., Dept. ED, 81 Spring St., New York 12, N. Y.

CIRCLE 96 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.

Whatever the application, ESC can design and build precisely the delay line you need - easily, efficiently and exactly as specified.

PLEASE WRITE FOR
COMPLETE TECHNICAL DATA



ESC

CORPORATION

534 Bergen Boulevard, Palisades Park, New Jersey



exceptional employment opportunities for engineers experienced in computer components... excellent profit-sharing plan.

Distributed constant delay lines • Lumped constant delay lines • Variable delay networks • Continuously variable delay lines • Pushbutton decade delay lines • Shift registers • Pulse transformers • Medium and low power transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

CIRCLE 97 ON READER-SERVICE CARD



DECISION MAKER

for simplified monitoring,
controlling, high-precision switching

Normal/abnormal . . . high/low . . . go/no-go: these are important decisions being made by A.P.I. Very High Sensitivity Measuring Relays.

Direct from sensory elements or circuits, the A.P.I. measuring relay makes a decisive "yes or no" decision on the basis of very close-tolerance voltage or current changes. In typical, critical applications, this measuring relay is saying "yes or no" on a change of ± 1 microamp; or in a 400- to 500-volt circuit, on a variation of only a few percent.

Moreover, the relay is capable of actuating on very tiny currents: for example, total inputs as small as 0.2 microampere or 0.1 DC millivolt. It does so without signal amplification, amplifier costs or the signal distortion problems that often go along.

Performance stability is inherent; reliability is exceptional due to the A.P.I. locking-coil design. On "make", contact is firm with substantial contact pressure; contact resistance is low. On "break", separation is clean and quick without contact teasing.

10,000,000 perfect operations is not an all-time record; it's a reasonable expectation of service life.

Widely used for precision switching in computer, control and alarm circuits, VHS measuring relays are practically unlimited in scope of application.

For more information, send for Bulletin 104-D.



ASSEMBLY PRODUCTS, INC.
Chesterland 17, Ohio

CIRCLE 98 ON READER-SERVICE CARD

NEW PRODUCTS

Motor-Generator Miniature



Type RBG-2407 miniature motor-generator unit combines a low inertia control motor with an ac drag-cup rate generator. The rate generator has an output of 10 v, 1000 rpm with a linearity of about 1%. The motor gear ratio can be from 2.5:1 to 3600:1. The standard control winding impedance is 5400 ohms locked rotor; other impedances can be supplied. All units are 2-17/32 x 2-17/32 in. in cross section and have a maximum length of 4-1/8 in. for direct-drive motors and 5 in. for gear motors.

National Pneumatic Co., Inc., Holtzer-Cabot Motor Div., Dept. ED, 125 Amory St., Boston, Mass.

CIRCLE 99 ON READER-SERVICE CARD

Receptacles

For plug-in components



These receptacles use crimp type, snap-locked contacts for use with plug-in relays and other plug-in components. Closed-entry sockets are crimped to wire ends and snap-locked into the relay receptacle. Suitable for use in missile guidance and control equipment, these receptacles meet or exceed Mil specs for voltage drop, dielectric strength, contact engaging and retention forces, corrosion resistance, and mechanical strength.

Burdny Corp., Dept. ED, Norwalk, Conn.

CIRCLE 105 ON READER-SERVICE CARD



BIG news in electronics for vibration testing

One of the world's largest vibration test systems was recently shipped by MB to the Sperry Gyroscope Company. It featured an electrodynamic exciter of 25,000 pounds force output, a 100 KW high fidelity power amplifier of advanced design, and fully integrated, electronic controls for complex motion tests.

What makes one company a preferred source of supply in its field? Reliability, of course. But among other things, a record of "firsts." Look at MB's record in electronics alone, as applied to vibration:

- first KVA amplifier design for shaker drive
- first automatic sequencing with interlocks
- first completely remote operation
- first amplifier with full current capacity down to 5 cps
- first use of active analog computers
- first application of XY recording technique
- first to achieve low distortion in big-output amplifiers
- first displacement limiter providing protection without complete system shutdown
- first use of high-degree negative feedback around output tubes
- first use of regulated tube filaments

When you need vibration test equipment, make *your* investment in MB quality and capabilities.


MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC.
1058 State Street, New Haven 11, Conn.

Pioneer and leader in the field of vibration

CIRCLE 106 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959



Now on tap . . .

**20,000,000 watts
of audio power**

from MB
ELECTRONICS!

TWENTY million watts—that's the cumulative output available from MB power supplies now driving vibration test systems in the field.

The figure is more than a measure of the new importance of vibration testing. It's a measure of MB's technical advancement in the field of electronics for vibration, acoustics, and sonar.

And it's a measure of the company's unequalled background of experience in designing electronic power for dynamic forces . . . in producing *integrated* vibration testing systems including amplifiers of 100KW output and more, and exciters that utilize amplifier power more efficiently . . . in programming vibration tests to any required specification. This experience is available to you through MB's staff of vibration specialists and the largest force of field service technicians. Avail yourself of their expert recommendations on your vibration test problems.



Pioneer and leader
in the field of vibration

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC., 1058 State Street, New Haven 11, Conn.

Magnetic Shielding Kits

For on-the-spot evaluation

These magnetic shielding kits are for on-the-spot evaluation of non-shock sensitive, non-retentive Netic and Co-Netic shielding materials. The kits assist in finding out how many layers of material are needed and what configuration is best. Five types of kits are available. A variety of configuration as well as sheet stock and foils are provided. Kit No. 1, the largest in the series, has a magnetic and electrostatically shielded calibrated probe with standard shielded plug connector for ac field intensity evaluation.

Perfection Mica Co., Magnetic Shield Div., Dept. ED, 1322 N. Elston Ave., Chicago 22, Ill.

CIRCLE 107 ON READER-SERVICE CARD

Vacuum Oven

Provides to 500 F



This vacuum oven provides temperatures to 500 F and a vacuum to 29.5 in. mercury. A rotary vane type water cooled pump with forced feed lubrication is used. Vacuum break is through a filtered inlet. A recirculating blower increases speed in work load heating before and during vacuum pumping. The 45 kw input required for heat-up is reduced to 15 kw when the heaters have reached the maximum surface temperature. The unit has doors at each end of the 48 x 72 in. work chamber; the doors are sealed with double silicone rubber gaskets and locked with spinner handle clamps.

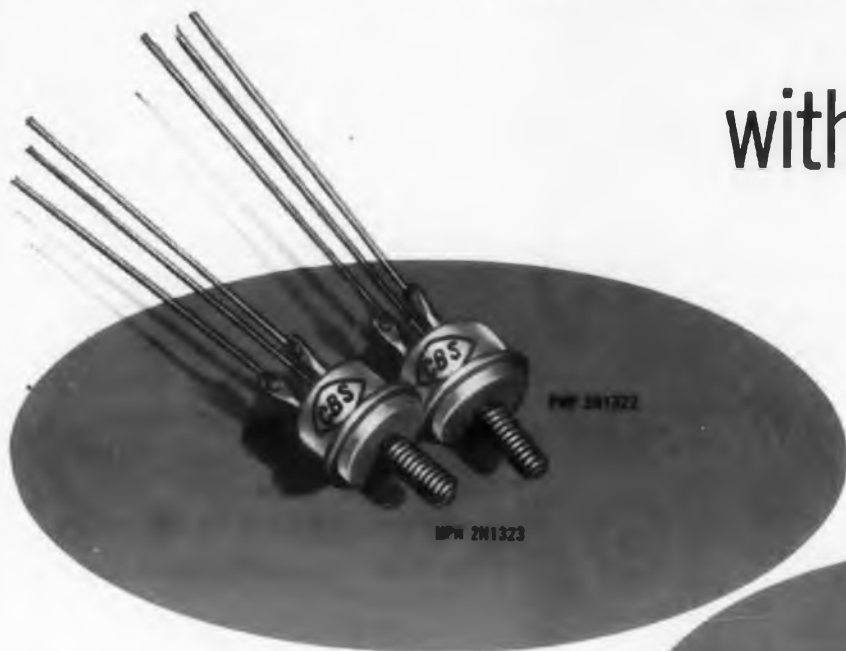
Grieve-Hendry Co., Inc., Dept. ED, 1330 N. Elston Ave., Chicago 22, Ill.

CIRCLE 108 ON READER-SERVICE CARD

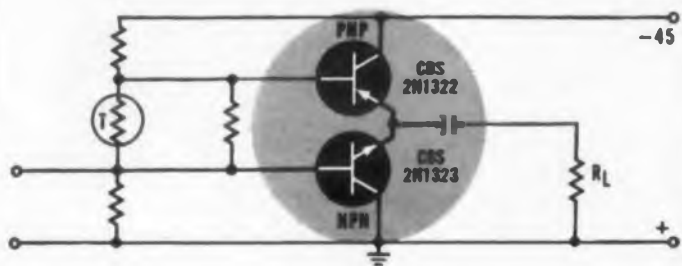
◀ CIRCLE 109 ON READER-SERVICE CARD

NOW... COMPLEMENTARY CIRCUIT ECONOMIES

with **INDUSTRIAL** NPN-PNP POWER TRANSISTOR PAIRS



Complementary pairs of CBS NPN and PNP power transistors eliminate input and output transformers in push-pull circuits. Resulting advantages are many: Economy. Miniaturization. Improved frequency response. Ease of applying negative feedback. Etc.



Typical Industrial Complementary Push-Pull Amplifier

INDUSTRIAL NPN-PNP POWER TRANSISTOR PAIRS

| NPN Type | Package | Max. W. Diss.* | Max. V _{CEO} ‡ | Max. V _{CE} ‡ | Min. h _{FE} (I _C =0.5A) | Max. Thermal Res. °C/W | PNP Type |
|----------|---------|----------------|-------------------------|------------------------|---|------------------------|----------|
| 2N1321 | Male | 20 | 35 | 30‡ | 30 | 3 | 2N1320 |
| 2N1329 | Female | 20 | 35 | 30‡ | 30 | 3 | 2N1328 |
| 2N1323 | Male | 20 | 60 | 45‡ | 30 | 3 | 2N1322 |
| 2N1330 | Female | 20 | 60 | 45‡ | 30 | 3 | 2N1070 |
| 2N1325 | Male | 20 | 80 | 60‡ | 30 | 3 | 2N1324 |
| 2N1332 | Female | 20 | 80 | 60‡ | 30 | 3 | 2N1331 |
| 2N1327 | Male | 20 | 100 | 80‡ | 30 | 3 | 2N1326 |
| 2N1334 | Female | 20 | 100 | 80‡ | 30 | 3 | 2N1333 |

All types have: Max. collector current, 3 amps; storage temperature, -65 to +85°C. *25°C base mounting temperature. ‡Polarity: NPN positive, PNP negative. †I_{CS} = 10 ma.

Enthusiastic acceptance of the diamond-package line of CBS NPN-PNP power transistors has disclosed a demand for additional pairs in industrial packages. These new industrial types make possible the same design economies of complementary circuitry. Mounted in TO-10 and TO-13 male and female packages, they are supplied with solder lugs or flying leads. And they feature high voltages (up to 100 volts) and proven quality (they exceed the MIL-T-19500A specification). The new units add another complete industrial line to the growing lines of CBS complementary power transistors for audio, control, voltage-regulation, servo and computer applications. Check circuit and abbreviated data. Write for complete data sheets: Industrial types, Bulletin E-360; diamond types, E-355. Order now from your local Manufacturers Warehousing Distributor. Watch for a higher power line soon.

More reliable products
through Advanced Engineering



semiconductors

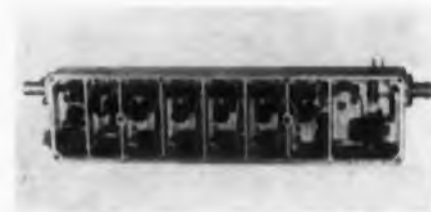
CBS ELECTRONICS, Semiconductor Operations
A Division of Columbia Broadcasting System, Inc.

Sales Offices: Lowell, Mass., 900 Chelmsford St., GLenview 4-0446 • Newark, N. J., 32 Green St., MArket 3-5832
Melrose Park, Ill., 1990 N. Mannheim Rd., EStebrook 9-2100 • Los Angeles, Calif., 2120 S. Garfield Ave., RAYmond 3-9081

CIRCLE 110 ON READER-SERVICE CARD

NEW PRODUCTS

IF Amplifier Transistorized



Type 83 transistorized IF amplifier is a hybrid unit combining the low-noise properties of a tube input circuit with the low-power requirements of transistors. A type 7077 miniature ceramic triode with five silicon tetrode transistors helps the unit stand high shock and vibration. The noise figure is better than 2.5 db.

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

CIRCLE 111 ON READER-SERVICE CARD

Oscillator Transistorized



This transistorized oscillator makes it possible to use the output of low-level transducers such as thermocouples or accelerators without dc amplification. The unit is made to IRIG specs of frequencies and deviations for channels 5 through 18 and A through E. The output signal amplitude is 0 to 2.2 v rms. The output impedance is 24 K direct. The harmonic distortion is less than 1% of center frequency, the linearity is within 1.5% of bandwidth and the output amplitude stability is within 1.35 db for full bandwidth. The power requirements are 26 v dc \pm 15% at a nominal 15 ma. The dc common mode rejection is rated at 10⁷ within \pm 20 v of ground. The unit weighs 10 oz and measures 63/64 x 1-57/64 x 3-19/32 in.

Hoover Electronics Co., Dept. ED, 110 W. Timonium Rd., Timonium, Md.

CIRCLE 112 ON READER-SERVICE CARD

DC Voltage Regulators

Transistorized



These transistorized voltage regulators provide fixed and variable outputs of 6 to 20 v dc and 15 to 35 v dc at 0.5 amp from unregulated sources of 24 to 32 v dc and 35 to 45 v dc. Typical ripple reduction is 500:1, line regulation is $\pm 0.1\%$ or 10 mv, and load regulation is 50 mv for 0 to 0.5 amp load change. Typical residual noise is 1 mv. The maximum output impedance is 0.1 ohms for 5 kc to dc. Applications include airborne equipment, missiles, telemetry, and computers. The unit measures 3 x 3 x 5 in. and weighs 16 oz.

Valor Instruments, Inc., Dept. ED, 13214 Crenshaw Blvd., Gardena, Calif.

CIRCLE 113 ON READER-SERVICE CARD

Insulated Tubing

Multichannel type

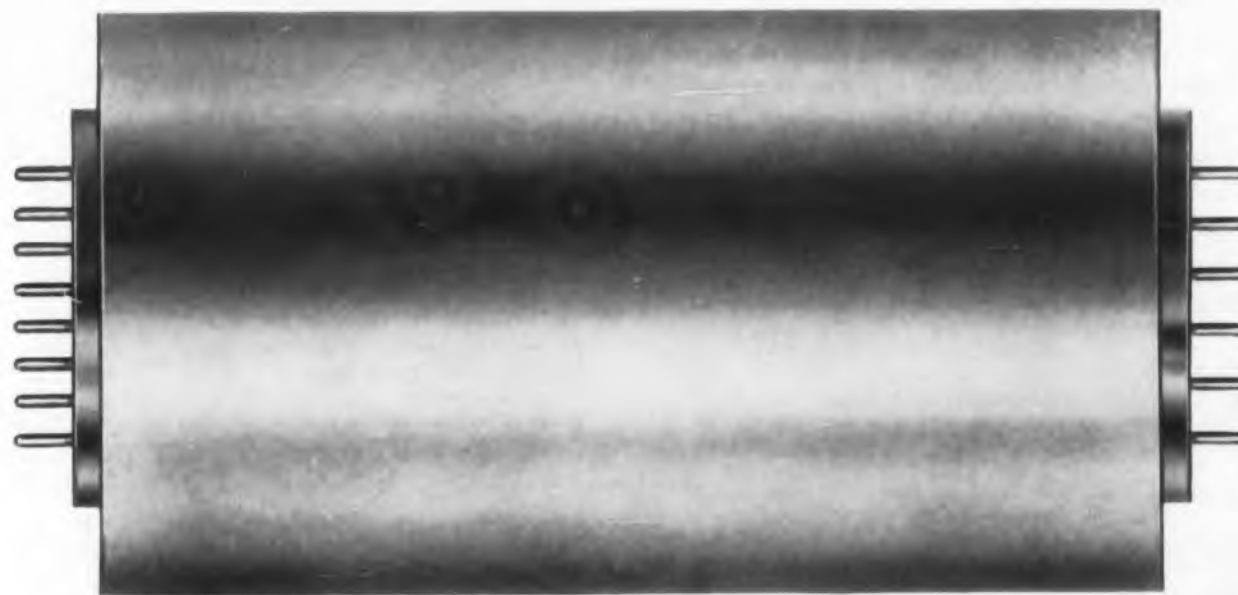


For use on cables between bulkheads, under floors, and in other tight areas, this multichannel Zippertubing permits large diameter cables to be broken down into two or more smaller cables. The cables may be of the same or different diameters, can be sealed together, and branched off into desired locations. The tubing is made of vinyl plastic for general use. For airborne applications, type 74 polyvinylchloride can be subjected to temperatures from -90 to $+185$ F and meets the chemical and physical requirements of MIL-I-7444A. Type 63 polyvinylchloride is also available and conforms to the chemical and physical requirements of MIL-I-631C, grade C, class I, category I.

The Zippertubing Co., Dept. ED, 752 S. San Pedro St., Los Angeles 14, Calif.

CIRCLE 114 ON READER-SERVICE CARD

AIRBORNE TRANSISTORIZED COMMUTATOR SIMULTANEOUS SAMPLING OF MILLIVOLT AND VOLT SIGNALS



No back currents. Pulse rates up to 25 kc. Usable as either PAM, PDM or PCM sampling switch. Linearity less than 0.1%. Input range; high level 0 to 5 volts, low level 0 to 10 millivolts.

Solid state Pulse Width Modulator available to operate with the commutator.

Write Dept. L Vector Mfg. Co., Southampton, Pa.



CIRCLE 115 ON READER-SERVICE CARD

A revolutionary approach to

INCOMING INSPECTION...



... the CTI card-programmed Component Tester

Reduce your incoming-test procedures to the insertion of a card and the push of a button! Large quantities or varied, small lots of any of the basic electronic components can be handled with equal efficiency by the CTI Component Tester. An unskilled operator merely selects the appropriate card. The Component Tester performs the required series of tests and indicates either that the component has passed or the type of failure that has been found. "Over", "under", and "pass" circuits are provided for completely automatic operation with handling and sorting devices.

CAPACITORS

Capacity: .002 to 100 mfd; smaller values using external oscillator
Leakage or Shunt Resistance Limit: 1 ohm to 1.62 megohms at 6 volts d-c, or 50 megohms at 100 v d-c

TRANSISTORS

Cut-off Current (I_{CO}): 0.375 microamperes to 1 amp
A-C Current Gain (base to collector-emitter common): 10 to 100

CHOKES

Inductance with rated D-C Current flowing: .03 to 50 henries; 0.5 to 161 ma
D-C Winding Resistance: 1 ohm to 1.62 megohms
Leakage Resistance Limit from winding to core: 50 megohms

DIODES and RECTIFIERS

Forward Resistance at 1 volt: 1 ohm to 1.62 megohms
Reverse Resistance at rated Reverse Voltage: 1 ohm to 1.62 megohms, 1 to 161 volts d-c

The simplicity of operation and surprisingly low cost of this instrument are the result of CTI's extensive experience in the field of automatic testing. An ingenious card reader provides both reliability and economic design. Precision bridge measurements and fail-safe circuitry are features gained in the development of CTI's automatic circuit testers.

Programming is accomplished with an ordinary hand punch. A single hole selects one of the test sequences listed below. Several additional holes dictate specific values and tolerances. Combinations or modifications of these standard tests can be used for special measurements.

RESISTORS

Resistance: 1 ohm to 16.2 megohms

TRANSFORMERS

Primary Inductance: .03 to 12 henries
Winding Ratio: 1:1 to 100:1
Winding Polarity
Leakage Resistance Limit from winding to core: 50 megohms at 100 v d-c

RELAYS

Pull-In Voltage: a-c or d-c, 0.5 to 161 volts
Continuity of each contact when closed: 1 ohm to 1.62 megohms
Leakage Resistance Limit between contacts in open position: 50 megohms at 100 v d-c
Coil Resistance: 1 ohm to 16.2 megohms
Leakage Resistance Limit from coil to frame: 50 megohms at 100 v d-c
Leakage Resistance Limit from all swingers and fixed contacts to frame: 50 megohms at 100 v d-c

Engineers: Career opportunities are currently available at CTI



CALIFORNIA TECHNICAL INDUSTRIES
DIVISION OF TEXTRON INC.
BELMONT 2, CALIFORNIA

Foremost in Automatic Testing

CIRCLE 116 ON READER-SERVICE CARD

NEW PRODUCTS

Power Supply

Provides 0 to 2000 v dc



Model 2000VPS-100 power supply has double and triple filament regulation to provide a stability of 0.0004 per day. In addition to its use in nuclear reactor instrumentation and scintillation counter spectrometry, it provides precise regulation of line voltages from 105 to 125, 60 cps, for all types of circuits requiring negative polarity in the 0 to 2000 v range. A one-volt change in line voltage changes the output 500 μ v. Power consumption is 60 w, output current is 5 ma, output impedance is less than 0.1 ohm, and ripple is less than 5 mv rms. The unit has dual switches, each with its own pilot light, and a precision potentiometer mounted at the front panel. It measures 3-1/2 x 19 x 10 in. and weighs 12 lb.

Gyra Electronics Corp., Dept. ED, Washington and Elm Sts., P.O. Box 184, La Grange, Ill.

CIRCLE 117 ON READER-SERVICE CARD

Current Governor

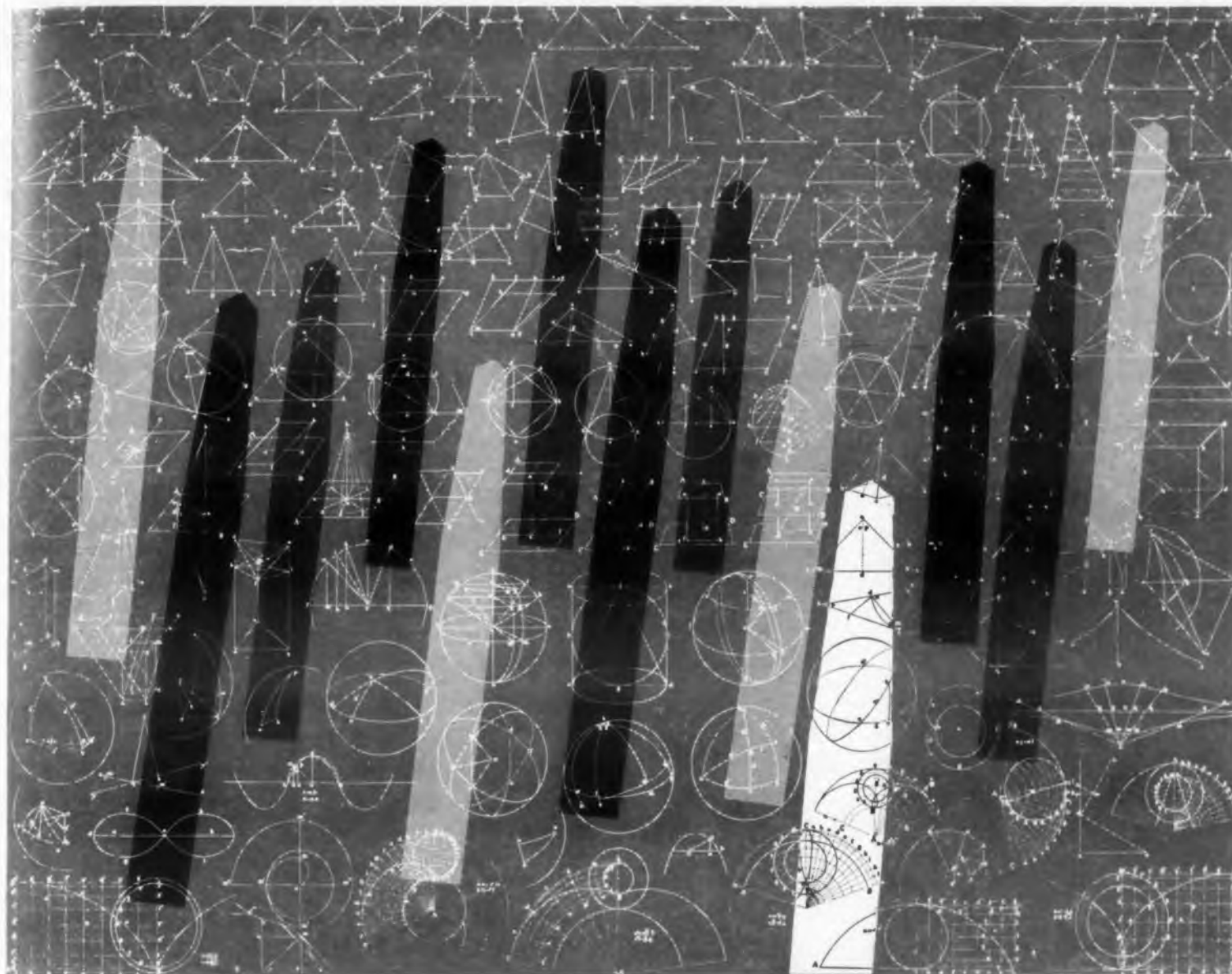
Provides 0.1 μ a to 10 ma



Designed especially for transistor testing, CS-112 current governor furnishes currents from 0.1 μ a to 10 ma in steps of 0.1 μ a at load voltages from 0 to \pm 100 v. The current is set by decade knobs arranged to provide a digital inline readout. Accuracy at any current setting is 1% \pm 0.1 μ a; short term stability is 0.05%; line regulation is better than 0.1%; and load regulation is better than 0.1%. The unit measures 19 x 8-3/4 x 15 in. and weighs 35 lb. Its applications include calibration, measurements of Zener diodes, potentiometers, solenoids, and other devices.

North Hills Electric Co., Inc., Dept. ED, 402 Sagamore Ave., Mineola, N.Y.

CIRCLE 118 ON READER-SERVICE CARD



Space veteran at the age of two

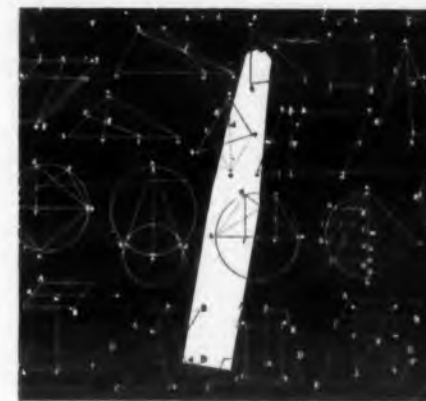


The Air Force THOR, built by Douglas and three associate prime contractors, shows how well a down-to-earth approach to outer space can work. Since its first shoot early in 1957, it has had more than *forty* successful launchings...at a variety of jobs from re-entry vehicle testing at ICBM ranges to placing satellites in orbit. Initial planning for THOR included volume production tooling, ground handling equipment and operational systems. This typical Douglas approach made the giant IRBM available in quantity in record time, and THOR has performed with such reliability that it has truly become the workhorse of the space age. Douglas is now seeking qualified engineers and scientists for new projects with even more exciting prospects.

Robert Johnson, Missile and Space Systems Chief Engineer, reviews results of a THOR-boosted 5000 mile flight with **DOUGLAS**
Donald W. Douglas, Jr., president of

MISSILE SYSTEMS ■ SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND HANDLING EQUIPMENT

Please write direct to advertiser mentioning *ELECTRONIC DESIGN*



If *you* are or would like to become a space veteran...

DOUGLAS AIRCRAFT COMPANY MISSILES AND SPACE SYSTEMS

has immediate openings in the following fields—

Electrical and Electronics:

- Control System Analysis & Design
- Antenna & Radome Design
- Radar System Analysis and Design
- Instrumentation
- Equipment Installation
- Test Procedures
- Logic Design
- Power System Design

Mechanical Engineering —

Analysis and Design of the following:

- Servo Units
- Hydraulic Power Systems
- Air Conditioning Systems
- Missile Launcher Systems
- Propulsion Units and Systems
- Auxiliary Power Supplies

Aeronautical Engineering:

- Aerodynamic Design
- Advanced Aerodynamic Study
- Aerodynamic Heating
- Structural Analysis
- Strength Testing
- Dynamic Analysis of Flutter and Vibration
- Aeroelasticity
- Design of Complex Structure
- Trajectory Analysis
- Space Mechanics
- Welding
- Metallurgy

Physics and Mathematics:

- Experimental Thermodynamics
- General Advanced Analysis in all fields
- Computer Application Analysis
- Computer Programming and Analysis
- Mathematical Analysis

For full information write to:

Mr. C. C. LaVene
Box 601-E
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

USE ELECTRONIC COUNTERS AS DIGITAL VOLTMETERS

with SYSTRON'S NEW MODEL 1230
VOLTAGE TO TIME CONVERTER

- | | |
|-----------------------------|----------------------------------|
| FEATURES: | PROVIDES: |
| • All-Electronic System | • Automatic Polarity |
| • 10 Millisecond Conversion | • \pm Microvolts to 1000 Volts |
| • .05% Accuracy | • 1 Megohm Input Impedance |

The development of Systron's new Model 1230 now makes it possible to convert any existing period or time counter into a precision high speed digital voltmeter. Connects directly to Systron Models 1010, 1040, 1043 and 1031 to provide an IN-LINE readout ($\pm 10,000$) of DC voltages.

Systron manufactures IN-LINE Counters for laboratory, military and industrial applications, as well as complete Data Processing and Control Systems tailored to meet individual specifications.

Write today for complete specifications of Model 1230 and your free copy of our new Short Form Catalog...



S Y S T R O N
C O R P O R A T I O N

S Y S T R O N
C O R P O R A T I O N
950 GALINDO STREET • CONCORD, CALIFORNIA

Representatives in
Principal Cities

S P E C I F I C A T I O N S
M O D E L 1 2 3 0

| | |
|--|---|
| Input Voltage Ranges 0 to -1, -10 and -100v DC Option A - -10 and -100 millivolts full scale Option B - ± 1000 volts | Errors: Conversion - $\pm 0.05\%$ of full scale Input Impedance: 1 Megohm (standard ranges) Option A - 100,000 ohms Polarity: Automatic polarity sensing |
| Indication: NIXIE IN- LINE, $\pm 10,000$ (on Model 1031) | Price: Model 1230 \$1095 00 Option A 895 00 Option B 180 00 Option C 100 00 |
| Conversion Time: .010 seconds (Time between pulses) Option C .100 seconds (100KC counters) | |

SYSTRON CORPORATION
950 GALINDO STREET • CONCORD, CALIFORNIA

CIRCLE 119 ON READER-SERVICE CARD

RAYTHEON KNOBS for that precision-engineered look!



WRITE TODAY FOR DETAILS



Excellence in Electronics

CIRCLE 120 ON READER-SERVICE CARD

Please address your inquiry to:
RAYTHEON COMPANY
Industrial Apparatus Division
Department 6836
Waltham 54, Massachusetts



FREE!
From ALPHA METALS

New Tips on Soldering

This handy ALPHA soldering guide contains valuable technical data. Included are:

- Prevention of silver scavenging
 - Effects of rare metals in soldering
 - Effective soldering of joints requiring high creep strength
- Get your copy... Act now!

In Chicago, Ill.
ALPHA-LOY CORP.
2250 S. Lumber St.

Other ALPHA products:
Solder Preforms.
Wide Range of Fluxes.
High Purity Metals.

ALPHA METALS, INC., 58C Water St., Jersey City 4, N.J.
Send me free your New Tips on Soldering.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

CIRCLE 121 ON READER-SERVICE CARD

NEW PRODUCTS

Capacitors

Range from 3.5 to 18 μf and 7.5 to 138 μf



Series MCA capacitors have straight-line capacity characteristics and come in six standard sizes ranging from 3.5 to 18 μf and 7.5 and 138 μf . They have silver-plated phosphor bronze wiping contact, silicon-treated steatite insulation, and soldered nickel-plated brass rotors and stators.

Hammarlund Manufacturing Co., Inc., Dept. ED, 460 W. 34th St., New York 1, N.Y.

CIRCLE 122 ON READER-SERVICE CARD

Miniature Choke Coil

Inductance is 1.5 to 18 mh



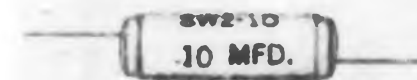
Measuring 0.16 in. in diameter and 0.375 in. long, this choke coil has a range of inductance from 1.5 to 18 mh. Sealed in epoxy resin for protection against climatic and mechanical conditions, the unit is designed to meet MIL-C-15305A.

Essex Electronics, Div. of Nytronics, Inc., Dept. ED, 550 Springfield Ave., Berkeley Heights, N.J.

CIRCLE 123 ON READER-SERVICE CARD

Capacitors

Use polystyrene film



These capacitors use polystyrene film for both

the dielectric and the encasement. Metal or plastic shells and the use of glass seal terminals are eliminated. A complete range of capacity ratings is available with working voltages of 200, 400, and 600 v dc.

The Potter Co., Dept. ED, 1950 Sheridan Road., N. Chicago, Ill.

CIRCLE 124 ON READER-SERVICE CARD

Multicoder

Samples to 90 channels



Measuring 4 in. sq, this solid state telemetering multicoder samples to 90 channels of information at an input level of 0 to 5 v dc. Simultaneous outputs are available in PAM, PDM, and magnetic tape recording format. The units are supplied for multiple speeds and selectable channel configurations; the speed and number of channels is selected by insertion of programming plugs. The unit operates in typical missile environments to 100 C and requires less than 4 w of power from an unregulated 28-v source. It weighs less than 3 lb.

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

CIRCLE 125 ON READER-SERVICE CARD

Ceramic Transducers

Curie temperature is 750 F

Having a Curie temperature of 750 F, the Glennite Hi-T transducer elements are made of lead zirconate and lead titanate compounds. The standard frequency tolerance is $\pm 10\%$; tolerances to $\pm 1\%$ can be obtained. They can be used in ordnance systems, high temperature electromechanical sensors, missile and underwater sound applications, and ultrasonic industrial equipment. Square plates and rods, circular discs and rods, thin walled cylinders and rings, focusing cylindrical sections, and hemispheres are available.

Gulton Industries, Inc., Dept. ED, 212 Durham Ave., Metuchen, N.J.

CIRCLE 126 ON READER-SERVICE CARD

They got rid of the dobbin...



We got rid of the bobbin!

Why should precision wire wound resistors continue to be wound on bobbins and encapsulated in epoxy resin . . . when we know the life of the resistor is shortened and its stability lowered by the varying expansion rates of the wire, bobbin, and resin.

Let's face it: Bobbin's ready for the pasture! General Transistor has developed a precision wire wound **bobbinless** resistor that floats in a special viscous fluid. Result: a strain-free resistor with tolerances as low as 0.05% and Temperature Coefficients of Resistance as low as 2PPM/°C.

These facts alone are proof that it's time to learn more about GT Precision Wire Wound Bobbinless Resistors.

Get the full details! Write today for brochure GR-30.

GENERAL TRANSISTOR CORPORATION

91-27 138th Place • Jamaica 35, New York • Phone: HICKORY 1-1000

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. PRECISION MAGNETIC RECORDING HEADS AVAILABLE FROM GENERAL TRANSISTOR WESTERN CORP., 6110 VENICE BLVD., LOS ANGELES, CALIF.

CIRCLE 127 ON READER-SERVICE CARD



Gertsch Complex Ratio Bridge



-measures both in-phase and quadrature voltage ratios - with high accuracy

This instrument cancels quadrature effects, giving a sharp, true null.

In eliminating quadrature voltage, this Gertsch bridge achieves an in-phase ratio accuracy as good as 0.001%. Quadrature voltage ratios are read as rectangular coordinates, tangent of phase-shift angle, or magnitude of phase-shift angle in degrees directly.

Write for complete data in Bulletin CRB.

- SELF-CONTAINED PHASE-SENSITIVE DETECTOR
- SIX-PLACE RESOLUTION
- TWO FREQUENCY RANGES
 - 30 TO 1000 CPS
 - 50 TO 3000 CPS

Gertsch

GERTSCH PRODUCTS, Inc.

3211 South La Cienega Boulevard, Los Angeles 16, California
Upton 0-2761 - VErmont 9-2201

CIRCLE 128 ON READER-SERVICE CARD

DIALS ACCURATE TO ± 0.002 TURNS



INSURES ACCURATE POSITIONING of multi-turn potentiometers and variable capacitors.

Digital readout or dual turns counters for precise settings up to 3600°. Constant torque permits delicate adjustment of the easy-to-read "CM-3" precision turns counter.

Write today for technical data.

GENERAL CONTROLS

Automatic Controls for Product or Process
Glendale, Calif. - Skokie, Ill. - Guelph, Ontario, Canada
Nine Plants - 44 factory branch offices
Serving the United States, Canada and Western Europe



CIRCLE 194 ON READER-SERVICE CARD

NEW PRODUCTS

Frequency Standard

Provides 0.1, 1, and 5 mc



Using a transistorized crystal oscillator, model NC-1200 frequency standard provides outputs of 0.1, 1, and 5 mc. The outputs are stable to 1 ppb per day and may be used simultaneously. Each output can furnish 200 mv across a 50-ohm load. The frequency is adjustable permitting calibration to one part in 10^{10} . The required input is 115 v ac, 60 cps; special power requirements can be provided for including battery and 400 cps operation. The oscillator meets MIL-E-16400 shock and vibration specifications. The components can be repackaged to meet Mil specs. Designed for relay rack installation, the unit measures 6 x 7 x 11 in.

National Company, Inc., Dept. ED, Malden, Mass.

CIRCLE 129 ON READER-SERVICE CARD

VHF-FM Receiver

For 30 to 15,000 cps



Type ESB vhf fm receiver provides distortion-free transmission of the band from 30 to 15,000 cps and eliminates cross-modulation. The unit is available in these three versions: a relay receiver for broadcasting; a long-distance link receiver for cf systems or radio transmission over wide areas, and a short-distance link receiver for cf or radio relay links. For all standard types, the frequency ranges are 87.5 to 100 mc, 41 to 68 mc, 60 to 88 mc, 156 to 174 mc, 174 to 220 mc, and 50 to 80 mc. The maximum swing specifications are 50, 75, 150 kc. Modulation frequency ranges are 30 to 15,000 cps, 300 cps to 60 kc, 300 cps to 120 kc.

Rohde & Schwarz Sales Co., Dept. ED, P.O. Box 257, 111 Lexington Ave., Passaic, N.J.

CIRCLE 130 ON READER-SERVICE CARD

a measure
of
perfection...



**IDEAL
PRECISION**

Panel Meters
*the complete line
for every application*

IDEAL Panel Meters are assembled in controlled atmospheric and climate conditions and 100% inspected at every step of production to insure highest quality and dependability.

- D'Arsonval movements guarantee minimum accuracy of 2% (full scale).
- Rugged construction means trouble-free, long-lived service.
- Durable plastic meter cases provide greater clarity, easier readability.
- Beauty of design enhances your product.

For more information on the entire IDEAL line, write for Catalog No. 32.

Sold to Electronic Parts Distributors exclusively through Waldom Electronics, Inc., 4627 West 53rd Street, Chicago 32, Illinois.

IDEAL

IDEAL PRECISION METER CO., INC.
126 Greenpoint Ave., Brooklyn 22, N. Y.

CIRCLE 131 ON READER-SERVICE CARD

NEW PRODUCTS

Pressure Sensitive Tape

Used over range of -50 to $+400$ F

This pressure sensitive tape is composed of a 3-mil Teflon backing and a fluoropolymer adhesive and has a total thickness of 6 mils. Called Temp-R-Tape FR, it can be used over the temperature range of -50 to $+400$ F.

The Connecticut Hard Rubber Co., Dept. ED, 407 E. St., New Haven 9, Conn.

CIRCLE 136 ON READER-SERVICE CARD

Stampings

For electronic applications

Included in the applications of these precious metal stampings are electrical contacts, protective rupture discs, and solder preforms for semiconductor devices. A variety of alloys are available including 99% gold and 1% arsenic, 99.99% fine gold, 99.5% silver and 0.5% antimony, and 99.99% fine silver. Components may have 0.025 to 2 in. OD with less than ± 0.00025 in. variation. Thicknesses of the parts are held to ± 0.0002 in., and flatness to within 0.0002 in.

Accurate Specialties Co., Inc., Dept. ED, 37-11 57th St., Woodside 77, N.Y.

CIRCLE 137 ON READER-SERVICE CARD

High-Purity Gold Preforms

For semiconductors

For use in the production of semiconductor devices, the gold is about 99.999% pure. It can be alloyed with high-purity antimony, gallium aluminum, tin, cadmium, tellurium, zinc, and silicon. It is available in spheres from 0.001 to 0.1 in. in diam, discs from 0.005 to 1 in. OD with thicknesses down to 0.0004 ± 0.0001 in. prior to stamping, pellets with diameters down to 0.001 in., and washers of any size. Doping can be either positive or negative.

Alloys Unlimited, Inc., Dept. ED, 21-01 43rd Ave., Long Island City 1, N.Y.

CIRCLE 138 ON READER-SERVICE CARD

TI 2N696 AND 2N697



100% DEVICE TEST WITH 'CAT' AUTOMATIC TEST EQUIPMENT

100% test of the performance and uniformity built into TI 'mesa' units is conducted automatically by CAT—Centralized Automatic Test equipments. Designed and built by TI, these machines each have a capacity of 40,000 units a day.



Currently doubling in size is the 310,000-sq ft TI Semiconductor-Components division plant, already the world's largest semiconductor facility.

TEXAS

2N697 MULTI-PURPOSE SILICON 'MESAS' NOW MASS-PRODUCED BY WORLD'S LARGEST TRANSISTOR MANUFACTURER

MEDIUM-POWER AMPLIFIERS • SMALL-SIGNAL AMPLIFIERS • SWITCHERS

FEATURE:

- Diffused-base 'mesa' construction
- 2-w maximum power dissipation at 25°C
- DC betas of 20-60 and 40-120



Available now in production quantities . . . TI 2N696 and TI 2N697 multi-purpose silicon 'mesa' units for amplifier, switching and medium-power applications.

Produced by the pioneer of the diffused-base process, these highly reliable 'mesa' units feature . . . 2-w maximum power dissipation . . . beta spreads of 20-60 (TI 2N696) and 40-120 (TI 2N697) . . . 10-ohm maximum saturation resistance.

Your full-year guarantee is backed by TI's proven production capabilities (largest in the world and currently being doubled) and a stringent quality assurance program.

Check these specs and contact your nearest distributor or TI sales office for *immediate* delivery.

electrical characteristics at 25°C ambient

(unless otherwise noted)

| PARAMETERS | TEST CONDITIONS | min. | max. | unit |
|--|---------------------------------------|------|------|------------|
| I_{CBO} Collector Reverse Current | $V_{CB} = 30v$ $I_E = 0$ | — | 1.0 | μA |
| | at 150°C $V_{CB} = 30v$ $I_E = 0$ | — | 100 | μA |
| BV_{CBO} Collector-Base Breakdown Voltage | $I_{CBO} = 100\mu A$ $I_E = 0$ | 60 | — | v |
| BV_{CER} Collector-Emitter Breakdown Voltage | $I_{CER} = 100ma$ $R_{BE} = 10$ ohms | 40 | — | v |
| BV_{EBO} Emitter-Base Breakdown Voltage | $I_{EBO} = 100\mu A$ $I_C = 0$ | 5 | — | v |
| h_{FE}^* D-C Forward Current Transfer Ratio | $I_C = 150ma$ $V_{CE} = 10$ v (2N696) | 20 | 60 | — |
| | (2N697) | 40 | 120 | — |
| $V_{BE(sat)}^*$ Base-Emitter Saturation Voltage | $I_C = 150ma$ $I_B = 15ma$ | — | 1.3 | v |
| $V_{CE(sat)}^*$ Collector-Emitter Saturation Voltage | $I_C = 150ma$ $I_B = 15ma$ | — | 1.5 | v |
| h_{fe} A-C Common Emitter Forward Current Transfer Ratio | $I_C = 50ma$ $V_C = 10v$ $f = 20mc$ | 2.5 | — | — |
| C_{ob} Collector Capacitance | $I_E = 0ma$ $V_C = 10v$ | — | 35 | $\mu\mu f$ |

*Pulse conditions: length = 300 μs ; duty cycle < 2%.

maximum ratings at 25°C ambient

| | |
|--|-----------------|
| Collector-Base Voltage | 60v |
| Collector-Emitter Voltage ($R_{BE} = 10 \Omega$) | 40v |
| Emitter-Base Voltage | 5v |
| Total Device Dissipation | 0.6w |
| Total Device Dissipation at case temperature 25°C | 2w |
| Storage Temperature Range | -65°C to +175°C |



DELIVERED
OFF-THE-SHELF

From
MILGRAY

Your Authorized
TI Distributor

ALL TI semiconductors are in stock, ready to be rushed to you NOW! There is no delay when you order from MILGRAY.

You know you are getting maximum reliability when you specify Texas Instruments semiconductors, USE PROVED by thousands of customers and GUARANTEED for one full year by TI.

DIAL RECTOR 2-4400 for fast delivery at factory prices in the following quantities:

Silicon Transistors: 1-999
Germanium Transistors: 1-99
Silicon Diodes and Rectifiers: 1-999



**INSTRUMENTS
INCORPORATED**
SEMICONDUCTOR-COMPONENTS DIVISION
13500 N. CENTRAL EXPRESSWAY
POST OFFICE BOX 312 • DALLAS, TEXAS

Write on your company letterhead describing your application for specific details on TI products.



CIRCLE 139 ON READER-SERVICE CARD
◀ CIRCLE 140 ON READER-SERVICE CARD

for
**HEARING
AIDS**



or
**RECORDING
HEADS**



or ANY MAGNETIC MATERIALS JOB ...

Write for
your Copy

"MAGNETIC
MATERIALS"



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

ADDRESS DEPT. ED-22

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

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

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

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

STEELMAKERS to the Electrical Industry

Allegheny Ludlum

CIRCLE 141 ON READER-SERVICE CARD

W 60 5335



SERVICES FOR DESIGNERS

Computing Services

A four-page, two-colored brochure, titled *Computing Services*, gives an account of mathematical services for scientific, industrial and business applications provided by a firm specializing in the digital computer and industrial control fields. Types of mathematical and organizational services are listed, as are typical problems solved by this company. Featured is a check list enabling the reader to determine if mathematical services are needed by his firm, plus notations on the benefits of a computing service.

Computer Control Company, Inc., Mathematical Services, Dept. ED, 2251 Barry Avenue, Los Angeles 64, Calif.

CIRCLE 142 ON READER-SERVICE CARD

Field Service Capabilities

A new eight-page, illustrated brochure describing the field service capabilities of Hoffman Electronics Corp.'s Laboratories Division is now available. The booklet outlines the field services Hoffman offers on a world-wide basis in the areas of field engineering, overhaul and repair, test equipment, standards, training and medical electronics.

Under the direction of William R. Barnes, Hoffman's field service department offers a complete package of the services, or any combination of them, to both military and industrial customers.

Hoffman Electronics Corp., Field Services, Laboratories Div., Dept. ED, 3740 S. Grand Ave., Los Angeles, Calif.

CIRCLE 143 ON READER-SERVICE CARD

Construction Services

Complete installation through start-up service for automation and instrumentation systems is being offered by the Panellit Service Corp. Services include a contract organization furnishing installation drawings and installation of the panels, field instruments, the field interconnections, commissioning, operator orientation and providing supplementary instrumentation personnel where needed. The services are described and illustrated in two-color, 16-page brochure, No. 107.

Panellit Service Corp., Dept. ED, 7401 N. Hamlin Ave., Skokie, Ill.

CIRCLE 144 ON READER-SERVICE CARD

Environmental Test Facilities

The environmental test facilities, located at the firm's plant in Philadelphia, are primarily intended for making reliability and performance checks of TDI telemetry equipment. But these test facilities are available to other organizations. Products are subjected to applicable vibration, temperature, humidity and altitude tests in simulated adverse conditions. Facilities also provide for acoustical noise and shock tests, radio interference and susceptibility measurements, and simulation of static acceleration encountered in missile launchings. Bulletin 859, eight pages, describes the facilities. It contains charts and tables that list equipment capabilities. Photographs show the equipment in operation in the laboratory.

Tele-Dynamics Inc., Dept. ED, 5000 Parkside Ave., Philadelphia 31, Pa.

CIRCLE 145 ON READER-SERVICE CARD

Nuclear Irradiation

Services of this firm include the handling of complete radiation effects programs, from planning through irradiation and post-irradiation and reporting. At its San Jose and Vallecitos facilities, GE's Atomic Power Equipment Dept. has what it claimed to be "the most complete privately owned nuclear research facilities in the world." Its integrated irradiation services range from basic and applied nuclear research programs to specific testing and development operations requiring specialized experience and equipment. They are available to private industry and government research. A variety of other technical services are available to meet specialized customer requirements. A bulletin, No. GEA-6934, eight pages, includes photographs and detailed descriptions of the irradiation services.

General Electric Apparatus Sales Div., Dept. ED, Schenectady 5, N. Y.

CIRCLE 146 ON READER-SERVICE CARD

Environmental Test Facilities

A "one stop" test facility laboratory, capable of simulating accurately the environments in which missiles and aircraft function, is being offered by Iteclab, Inc. In the laboratory, components can be subjected to combined environmental exposures, such as acoustic noise, vibration and elevated temperatures, simulated blast-off, rapid changes in pressure and temperature and all other conditions that might influence their operational reliability.

Iteclab, Inc., Dept. ED, Port Washington, N.Y.

CIRCLE 147 ON READER-SERVICE CARD

A MILITARY BACKGROUND QUALIFIES TUNG-SOL SUBMINIATURES FOR EXACTING APPLICATIONS

Designed and manufactured to MIL specs, Tung-Sol's rapidly growing line of rugged subminiatures has been finding increasing application in general industry.

Tung-Sol's stringent quality control plus its

unparalleled production ability assure that high-volume production units exhibit exactly the same fine quality as the engineering samples. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193



No. 1AD4
Spec. MIL-E-1/20D
Type Sharp cut-off pentode



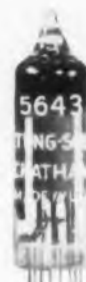
No. 1AH4
Spec. MIL-E-1/316B
Type Rf pentode



No. 5636
Spec. MIL-E-1/168D
Type 400 Mc mixer pentode, rugged



No. 5639
Spec. MIL-E-1/169C
Type Power amplifier pentode, rugged



No. 5643
Spec. MIL-E-1/757D
Type Xenon shield grid thyratron



No. 5672
Spec. MIL-E-1/280A
Type DH power amplifier pentode



No. 5676
Spec. MIL-E-1/79A
Type DH Vhf low mu triode



No. 5678
Spec. MIL-E-1/281C
Type DH sharp cut-off pentode



No. 5783
Spec. MIL-E-1/86A
Type Cold cathode 87 v voltage reference tube



No. 5783WA
Spec. MIL-E-1/87C
Type Cold cathode 87 v voltage reference tube, rugged



No. 5829WA
Spec. MIL-E-1/292A
Type 400 mc twin diode, rugged



No. 5840
Spec. MIL-E-1/140B
Type 400 mc sharp cut-off pentode, rugged



No. 5875
Spec. MIL-E-1/468A
Type DH high frequency sharp cut-off pentode



No. 5896
Spec. MIL-E-1/174C
Type 400 mc twin diode, rugged



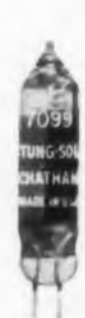
No. 6021
Spec. MIL-E-1/188B
Type Uhf medium mu twin triode



No. 6245
Spec. —
Type Vhf sharp cut-off pentode, rugged



No. 6542
Spec. 858-USAF
Type 150 v cold cathode voltage regulator



No. 7099
Spec. —
Type Low current 155 v voltage regulator



No. 7323
Spec. —
Type Indicating thyratron, formerly CK1050



No. 7401
Spec. —
Type Cold cathode indicating thyratron, formerly CH1125

For prompt and competent technical consultation on Tung-Sol tubes, call the Tung-Sol Commercial Engineering office nearest you.

Newark Region: One Summer Avenue, Newark 4, New Jersey • Chicago Region: 1975 North Hawthorne Ave., Melrose Park, Illinois • Columbus Region: 755 W. Goodale Blvd., Columbus 8, Ohio • Detroit Region: Tung-Sol of Mich., Inc. (Rep.) 17500 W. 8 Mile Rd., Detroit 35, Michigan • Dallas Region: 2334 Havenhurst Street, Dallas 34, Texas • Los Angeles Region: 8575 Washington Blvd., Culver City, California • Seattle Region: Ron Merritt Company (Rep.) 1320 Prospect Street, Seattle 9, Washington

TUNG-SOL
SUBMINIATURE TUBES

CIRCLE 148 ON READER-SERVICE CARD

FRANKLIN SERIES 1300



MODEL 1310N

ANALOG-TO-DIGITAL CONVERTERS

-  indefinite long-term stability
-  ± one count accuracy

...two good reasons why Franklin's Series 1300 instruments are preferred in dozens of demanding applications. But there's more...

Series 1300 Analog-to-Digital Converters are available in four basic configurations—off-the-shelf, ready-to-operate. Matching accessories perform additional functions—convert codes, extend sensitivity, provide for a-c input signals, furnish automatic features... give the engineer complete freedom in his data system design.

For all the facts, request Bulletin 606.

ANALOG-TO-DIGITAL CONVERTERS

| MODEL | * INPUT SIGNAL | READOUT | POLARITY AND DECIMAL INDICATION |
|-------|--|-----------------|---------------------------------|
| 1310 | 000.0 TO 120.0 V DC | VERTICAL | NO |
| 1310N | SAME AS MODEL 1310 | IN-LINE (NIXIE) | YES |
| 1321 | 000.0 TO 120.0 V DC, 1 TO 100,000 MMF | VERTICAL | NO |
| 1321N | SAME AS MODEL 1321 | IN-LINE (NIXIE) | YES |

* FOR SENSITIVITIES UP TO 100 MICROVOLTS PER DIGIT, SEE THE FOLLOWING LISTING.

FUNCTION AND RANGE EXTENDING AMPLIFIERS

| MODEL | GAIN RANGES | GAIN SWITCHING | | | AUTOMATIC POLARITY |
|-------|------------------|----------------|------|-------|--------------------|
| | | LOCAL | REM. | AUTO. | |
| 319RA | 1, 10, 100, 1000 | YES | NO | YES | YES |
| 319R | 1, 10, 100, 1000 | YES | YES | NO | NO |
| 319 | 1, 10, 100, 1000 | YES | NO | NO | NO |
| 318RA | 1, 10, 100 | YES | NO | YES | YES |
| 318R | 1, 10, 100 | YES | YES | NO | NO |
| 318 | 1, 10, 100 | YES | NO | NO | NO |



CIRCLE 149 ON READER-SERVICE CARD

NEW LITERATURE

Meter-Relay 150

The successive circuit stages involved in operation of a continuous reading meter-relay are shown in bulletin S-2, four pages. Diagrams, photos and specifications are included. Assembly Products, Inc., 75 Wilson Mills Rd., Chesterland, Ohio.

Semiconductor Alloys 151

The physical properties of lead-antimony, tin-antimony, tin-gold and other semiconductor alloys are discussed in a series of technical data sheets. Each of these sheets contains a phase diagram of a particular alloy combination and a description of the phase relationship and crystal structure, alloy properties and fabricating possibilities of those alloys. Alpha Metals, Inc., 56 Water St., Jersey City 4, N.J.

Nuclear Instrumentation 152

Over 50 nuclear instruments and monitoring systems are covered in 12-page bulletin C. Brief text outlines design, uses and performance data. Among the group classifications are: amplifiers, scalars, power supplies, electrometers, spectrometers, radiation monitoring systems, medical and survey instruments. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Crossbar Scanner 153

Driving circuitry and electrical and mechanical specifications for a self-stepping crossbar scanner appear in illustrated bulletin 58-217, two pages. Standard and optional features available with the unit are also included. James Cunningham, Son & Co., Inc., 100 Litchfield St., Rochester 8, N.Y.

Amplifiers and Preamplifiers 154

Wideband, if, and transistorized amplifiers and preamplifiers are treated in this four-page brochure. Illustrations, specifications, descriptions, unit price and quantity discounts are given for each model. Instruments for Industry, Inc., 101 New South Rd., Hicksville, N.Y.

Equipment Control Connectors 155

This 12-page, illustrated brochure, No. 372, covers connectors designed for applications up to 600 v. Dimensions, specifications, and examples of typical applications are included. Joy Manufacturing Co., 1201 Macklind Ave., St. Louis 10, Mo.

NEW!



COLORFUL,
LOW COST,
PRECISION
SHAFT TURNS
COUNTER

VerniDial

The VerniDial H5850 is a lightweight, reliable and economical turns counter for accurately positioning multi-turn devices such as potentiometers, capacitors, valves and other equipment where micrometer readout of a setting is desired. Graduated in hundredths, it accumulates to 20 turns... reading or positioning from zero to 2000/100.

7 Colors (solid or combinations!): Black, Gray, Off-white, Yellow, Orange, Red, Green.

RESISTS CORROSION
INSULATES CIRCUITRY
and BODY CAPACITY

COLORFUL
for CODING and DESIGN

LIGHT WEIGHT
MOLDED PLASTIC

EASILY INSTALLED

Write for
Bulletin H5850

HOWELL INSTRUMENT COMPANY

3101 Trinity Street, Fort Worth 7, Texas

CIRCLE 156 ON READER-SERVICE CARD

NEW line of STANDARD PLASTI-GROMMETS® CUTS FASTENING COSTS



GET THE FACTS—
SEND FOR THIS
TIMELY BOOKLET!

Using Fastex Plasti-Grommets to mount license plates demonstrates their use in blind applications, just one of their unique solutions to individual or mass-production fastening problems. They snap into place easily, lock tight when the screw is driven.

FASTEX

A DIVISION OF ILLINOIS TOOL WORKS
195 Algonquin Road, Des Plaines, Illinois
In Canada: SHAKEPROOF/FASTEX
Division of Canada Illinois Tools Ltd,
Don Mills, Ontario



CIRCLE 157 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 195

Circular Slide Rule

For those who must perform simple calculations in multiplication, division and proportion, this pocket-size calculator is available. Instructions will be included with each slide rule. Write on company letterhead to General Industrial Co., 1788J Montrose Ave., Chicago 13, Ill.

Data Translators 158

This eight-page, illustrated catalog covers special purpose record readers, which are used to convert information recorded in pictorial or graphic form into either digital or proportional analog resistance form. Also included are various types of automatic plotting machines used for graphing business, military, and scientific data. Benson-Lehner Corp., 11930 W. Olympic Blvd., Los Angeles 64, Calif.

Variable Resistors 159

Data sheet 175 contains dimensional drawings, tabular comparative data, and an illustration of the 1/2 in. diam high temperature variable resistors. Electrical and mechanical specifications appear. Chicago Telephone Supply Corp., Elkhart, Ind.

Motor Tach Generators 160

Catalog 6000, 16 pages, describes basic models of the firm's line of precision made motor tach generators, sizes 8 to 18, for scientific, military and industrial applications. Definitions, performance curves, dimensional drawings, and physical, electrical and mechanical characteristics are included. John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine, Wis.

Test and Industrial Instrumentation 161

Bulletin C706, 15 pages, describes and illustrates such devices as time interval meters, EPUT meters, preset counter-controllers, transducers, general and special purpose test instruments and electronic counters. Specifications and applications are given. Beckman Instruments, Inc., Berkeley Div., 2200 Wright Ave., Richmond 3, Calif.

Semiconductors

Revised and expanded to 40 pages, booklet CD-108B covers germanium and silicon transistors and silicon rectifiers. Maximum ratings, typical operation, characteristics, and dimensional outlines are given for each type. Schematic diagrams and tables also appear. Send 30 cents to Radio Corp. of America, Semiconductor and Materials Div., Somerville, N.J.

BENDIX-PACIFIC NEEDS SYSTEMS
AND CIRCUIT DESIGNERS FOR

advanced submarine detection systems

Unusual Creative Opportunities for

- Electronic engineers with a well rounded background to participate in a unique research and development program
- Qualified mechanical design engineers including structural thermo-dynamicists in this challenging new field.

SEND RESUME OF YOUR QUALIFICATIONS TO MR. WALKER



CIRCLE 901 ON CAREER INQUIRY FORM, PAGE 129

GEE-LAR KNOBS FOR IMMEDIATE DELIVERY

Fast Service is the big "plus" you get at GEE-LAR—the House of Knobs. Hundreds of styles, sizes and types, including deluxe Gold Inlay Knobs, are stocked . . . quickly shipped to you in any quantity. Best of all, your costs are always moderate . . . there's no charge for tooling or molds.

FAST SERVICE
Gee-Lar is geared for immediate deliveries. Get the facts today.

KNOBS FOR
Television • Home Radios
Phonographs • Clock Radios
Auto Radios • Instruments . . .
many others.

GEE-LAR MFG. CO.
Division of G-C-Textron Inc.
400 South Wyman Street • Rockford, Illinois

WRITE today for your big, free illustrated Gee-Lar Catalog. No obligation!

CIRCLE 162 ON READER-SERVICE CARD

marion
advancement
in instrument
design



MEDALIST* meters

Combine increased readability with attractive color styling. ASA/MIL 1 1/2", 2 1/2" and 3 1/2" mounting. Up to 50% longer scale in same space as conventional types. Standard and special colors. Bulletin on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Company, Manchester, N. H., U. S. A.

*T.M. Reg. U.S. Pat. Off. U.S. & Foreign Patents
Copyright © 1958, Marion

marion
"WHERE ELECTRONICS MEETS THE EYE"
meters



CIRCLE 163 ON READER-SERVICE CARD

WHEN YOU NEED CONNECTORS...CALL YOUR NEARBY CEC CONNECTOR REP.

THROUGH SALES OFFICES IN MAJOR CITIES THROUGHOUT THE COUNTRY a wide variety of rugged, lightweight CEC electrical connectors are available off-the-shelf. Standard types for flush or surface mounting...with jack screws or guide pins...straight or right-angle hoods... in 26-, 34-, 42-, 50-, 75-, or 104-pin configurations...are available—special types designed to your specifications.



SERIES 500-C multi-contact connectors, shown at left, feature easy-to-assemble snap-in contacts which simply push into place, yet permit fast, easy removal with a simple hand tool. Four-prong retention spring in each contact resists an axial pull of at least 20-lbs....equal to a cable-harness strength of 1,500 lbs. for a 75-pin connector.

CEC representatives in the cities listed below are ready to fill your requirements for dependable, advanced-design connectors. Call today and get detailed information.

Arizona, Phoenix—ALpine 2-8468
 California, Pasadena—MUrray 1-8421
 Connecticut, New Haven—STate 7-0115
 Florida, Miami—PLaza 1-4692
 Orlando—through Winter Park—Midway 4-4413
 Georgia, Atlanta—TRinity 5-8908
 Illinois, Chicago—AUstin 7-2089
 Indiana, Indianapolis—FLetwood 9-5374
 Iowa, Cedar Rapids—EMpire 2-6302
 Kansas, Wichita—MUrray 2-2731
 Maryland, Blandensburg—UNion 4-4722
 Massachusetts, Lexington—VOLunteer 2-2500
 Michigan, Detroit—VERmont 8-3460
 Minnesota, Minneapolis—FEderal 9-0707
 Missouri, Kansas City—WEstport 1-4884
 St. Louis—VOLunteer 3-6550
 New Jersey, Union City—UNion 7-3204
 New York, Fayetteville—NEptune 7-9531
 North Carolina, Charlotte—EXpress 9-3673
 Ohio, Cincinnati—MElrose 1-9210
 Dayton—AXminster 8-4261
 Westlake—SUperior 1-1855
 Pennsylvania, Wynnewood—Midway 2-9100
 Texas, Arlington—CREstview 4-0761
 Washington, Seattle—MAIn 4-1673

Electro Mechanical Instrument Division

CEC

CONSOLIDATED ELECTRODYNAMICS 360 Sierra Madre Villa, Pasadena, Calif.

NEW LITERATURE

Transistors

165

"Understanding Transistors," a 64-page handbook with over 50 diagrams and illustrations, explains transistor theory and applications. Junction transistors, drift transistors, tetrode transistors, alloy-junction transistors, surface barrier transistors, transistor oscillators, and silicon transistors are among the subjects covered. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Linear Actuators

166

Three data sheets describe various models of three linear actuators. Load, stroke, speed, performance, and other elements are listed in table form. Performance curves are given for each series. Lear, Inc., 110 Ionia Ave., N.W., Grand Rapids 2, Mich.

Meters

167

Expanded scale ac and dc voltmeters, expanded scale frequency meters, and linear scale ammeters are discussed in this 20-page catalog. Operating principles and specifications are given for each. Various meter case styles and sizes are illustrated in photographs and drawings. Helipot Div. of Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Precision Potentiometers

168

Six data sheets present electrical and mechanical specifications for six types of precision potentiometers. Diagrams, resolution and power dissipation graphs, environmental test data, and parameters for custom designs also appear. Guidance Controls Corp., 110 Duffy Ave., Hicksville, N.Y.

Cables

169

The firm's line of cables for data transmission and processing requirements is discussed in this four-page bulletin. Miniaturized low-capacitance coaxial cables, low-loss coaxial cables and shielded twisted pair cables are covered. Times Wire and Cable Co., Inc., 358 Hall Ave., Wallingford, Conn.

DC Power Supplies

170

This four-page bulletin describes 63 high-voltage dc power supply models. Illustrations, tabular specifications, and protective and optional features are included. Sorensen & Co., Richard Ave., S. Norwalk, Conn.

Relays 171

Catalog A-101MM describes microminiature crystal-case relays. Features, specifications, a photo and a schematic diagram appear on this sheet. The Amerelay Corp., 130 County Courthouse Rd., New Hyde Park, N.Y.

Traveling-Wave Amplifiers 172

This catalog sheet lists principal electrical characteristics as well as physical dimensions and weights for 15 types of traveling-wave amplifiers and three types of backward-wave oscillators. Four of the traveling-wave amplifiers described employ permanent-magnet focusing; the other 11 and the three backward-wave oscillators are solenoid focused. Sylvania Electric Products, Inc., 730 Third Ave., New York 17, N.Y.

Components 173

Neon and incandescent indicators, both conventional and transistorized, push button switches, combination indicators-switches, decimal readout devices and other display panel components are described in this 30-page catalog. Also described is a transistor-diode tester. Photographs and technical data are provided. Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26, Minn.

Analog Computer 174

"Analog Computer CM-2," a two-page brochure, describes and illustrates a solid-state computing device for mathematical calculations. It lists all technical data and specifications, including special amplifiers and networks which are available. Pictorial material is included. Southwestern Industrial Electronics Co., a division of Dresser Industries, 10201 Westheimer Rd., P.O. Box 22187, Houston 27, Tex.

Transducer 175

The Hi-Ac-Tran model 106 transducer, designed especially to connect control computers to pneumatic equipment, is described in Bulletin No. E-106. The bulletin describes the principle of operation and outlines the transducer's pneumatic and electrical rating specifications, performance data and special features in two pages. Associated Control Equipment, Inc., P.O. Box 136, 853 Fourth Ave., Coraopolis, Pa.

Power Transistors 176

This two-page engineering bulletin describes the type 2N1069 and 2N1070 npn high-power silicon transistors. Temperature range for the units is -65 to +175 C. Form 1953 contains a dimensional outline, a graph and tabular data. Silicon Transistor Corp., Carle Place, N.Y.

Wright Servo Motors With Inertia Damping Eliminate Need For Tachometer Generator

These new Wright-designed motors eliminate the need in high response systems for tachometer generator feed-back. They have built-in damping to resist sharp acceleration or deceleration. They provide stabilization through reversible viscous torque which has no effect at constant speed, and only minute effect on small incremental changes in velocity.

Their fly-wheel, which contains a permanent magnet, is mounted on independent bearings in the motor. This is viscously coupled to the rotor via a drag cup carried by the rotor. The fly-wheel effect is not felt by the rotor until a significant velocity difference appears between rotor and fly-wheel.

Your inquiry is invited. Please specify the motor size and/or torque output you require.

SIZE 11



SIZE 15



WRIGHT MACHINERY COMPANY

DIVISION OF SPERRY RAND CORPORATION
DURHAM, NORTH CAROLINA



CIRCLE 177 ON READER-SERVICE CARD

NEW LITERATURE

Silicon Semiconductor Devices

Called SPAN (Semiconductor Product Application News), this publication will be published bi-monthly and contains technical data and application information on silicon semiconductor devices. This first issue covers, among other subjects, silicon photo-voltaic detection cells. Write to SPAN editor, Semiconductor Div., Hoffman Electronics Corp., Dept. ED, 1001 Arden Drive, El Monte, Calif.

Automatic Checkout Equipment 178

"Demon," the firm's universal digital automatic checkout equipment, is described in this illustrated catalog sheet. The equipment, when used with appropriate signal sources, can handle a wide variety of checkout problems of varying degree and complexity. General specifications are included. Curtiss-Wright Corp., 6767 Hollister Ave., Goleta, Calif.

Semiconductor Directory

This directory, No. 5, provides pricing data on transistors, diodes and rectifiers produced by 16 leading U. S. manufacturers. Over 2100 types are in the directory, including the latest high speed switching, high current power, Zener and diffused junction mesa types. Also included are microdiodes, variable capacitors and photosensitive devices. Write on company letterhead to Allied Radio Corp., Dept. ED, 100 N. Western Ave., Chicago 80, Ill.

Connectors 179

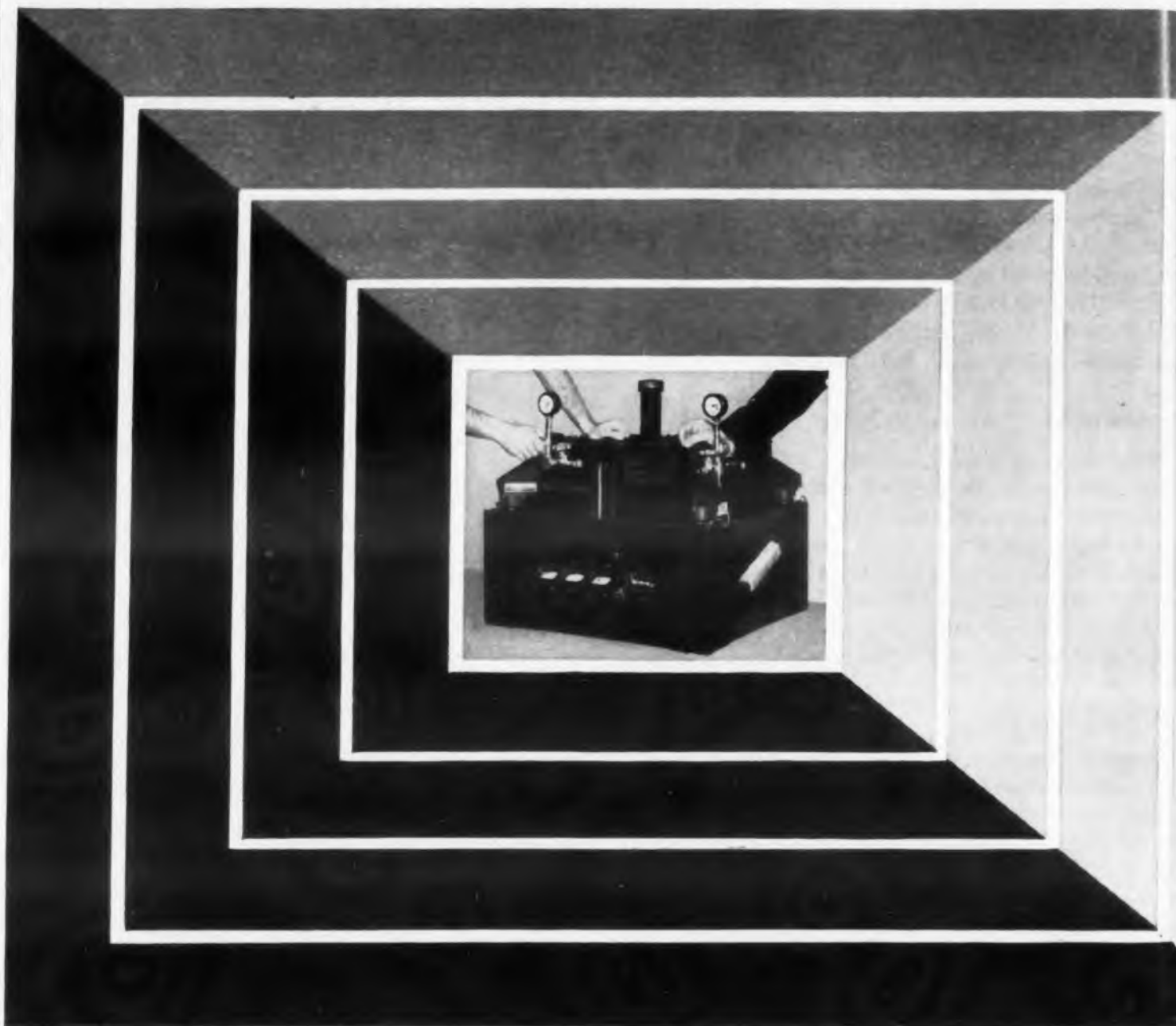
This two-color, four-page brochure is designed to aid in the selection of Amphenol AN/MS connectors (MIL-C-5015C and MIL-C-5015D). The reference shows available AN/MS insert contact arrangements and contains a quick reference for insert specifications. Schweber Electronics, 60 Herrington Rd., Mineola, L.I., N.Y.

Socket Screw Products 180

This eight-page bulletin describes the complete line of Unbrako standard socket screw products. It covers socket head cap screws, set screws, button heads, flat heads, shoulder screws and socket screw keys, as well as dowel pins, pressure plugs, and square head set screws. Configurations, sizes, materials, design features, and proper installation are charted for reference and comparison. Photographs, line drawings, cutaway views and microphotographs are included. Standard Pressed Steel Co., Box 202, Jenkintown, Pa.



THE RAW MATERIALS OF PROGRESS



VHF AMPLIFIER WEIGHT REDUCED

Dramatic results in miniaturization were achieved by The Martin Company on their airborne electronics equipment through use of FC-75 Dielectric Coolant by 3M.

The conventional amplifier, complete with power supply, weighed more than half a ton, required a standard 6 foot high relay rack for installation. Yet elaborate as this system was, it was still not immune to extreme temperature ranges, aircraft speeds and altitudes.

Then, non-corrosive 3M inert fluids were used to help

protect from internally generated heat using the evaporative cooling qualities of FC-75. The result: a new 2-stage VHF amplifier that weighs less than 200 pounds, occupies less than 3 cubic feet of space and operates under all extremes encountered.

Investigate the remarkable properties of 3M inert fluids in terms of your own product design, miniaturization and performance problems. 3M inert fluids are non-flammable, non-explosive, non-toxic and odorless, ideal as evaporative coolants and insulators.

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

... WHERE RESEARCH IS THE KEY TO TOMORROW



Frequency Meter

182

In one page this data sheet covers a heterodyne frequency meter designed to measure 100 to over 10,000 mc. The unit generates 500 to 900 mc and harmonics. A photograph and technical specifications are given. Polytechnic Research and Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y.

Magnetic Rectifier Controls

183

Bulletin MRC 658 describes a line of small and light magnetic rectifier controls for power and servo control applications. The units are applicable in systems ranging in power from a few watts to many kilowatts. Included in the bulletin are schematic diagrams and a description of the operation of many magnetic rectifier control applications. These include: half-wave rectified power supply, full-wave power supply, ac motor speed control system, ac servo drive, dc motor speed control, and three-phase ac to dc power control system. Fairfield Engineering Corp., 934 Hope St., Springdale, Conn.

Semiconductor Journal

The Lattice, a new semiconductor technical journal, is being published principally for use by design engineers interested in solid state devices. Issue No. 1 covers the Army's Micro-Module Program. The Lattice will be devoted entirely to the theory and practice of the semiconductor art. Within this broad field, various timely subjects will be presented in the future. Microelectronics and miniaturization is the topic for the first series of three issues. Write on company letterhead to: Tung-Sol Electric Inc., Dept. ED, Summer Ave., Newark 4, N.J.

Two-Circuit Journal

184

This two-page data sheet, No. 164, describes the 3MN series of 2-circuit switches for use on machine tool limit and control mechanisms. The snap-action switches have a median mechanical life of over 10 million operations at full overtravel. Three switches have a combined stacking width of only 2.03 in. Contact arrangement is single-pole two-circuit double-break. The data sheet has photographs, mounting dimension information, characteristics, complete electrical data and prices. Micro-Switch, A Division of Honeywell, Freeport, Ill.

Power Supply

185

Data sheet 3070, two pages, describes the Regatron model 2-212A power supply, a dual unit designed for transistor applications. Photographs, a graph, electrical specifications, dimensions, and prices are included. Electronic Measurements Co., Inc., Eatontown, N.J.



3M FLUORO-CHEMICAL FC-75 has a useful liquid range of -150°F. to 212°F. at atmospheric pressure, with a viscosity of 16 Centistokes at -90°F. 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 . . . excellent wetting power . . . compatible with materials commonly used in the construction of high temperature equipment . . . thermally stable to temperatures in excess of 750°F. and, even under extreme use conditions, does not form sludge or corrosive products. Heat capacities in liquid and vapor state are approximately equal.

BY 80%

See what 3M Chemicals can do for you! For free literature, write on your company letterhead, specifying product interest, to 3M Chemical Division, Dept. KAP-109, St. Paul 6, Minnesota.



3M CHEMICAL DIVISION, MANUFACTURERS OF:
Acids • Resins • Elastomers • Plastics • Oils,
Waxes and Greases • Dispersion Coatings
• Functional Fluorochemicals • Surfactants
and Inert Liquids

CIRCLE 181 ON READER-SERVICE CARD
ELECTRONIC DESIGN • October 28, 1959

NEW MICROWAVE LIMITER

*protects receivers
against overload
and burnout*

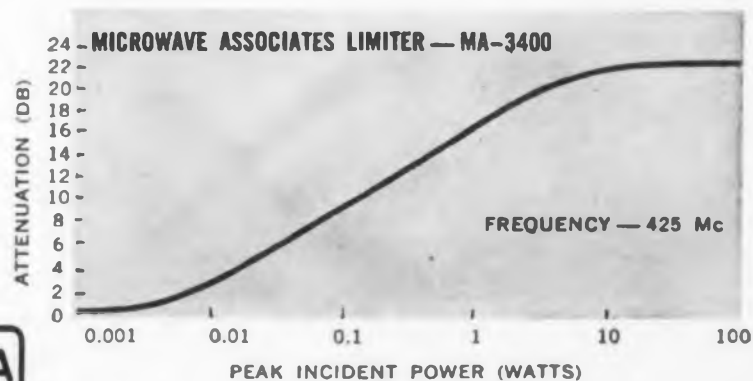
Another unique "first" from Microwave Associates, Inc., is this family of all-new solid state devices, which require no external bias and are self-limiting devices. It is the simplest way yet to give radar and communication receivers needed protection.

The specifications chart and performance curve below tell you all you need to know to evaluate its capabilities. The two models are typical of units which can be designed for your applications at other frequencies. The package has female Type N coaxial connectors, for input and output.

Today for UHF . . . tomorrow for higher frequencies.

SPECIFICATIONS

| | MA-3400 | MA-3401 |
|---------------------------|--------------|--------------|
| Frequency (center) | 425 \pm 5% | 600 \pm 5% |
| Low Level Insertion Loss | 0.3 db | 0.5 db |
| Peak Power | 400 watts | 200 watts |
| Duty Cycle | .002 | .002 |
| High Level Insertion Loss | 20 db | 20 db |



MICROWAVE ASSOCIATES, INC.

BURLINGTON, MASSACHUSETTS • Telephone: BRowing 2-3000

CIRCLE 186 ON READER-SERVICE CARD

Planning
your circuitry
is like child's play
with Alden
Basic Building Blocks



THE PLUG-IN COMPONENT IDEA...
part one of a continuing series

Alden plug-in components simplify engineering, cut layout time, and speed production. These basic building blocks help you move faster from idea right on through to completed equipment... beginning with planning and circuit layout.

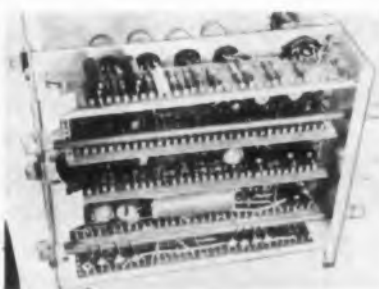
Take the Alden Terminal Card Mounting System, for example. Alden provides everything you need to make planning and layout slick... and quick: scaled layout sheets, pre-punched terminal cards, card mounting tube sockets, brackets, and tools — all available from stock.

It adds up to unit planes of circuitry, organized function by function, as complete sub-assemblies ready for packaging — like the one our engineer friend is holding in the picture.

It's all part of Alden's unique plug-in-component idea — a complete integrated system designed to make life easier for the design engineer — and definitely worth knowing more about. Watch for future ads. Or, if you're the impatient type, write now for Alden's 250-page handbook.

ALDEN

PRODUCTS COMPANY
10139 N. Main Street, Brockton, Mass.



THIS... Alden terminal card mounting — a servicing dream
NOT THIS... conventional wiring — a rat's nest — a servicing nightmare



NEW LITERATURE

Data Reduction

188

Data reduction and digital control systems are the subjects discussed in this 76-page handbook. The handbook covers the theory behind the firm's Digitizer, a shaft position encoder; Digitizer systems; input, processing and output components; accessories; and case histories of representative systems now in use in varied industries throughout the United States. Photographs, schematics and block diagrams are included. Coleman Electronics, Inc., 133 E. 162nd St., Gardena, Calif.

Pull-Push Switches

189

This data sheet, one-page, contains a dimensional drawing and complete technical data on two new 13/16-in. diameter pull-push switches for electronic and electrical applications. The type SK-1 unit has a 3 amp, 125 v rating with the operating force of 8 to 17 oz. Type SMK has a 1-amp, 125-v rating with a maximum operating force of 6 oz. Both switches are available in spst switching sequence only. Chicago Telephone Supply Corp., Elkhart, Ind.

Instrumentation Recorder

190

The firm's FR-600 instrumentation recorder which offers a frequency response of 250 kc in direct recording and to 20 kc in fm work, is described in this four-color, 10-page brochure. Full specifications and descriptions of accessories, optional equipment, and human engineering are included. Also provided are photographs. Amper Corp., Instrumentation Div., 934 Charter St., Redwood City, Calif.

Shock Mounting

191

Data sheet 149 explains and gives suggested approaches for low cost shock mounting of cathode ray, memory or data storage tubes within non-shock sensitive and non-retentive Netic Co-Netic magnetic shields. Photographs are included in this two-page data sheet. Magnetic Shield Division, Perfection Mica Co., 1322 No. Elston Ave., Chicago 22, Ill.

Silver-Zinc Batteries

192

Design details for over 20 manual and automatically activated silver-zinc primary batteries are given in this six-page illustrated brochure. The batteries are for one-shot single use installation in operational weapons systems. There are specification tables showing electrical performance, environmental capabilities, physical specifications, energy-to-weight ratios, and automatic activation times. Cook Batteries, Subsidiary of Telecomputing Corp., 3850 Olive St., Denver 7, Colo.

CIRCLE 193 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Capacitors

221

The six-page illustrated brochure contains listings of the company's commercial capacitors. Included are over 500 listings of twist-prong electrolytics in single, dual, triple and quadruple styles. Other capacitors include molded tubular and metal and cardboard case electrolytics for various applications. Astron Sales Corp., E. Newark, N.J.

Wiring Harnesses

222

"Key Points in the Design, Manufacture and Use of Wiring Harnesses," a 14-page booklet, offers practical hints for improving, stripping, tinning and soldering of cable wires. It suggests design procedures for facilitating in-the-instrument connecting operations and ways for the harness user to improve cable installations. Line drawings illustrate techniques. Methods, Inc., 12 Bland Ave., Emerson, N.J.

Vibration Interferometer

223

Designed for precise checking and calibration of accelerometers, the vibration interferometer is the subject of two-page bulletin 204-59. Applications, product features, description and specifications are given. Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.

Voltage-Tunable Magnetrons

224

Bulletin PT-1, 26 pages, describes the firm's four new S-band packaged voltage-tunable magnetrons. Illustrated with photos, diagrams and charts, the manual includes data on design, typical applications, operation and manufacturing. General Electric Co., Schenectady 5, N.Y.

Pressure Pickup

225

Bulletin 1620, two pages, describes a pressure pickup capable of absolute and gage measurements to 10,000 psi. In addition to sections on design features and specifications, a schematic drawing and a wiring diagram are included. Consolidated Electrodynamics, 360 Sierra Madre Villa, Pasadena, Calif.

Synchros

226

This illustrated 170-page catalog of synchros, servo motors, servo amplifiers, resolvers, rate gyros, and potentiometers contains specifications and outline drawings of 200 units. Included are details on synchros manufactured to the latest MIL specifications. United Aircraft Corp., Norden Div., Commack, L.I., N.Y.

CIRCLE 193 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Now MICRO-MINIATURE SENSITIVE RELAYS

by Iron Fireman



Sensitivity down to 25 mw.

The sensitivity ratings, vibration and shock immunities shown above are achieved for the first time in a micro-miniature package.

Where only limited power is available, the Iron Fireman R800 offers sensitivities as low as 25 MW of unpolarized exciting power and a high degree of reliability and environmental immunities.

Conforming to and exceeding the test requirements of MIL-R5757C, the performance and reliability of this relay is further enhanced by separately sealing the coils within the outer shell.

Complete performance data available on request. Write to the address below.

When space, weight and sensitivity are a problem specify the Iron Fireman R800 Relay



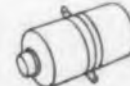
MICRO. MIN. RELAYS



HIGH SPEED RELAYS



SLIP RINGS & BRUSHES



FREE AND VERTICAL GYROS



IRON FIREMAN *Electronics* DIVISION

2838 S. E. NINTH AVENUE, PORTLAND 2, OREGON

CIRCLE 227 ON READER-SERVICE CARD

NEW LITERATURE

Filters 228

A line of high, low, bandpass and telemetering filters in custom or standard designs are described in two-page sheet 601. Dimensions, electrical characteristics, and special features are provided. Control Electronics Co., Inc., 10 Stepar Place, Huntington Sta., N.Y.

Transistor Amplifiers 229

Miniature transistor amplifiers are illustrated and described in six-page bulletin 59 25M. Electrical, physical, and dimensional specifications are given on 13 types of amplifiers as well as a miniature pressure transducer. Taber Instrument Corp., Electronics Div., 107 Goundry St., N. Tonawanda, N.Y.

Magnetic Amplifier 230

Bulletin M-62, two pages, describes a high-sensitivity dc magnetic amplifier. Illustrations of the unit, transfer characteristics, a schematic diagram, and electrical, mechanical, and dimensional specifications are given. Airpax Electronics Inc., Seminole Div., Fort Lauderdale, Fla.

Silicon Transistors 231

Five new silicon transistors are described in this two-page bulletin. Electrical and physical specifications, illustrations and a table of operating characteristics of the firm's silicon transistors are provided. Transatron Electronic Corp., 168-182 Albion St., Wakefield, Mass.

Semiconductor Directory 232

Over 2100 types of transistors, diodes and rectifiers produced by 16 manufacturers are listed in this semiconductor directory. Stock numbers, manufacturers and prices are given. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Analog Computer 233

A transistorized, desk-top analog computer is illustrated and described in 10-page bulletin AC934. Problem illustrations, component specifications, and a physical description are given. Electronic Associates, Inc., Long Branch, N.J.



John A. Hickey, Industrial Products Manager, discusses new Raytheon PF Transformer line with William P. Sharpe, Product Planning Manager.

Now Locally Stocked...

RAYTHEON'S NEW PF LINE

*New constant voltage plate-filament power transformers
now available at Raytheon Distributors*

These new Raytheon stabilizing transformers provide constant voltage better than $\pm 3\%$. They prolong tube life and improve reliability and performance of electronic equipment. Often eliminate need for other voltage-regulating components. Also serve as effective "first-stage" regulators ahead of other voltage-stabilizing circuits. What's more, these new Raytheon-manufactured Transformers eliminate the need to match capacitors to the transformers when replacements are made.

Back-up Stock — Ask your nearest Raytheon Distributor to inventory your electronic components needs. He'll carry a complete back-up stock. Ray-

theon engineers are at his service to help solve your applications problems, too.

Single Source — Whatever electronic components you need, your local Raytheon Industrial Products Distributor can supply them. Electronic tubes, semiconductors, voltage regulators, knobs and hardware. And, A COMPLETE LINE OF STABILIZING PLATE AND FILAMENT TRANSFORMERS.

If you don't know your nearest Raytheon Industrial Electronics Distributor, write to John Hickey, Industrial Products Manager, who will be glad to give you his name or have him call you.



RAYTHEON COMPANY • DISTRIBUTOR PRODUCTS DIVISION



Raytheon Distributors
Serving Key Markets
Include:

Baltimore, Md.
Wholesale Radio Parts Company

Birmingham, Ala.
Forbes Distributing Company

Boston, Mass.
DeMambo Radio Supply Company
Lafayette Radio

Chubbuck, Cal.
Valley Electronic Supply Company

Chicago, Ill.
Newark Electric Company

Cleveland, Ohio
Main Line Cleveland, Inc.
Pioneer Electronic Supply Corporation

Columbus, Ohio
Srepco, Inc.

Denver, Colo.
Ward Terry & Company

Detroit, Mich.
Ferguson Electronic Supply Company

Englewood, Cal.
Newark Electric Company

Kansas City, Mo.
Burstein-Applebee Company

Knoxville, Tenn.
Bondurant Bros. Company

Los Angeles, Cal.
Kierulff Electronics Corporation

Milwaukee, Wis.
Electronic Expeditors, Inc.

Mobile, Ala.
Forbes Electronic Distributors, Inc.

New York City
Arrow Electronics, Inc.
H. L. Dalis, Inc.
Milo Electronics Corporation

Oakland, Cal.
Elmar Electronics

Philadelphia, Pa.
Almo Radio Company

Phoenix, Ariz.
Radio Specialties & Appliance Corporation

Portland, Ore.
Lou Johnson Company

Tampa, Fla.
Thurrow Distributors

Tulsa, Okla.
S & S Radio Supply

Washington, D. C.
Electronic Wholesalers, Inc.

This is a partial listing only.

Names of other Raytheon Industrial Distributors
on request from John Hickey, Raytheon Distributor
Products Division, Westwood, Mass.



Stored Program Educational Computer 235

Catalog S 1, 14 pages, describes a general purpose stored program digital computer and digital differential analyzer plus a logical design implementer. Specifications, operation codes, a block diagram, and physical components are included. Computer Control Co., Inc., 2251 Barry Ave., Los Angeles 64, Calif.

Selenium Rectifiers 236

This 27-page booklet, ECG-402, contains basic information on junction rectifiers, capacitive loading, purposes of capacitance in the load, how to boost the output voltage, and the effect of capacitance on voltage regulation. Included are test specifications for selenium rectifiers, frequency characteristics, and protective finishes. General Electric Co., Semiconductor Products Dept., Liverpool, N.Y.

Ferrites 237

The "Ferrite Selector," 20 pages, contains characteristics, physical properties, and applications for over 37 types of ferrites distributed by the firm. Technical information includes saturation magnetization, Curie temperature, resistivity, dielectric coefficient, and line width. The key features of each material are described in relation to microwave applications. Ferromagnetic Distributors, 15015 Ventura Blvd., Sherman Oaks, Calif.

Pulse Height Analyzer 238

A 100-channel pulse height analyzer with 20-channel storage, model PHA-120 is discussed in bulletin 3021-9. The four-page brochure illustrates the equipment, gives a block schematic diagram, and describes such applications as fall-out studies, whole-body counting, and background studies. Specification data and performance figures also appear. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Coaxial Attenuators 239

Four-page illustrated bulletin 17R describes 1 to 12.4 kmc fixed coaxial attenuators. Electrical, physical, and dimensional specifications are given, as well as vswr vs. frequency, and frequency sensitivity of insertion loss graphs. These attenuators are used in all applications requiring isolation between rf component and in the extension of the ranges of power meters. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.



UNIQUE ELECTRICAL PRODUCT



DESIGN IDEAS OFTEN BEGIN



WITH THESE VERSATILE



STACKPOLE SWITCHES!

Get This GUIDE TO MODERN SWITCHING

Ask for 8-page Switch Bulletin RC-11D
World's largest slide switch line—over 12 low cost standard types—dozens of economical adaptations. NEW colored knobs. Special conventional and miniaturized switches designed and produced for large quantity users. Electronic Components Division, STACKPOLE CARBON COMPANY, St. Marys, Pa.



CIRCLE 240 ON READER-SERVICE CARD

CIRCULATORS

Basically, the Rantec circulator is a non-reciprocal hybrid junction with three or more ports. Non-basically, the circulator is finding more and more use in advanced radar and microwave systems. In addition, Rantec research and development has led to many other sophisticated "active" and "passive" microwave ferrite components. Your inquiry is welcomed.

ran-tec corporation • calabasas, california



CIRCLE 241 ON READER-SERVICE CARD

Now from CMC— SOLID STATE DCU's



1 mc and 220 kc

Computer Measurements Company's high reliability transistorized DCU's are ideally suited to industrial and weapons system applications.

Models 100T (0-220 kc) and 111T (1 mc) measure 1" W x 4 3/8" H x 3 1/4" D and weigh only 6 ounces. Power requirements are -18 v at 170 ma, -6 v at 2 ma. Direct reading from 0 to 9 with either vertical numeral panels or Nixie readout, these units may be connected in cascade to obtain any total count required. 1-2-2-4 binary coded decimal output is available to drive digital recorders, etc. Model 100T — \$130.00; 111T — \$175.00. Quantity discounts and special OEM prices on request.

CMC solid state DCU's are part of the most complete line of decade counting units available from one source. Write for DCU catalog Dept. 1910-A.

CMC

**Computer
Measurements Co.**

A Division of Pacific Industries, Inc.
12970 Bradley Avenue
Sylmar, California

CIRCLE 242 ON READER-SERVICE CARD

NEW LITERATURE

Selenium Rectifiers

243

Brochure EGG-344, 24 pages, describes a step-by-step method for selecting specific selenium rectifiers for circuit applications. Its three sections cover basic selenium rectifier information, a product description of the rectifiers, and the method used in selection of the right rectifier. Work sheets, charts, graphs and nomographs are also included. General Electric Co., Semiconductor Products Dept., Syracuse, N.Y.

Code Bar Switches

244

Four-page bulletin CBS 1 describes features and specifications of code bar switches designed to meet the need for keyboard switches featuring direct binary-coded outputs. A cutaway drawing shows the operating principle. Three models are covered. Computer Control Co., Inc., 2251 Barry Ave., Los Angeles 64, Calif.

Printed Circuit Boards

"Quality Control Manual for Printed Circuit Boards and Board Assemblies," a U. S. Air Force approved publication, deals with various phases of standardization, purchasing, government inspection, in process inspection, final inspection, and other allied material. Prepared in outline form, the 36-page manual contains the requirements for the establishment and maintenance of an inspection system. Write on company letterhead to the Bureau of Engraving, Inc., Industrial Div., Dept. ED, 500 S. Fourth St., Minneapolis 15, Minn.

Transformers

245

Catalog TR-60 lists the firm's line of transformers. Over 1000 items and several new lines, including microminiature transformers and transformers for transistor applications appear in the book. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Speed Changers

246

Bulletin 96 discusses applications and benefits of miniature adjustable ratio speed changers, which are continuously adjustable over a 25:1 range. Torque, speed, hp, and ratio ratings in addition to five different speed controls are also described in the two-page illustrated bulletin. Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Sine Wave and Square Wave OSCILLATOR



- ★ 20 to 500,000 cycles in five ranges
 - ★ Changes in minutes to sweep oscillator with addition of G-R Dial Drive
 - ★ Two sine-wave outputs: 0-7v at 50Ω; 0-45v at 12.5 kΩ
 - ★ Output constant within ±1 db over four lower ranges
 - ★ Square waves: 0-30v peak-to-peak, 1/3 μs rise time
 - ★ 0-50 db calibrated output control
 - ★ Fast responding AVC system
 - ★ Inexpensive
- Type 1210-C Unit R-C Oscillator, \$180.
Type 1203-B Unit Power Supply recommended, \$40.

Write For Complete Information

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

Broad Avenue at Linden, Ridgely, N. J. NEW YORK AREA 1000 N. Seward St. LOS ANGELES 21
8055 13th St., Silver Spring, Md. WASHINGTON, D. C. 1150 York Road, Abington, Pa. PHILADELPHIA
1186 Los Altos Ave., Los Altos, Calif. SAN FRANCISCO 6605 W. North Ave., Oak Park, Ill. CHICAGO

In CANADA: 99 Floral Parkway, TORONTO 15

CIRCLE 247 ON READER-SERVICE CARD

Type W, Impulse-Latching Relay

Insulated rocker arm is activated by a single coil, instead of two. Ideal for machine controls, appliances, positioning devices and other applications where opposite switching is desired each time circuit is pulsed. Contact combinations up to 4 "C". AC or DC.



2 of the many

COMAR RELAYS

designed to solve your relay problems



Type M, General-Purpose Relay

Suitable for a multitude of light duty applications. Compact size, lightweight. Good wipe and positive contact pressure. Contact combinations up to 3 "C". Available open, or in plastic dust covers with plug-in feature. AC or DC.

COMAR

ELECTRIC COMPANY
3349 ADDISON ST., CHICAGO 18, ILLINOIS

RELAYS • SOLENOIDS • COILS • SWITCHES • HERMETIC SEALING

CIRCLE 248 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1958

Magnetic Recording Heads 249

This illustrated four-page brochure and its data sheets give specifications, outline dimensions and general information on the firm's magnetic tape and drum heads. Also included are design sheets with spaces for electrical and mechanical parameters to aid in the design of a tape or drum head to customer specifications. General Transistor Western Corp., Magne-Head Div., 2660-64 S. La Cienega Blvd., Los Angeles 34, Calif.

Molded Plastic Fasteners 250

Screws, nuts, washers, insulators and bushings are discussed in this six-page bulletin on nylon products. The full range of sizes by types and quantity prices for easy ordering are given. Richco Plastic Co., 4445 W. Fullerton Ave., Chicago 39, Ill.

Transistor Plug-ins 251

Detailed physical and electrical specifications of transistorized plug-in units for digital systems appear in catalog PI-79. The flip-flop, amplifier, gating, buffering and other packages are described in this illustrated brochure. Core memory selection, signal circuits, and encoding and decoding networks are also discussed. A five-page addendum describes design criteria and systems applications. Digitronics Corp., Dykor Components Div., Albertson, L.I., N.Y.

Analog Computer 252

Tech Notes No. 1 explains "How to Simulate a Non-Linear Control System with an Analog Computer." Diagrams of a typical control system and plots showing response of the system at various points with different parameters are included in the four-page publication. Donner Scientific Co., 888 Galindo Rd., Concord, Calif.

Video Switching System 253

This system, used in industrial closed-circuit television circuits to switch a number of television cameras to any of a number of viewing monitors, is described in data sheet 6-99. Detailed specifications of each of the individual modular sections of the system are given. To facilitate application of the AVS-X system, a typical installation consisting of two cameras and five monitors is shown in simplified form. Also diagrammed in the bulletin is the schematic layout of the AVS-X for the same system, showing number and location of modules, relays, and amplifiers. Cohu Electronics, Kin Tel Div., 5725 Kearny Villa Rd., San Diego 12, Calif.

How plastic laminates behave at high temperatures



"How high is up?" to quote an old riddle, just about describes the high temperature possibilities of plastic laminates.

To a missile expert a high temperature might be in excess of 5000°F or of 20,000°F. To many of us high could mean 180°C, or over 250°C.

The key to the situation is Temperature Endurance. Where high temperature resistance is required, as in missile applications, the useful life of the part may be a matter of seconds. Under these conditions recent experiments show that reinforced organic plastics can compete with refractory metals and ceramics. And there are indications that the "old reliable" phenolic resin laminates might outshine the newer resins in this respect.

All of this is exciting yet the larger need is for plastic laminates which will endure moderately elevated temperatures for a

long time. The A.I.E.E. defines Class H and Class C materials as those which "by experience or accepted tests" can be shown to be capable of operation at temperatures of 180°C or 220°C respectively.

Tests of 7 standard grades of plastic laminates were made by members of the Laminated Products Section of N.E.M.A. (Table 1).

Obviously, Grades XX and LE are not 180°C material. Grade XXXP has excellent electrical properties after exposure. Grades G-5 and G-7 have excellent mechanical properties and good electrical properties.

Similar tests were made on 4 standard grades at 250°C with these results:

Table 2
Properties at 250°C after 1000 hours exposure to 250°C

| Grade | Flexural Strength | Dielectric Strength | |
|-------|-------------------|---------------------|----------|
| | | Perpendicular | Parallel |
| AA | 800 | 50 | 54 |
| G-5 | 1900 | 108 | 77 |
| G-7 | 11800 | 211 | 250 |
| G-10 | not tested | 112 | 100 |

These same materials often are satisfactory at temperatures in excess of 5000°F for a number of seconds required in these types of applications.

Just as the tests hold great promise for the future of laminated plastics in the very high temperature field, so do the

tests in the moderately elevated temperature applications demonstrate the remarkable endurance of plastic laminates.

Consider Other Properties

The thermal resistance and thermal endurance of laminates such as Synthane must be viewed in relation to other properties. Commercial applications include toasters, ironers, space heaters, water heaters, welding equipment, motors, generators, circuit breakers, electric furnaces and ovens, jet engines. These applications may require also resistance to moisture, chemicals, wear, ageing; ease of fabrication, mechanical strength, light weight. Since the life of a laminate in a heat environment may be affected by conditions not present during actual tests, special test procedures may have to be established. Synthane Corporation will be very happy to help you find a laminate suitable for your temperature-life problem. Write Synthane Corporation, 42 River Road, Oaks, Pa.

SYNTHANE
CORPORATION, OAKS, PENNA.

Laminated Plastics for Industry

Sheets, Rods, Tubes, Fabricated Parts
Molded-laminated, Molded-macerated

Table 1
Properties at 180°C after 1000 hours exposure to 180°C

| Grade | Flexural Strength | Dielectric Strength | |
|-------|-------------------|---------------------|----------|
| | | Perpendicular | Parallel |
| | psi | V.P.M. | V.P.M. |
| XX | 5600 | * | 170 |
| XXXP | 4100 | 530 | 250 |
| LE | 400 | * | * |
| AA | 5400 | 55 | 76 |
| G-5 | 17500 | 112 | 143 |
| G-7 | 18700 | 290 | 200 |
| G-10 | 5200 | 160 | 178 |

*Specimens blistered

We are now delivering for
Commutation - Thermocouples - Strain Gages

DIFFERENTIAL WIDE BAND D-C AMPLIFIER

Model 2340



STANDARD FEATURES

0-7500 c.p.s. Bandwidth.
300 Microseconds Settling Time
(To within 0.1% of final Output).
Common-Mode Signals can be as high as the
117 v. 60 c.p.s. Power Line.
Fully Floating Input and Output.
No Ground Connection Between Input and
Output.
Voltage Gains from 25 to 1000.
100,000 ohms Input Impedance.
20 ohms Output Impedance.
 ± 10 v. Output into 1000 ohm Load.
D-C Common-Mode Rejection Essentially
Infinite.

SPECIAL FEATURES

Readily available at additional cost.

OVERLOAD PREVENTION
for Commutation Systems.

DUAL-MODEL SWITCH
Gives full 30 k.c. Bandwidth and ± 50 v.,
 ± 40 ma Output in "Single-Ended" position.

ADJUSTABLE PASSBAND
CONTINUOUSLY VARIABLE GAIN
SPECIAL GAIN STEPS
HIGHER INPUT IMPEDANCE
CALIBRATION POTENTIOMETERS
ON EACH GAIN STEP

OVER 3,000,000 TO 1 COMMON-MODE REJECTION
AT 60 C.P.S. WITH 1000 OHMS LINE UNBALANCE

Without Balance Controls

| INSTRUMENT | PRICE (f.o.b. South Pasadena) | DIMENSIONS |
|------------------------------|-------------------------------|---|
| Model 2340 D-C Amplifier | \$825.00 | 3 $\frac{3}{8}$ " w. 10" h. 16 $\frac{3}{4}$ " d. |
| Model 2455 5-Channel Cabinet | \$250.00 | (19" rack) 8 $\frac{3}{4}$ " h. 20 $\frac{3}{4}$ " d. |
| Model 2673 1-Channel Cabinet | \$125.00 | 6 $\frac{5}{8}$ " w. 8 $\frac{7}{8}$ " h. 20 $\frac{3}{4}$ " d. |

DYNAMICS

INSTRUMENTATION COMPANY

A CALIFORNIA CORPORATION

1118 MISSION STREET, SOUTH PASADENA, CALIFORNIA • MURRAY 2-3318

In addition to Differential D-C Amplifiers, we invite inquiries concerning our other
D-C Amplifiers, Electronic Filters, wideband A-C Amplifiers, and our 100 Megohm
Transistor D-C Microvoltmeter.

NEW LITERATURE

Panel Switches 256

Switches for computers, office machinery, machine tool control and instrument panels are covered in bulletin 55. Characteristics, dimensional details and ordering information are included in the illustrated brochure. Electrosnap Corp., 4218 W. Lake St., Chicago 24, Ill.

Flow Regulators 257

Bulletin A-200, two pages, covers the inline type pressure compensated hydraulic flow regulator valves. Operation, performance standards, and ordering information are given. Waterman Engineering Co., P.O. Box 391, Evanston, Ill.

Special Purpose Tubes 258

High vacuum relays, vidicon camera tubes, and the firm's research and production facilities are described and illustrated in this four-page bulletin. Resitron Labs, Inc., 2908 Nebraska Ave., Santa Monica, Calif.

Heavy-Duty Counters 259

A line of heavy-duty counters for indication, recording, and automatic regulation of material flow is described in four-page bulletin O159. Illustrated with 13 photographs, the bulletin covers mechanically actuated counters, electrically impeded counters for remote indication and control, and solenoid-operated models. Richardson Scale Co., Clifton, N.J.

DC Amplifier 260

This two-page data sheet describes the firm's high performance dc operational amplifier for military applications. Illustrated with a photo and dimensional diagrams, the data sheet discusses such characteristics as power requirements, dimensions, weight, and output capability. George A. Philbrick Researches, Inc., 285 Columbus Ave., Boston 16, Mass.

Computers 261

Research in thin magnetic films, data recording and storage, and cryogenic electronics is discussed in this 20-page, illustrated bulletin on aircraft, missile, and space vehicle computers. Polaris computers, hybrid digital computers for AEW systems, and the firm's variable increment computer are covered. Automated production processes involved are shown in photos. General Electric Co., 600 Main St., Johnson City, N.Y.



- a wide range of standard sizes
- colored tubing and special sizes
- a wide range of wall thicknesses
- prompt deliveries of

**SPAGHETTI TUBING
MADE FROM**

TEFLON

by Pennsylvania Fluorocarbon

To obtain outstanding results from sheathing for wires, slip-on insulation and bushings, use the unique electrical properties of spaghetti tubing made from Teflon plus the outstanding engineering and manufacturing techniques developed by Pennsylvania Fluorocarbon.

The unique electrical properties of spaghetti tubing made from Teflon include: good dielectric strength (1000-2000 volts/mil); lowest dielectric constant (2.0) and dissipation factor (0.0002) of any solid dielectric; no change of electrical properties with temperature (-25°C. to +250°C.), or frequency (60 cycles to 100 mc.); unaffected by moisture. In addition, PF Teflon is not harmed by the hot soldering iron so assembly work is speeded up considerably.

The outstanding engineering and manufacturing techniques developed by Pennsylvania Fluorocarbon include: the tailoring of Teflon with colors for identification or with modifications for improved texture and mechanical properties; stress relieving spaghetti tubing for minimum shrinkage; cleaning and 100% inspection; the manufacture of a wide range of wall thicknesses and special sizes.

Write, wire or call and let us quote on your requirements. We can provide overnight delivery of standard sizes and many special sizes at competitive prices.

**PENNSYLVANIA
FLUOROCARBON CO., INC.**

1115 N. 38th Street, Phila. 4, Pa.
EVergreen 6-0603 TWX: PH 252

*DuPont registered trademark

CIRCLE 255 ON READER-SERVICE CARD

CIRCLE 262 ON READER-SERVICE CARD

NEW!

Engraved
Deep-Kut*
Perma-Grip
Peg Stamps
give you
fully
aligned
printing
impressions
every time!



VINYLLITE
Acid-Resistant
Stamps.

characters are
locked into
wooden pegs
...can't come off!

Made only by Kregel Mfg.
Co., Inc., Perma-Grip Peg Stamps
with DEEP-KUT dies
give you clear, clean,
sharp markings every time.
Each set of peg stamps
contains all the letters in
the alphabet plus all the
numbers 0 to 9.

| | |
|------|--------|
| 1/16 | ABC123 |
| 3/32 | ABC123 |
| 1/8 | ABC123 |
| 5/32 | ABC123 |
| 3/16 | ABC12 |
| 1/4 | A B C |

Complete set
of alphabet and
figures in any of
the 6 sizes shown.

\$15⁹⁵

KRENGEL

MANUFACTURING CO., INC.

227 Fulton St. - New York 7, N. Y.
COrtlandt 7-5712

Tantalum Capacitors

264

The 15 types of solid, foil and sintered anode tantalum capacitors are discussed in catalog 9-169, 16 pages. A table with over 600 listings arranged by microfarad and voltage ratings is included. Mallory Capacitor Co., Indianapolis 6, Ind.

Krypton Isotope

265

Krypton 85, a radioactive isotope of the rare, inert gas krypton, is discussed in four-page catalog 345A. The firm uses trace quantities of this radioisotope in gas-filled electronic tubes requiring free electrons. Catalog 345A answers such questions as: What is Krypton 85? Where is it used? How can it be obtained? Why are free electrons necessary to start gas-filled tubes? Air Reduction Sales Co., 150 E. 42 St., New York 17, N.Y.

Sealed Relays

266

Bulletin GEA-6628, 24 pages, describes hermetically sealed microminiature, subminiature, miniature, and high-speed relays for military and general purpose applications. Photographs, circuit diagrams, coil data, and specifications are provided. General Electric Co., Schenectady 5, N.Y.

Toroidal Signal Transformer

267

This data sheet discusses a miniature, toroidal signal transformer designed for low-level applications. Dimensional drawings, specifications and ordering information are given, in addition to a description of toroidal design. Arnold Magnetics Corp., 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

Print and Plot Scaler

268

Two-page bulletin 3027-9 outlines the features of the firm's print and plot scaler, which is designed for accurate digital and analog readout of spectrographic equipment. Applications, specifications and performance data are included in the illustrated bulletin. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Autographic Plotters

269

Multichannel autographic plotters are featured in bulletin PG-100. Application data and specifications on the modular plotter, the segmental recorder and scanner plotter, and the standard, high speed, and extra high speed strain gage plotters are included. Gilmore Industries, Inc., 13015 Woodland Ave., Cleveland 20, Ohio.

LEFT: STUD 7/16-11/16

CENTER: AXIAL LEAD TOP HAT

RIGHT: STUD INSULATED

COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS
COLUMBUS ELECTRONICS CORPORATION
DOUBLE DIFFUSED SILICON RECTIFIERS



Now ... an extensive line of
high performance, hermetically sealed,
silicon power rectifiers UP TO 35 AMPS.
JEDEC types exceeding MIL specifications.

NEW

SINGLE unit VERY HIGH
VOLTAGE silicon rectifiers ex-
hibiting these desirable char-
acteristics ...

HIGH
VOLTAGE
up to 2000 PIV

LOW
FORWARD DROP
1.5 Volts, DC

EXTREMELY
LOW LEAKAGE
1 μ A

FORWARD
CURRENT
up to 20 Amps.

NEW

INSULATED STUD silicon recti-
fiers offering these quality
features ...

- Simplify mounting
- Save assembly parts & costs
- Obtain efficient heat transfer
- Give greater design flexibility

AVAILABLE UP TO 10 AMPS
PER UNIT AND UP TO 2000
VOLTS PIV.

WRITE FOR FULL DETAILS

COLUMBUS ELECTRONICS CORP.

1010 SAW MILL RIVER RD., YONKERS, N. Y.
YOnkers 8-1221 • TWX-Yonkers, NY-1369

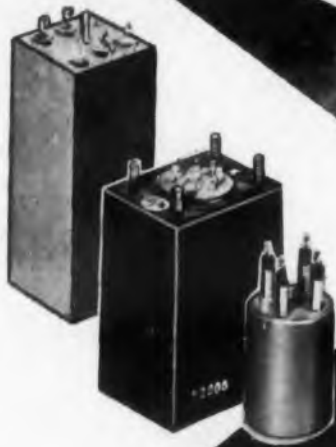
CIRCLE 263 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

CIRCLE 270 ON READER-SERVICE CARD

PRECISION - RELIABILITY - QUALITY

- FILTER NETWORKS
- MAGNETIC AMPLIFIERS
- TRANSFORMERS
(Pulse, Audio, Power)



custom made to MIL
and industrial specifications

keystone PRODUCTS COMPANY

904-6 TWENTY-THIRD STREET UNION CITY, NEW JERSEY
UNION 6-5400

CIRCLE 271 ON READER-SERVICE CARD



SAMPLE...PROTO-TYPE INSTRUMENTS

Available from this department within one week ARO, or sooner, if necessary, for small quantities.

The men in this department are highly skilled instrument technicians using the best standards and equipment available.

Phone or wire Sun Electric Corporation, Instrument Division, Collect for your immediate requirements of either standard or military types of panel meters.

Phone—Newcastle 1-6000 XT293,306 • TWX—CG 2341 • FAX—Chicago, Ill.

Sun ELECTRIC CORPORATION

HARLEM AND AVONDALE • CHICAGO 31, ILLINOIS, U.S.A.
INSTRUMENT DIVISION

CIRCLE 272 ON READER-SERVICE CARD

NEW LITERATURE

Solderless Wiring Devices 273

Solderless wiring terminals are illustrated and described in this four-page brochure. Five barrel styles are given, including insulated, non-insulated and vibrationproof styles. ETC Inc., 990 E. 67 St., Cleveland 3, Ohio.

Tantalum Capacitors 274

The firm's complete line of tantalum capacitors is described in 15-page brochure 9-169. Included are electrical and dimensional specifications on components having capacitances from 0.25 to 1300 μ f. Dimensional and cut-away diagrams are also provided. Mallory Capacitor Co., Indianapolis 6, Ind.

Ultrasonic Cleaning 275

The "Ultrasonic Cleaning Primer," 12 pages, describes ultrasonic cleaning, how it works, areas in which it can be used, and various solvents and detergents available for use with this type of equipment. National Ultrasonic Corp., 111 Montgomery Ave., Irvington 11, N.J.

Linear Transformers 276

Eight-page bulletin 1201-A provides notes on basic design of control systems using linear differential transformers as ac transducers with ac or dc outputs. Topics covered include simple circuits, mountings, and shielding. Minatron Corp., One Cliveden St., Belle Mead, N.J.

Centrifugal Blowers 277

This 12-page catalog describes and illustrates the firm's line of centrifugal blowers. Included are 54 flow charts, electrical specs and dimensions on blowers with free air ratings from 18 to 270 cfm. Air-Marine Motors, Inc., 369 Bayview Ave., Amityville, N.Y.

Brazing Alloys 278

Vacuum-tube grade brazing alloys are described in four-page bulletin 25. Included is information on temperature and composition of these brazing alloys, their brazing characteristics and their impurity values. These alloys are used in klystron and magnetron tubes. Handy & Harmon, 82 Fulton St., New York 38, N.Y.



CIRCLE 279 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

Solder Joint Reliability 280

This brochure is a four-page illustrated comprehensive report on a method of improving electronic equipment reliability through planned solder joint checks. Dressen-Barnes Corp., 250 N. Vinedo Ave., Pasadena, Calif.

Relays

Catalog No. 259, 20 pages, illustrates and describes a complete line of hermetically sealed balanced rotary-type relays. Electrical, physical, and mechanical specifications are provided, as well as dimensional diagrams. Write on company letterhead to Hi-G, Inc., Dept. ED, Bradley Field, Windsor Locks, Conn.

Galvanometer 281

Electrical and physical specifications and a complete description of an electronic galvanometer are given in two-page bulletin 14-10. Applications, a circuit diagram, and illustrations of the unit are also provided. Kin Tel Div. of Cohu Electronics, Inc., 5725 Kearny Villa Rd., San Diego 12, Calif.

Control Instrumentation 282

Bulletin A-913, eight pages, serves as a guide to electronic control instrumentation. The firm's Autronic control equipment is illustrated and described. A chart illustrates the major system components. Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

Encoders 283

Four-page bulletin 312-A illustrates and describes the firm's shaft position encoders. Basic design, mechanical and electrical design considerations, scanning rates, and coding are discussed in detail. A scanning circuit and a translator circuit are also given. Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.

Microwave Power Supply 284

A universal power supply which powers and modulates backward wave oscillators, backward wave amplifiers, voltage tuned magnetrons, and traveling wave amplifiers is described in this two-page bulletin. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y.

American Beauty...an iron for every Soldering Job

Whatever your soldering problem, American Beauty has the right iron for your particular job. The finest engineering, best materials and on-the-job experience since 1894 is yours with EVERY American Beauty.

There is a right model, correct tip size ($\frac{1}{4}$ " to $1\frac{1}{8}$ ") and proper watt-input (30 to 550 watts) to do any soldering job. Ask about which iron will do your job best. American Beauty electric soldering irons are the highest quality made.

ILLUSTRATED IS
CATALOG NO. 3125
 $\frac{1}{4}$ " TIP SIZE, 60 WATTS

TEMPERATURE REGULATING STANDS
Automatic devices for controlling tip-temperature while iron is at rest—prevent overheating of iron, eliminate frequent re-tinning of tip, while maintaining any desired temperature. Available with heavy-gauge perforated steel guard—protects user's hand.



YOU CAN'T BEAT A SOLDERED CONNECTION

WRITE FOR 26-PAGE ILLUSTRATED CATALOG CONTAINING FULL INFORMATION ON OUR COMPLETE LINE OF ELECTRIC SOLDERING IRONS—INCLUDING THEIR USE AND CARE.

AMERICAN ELECTRICAL HEATER COMPANY

DETROIT 2, MICHIGAN

CIRCLE 286 ON READER-SERVICE CARD

ANOTHER FIRST...



THE ONLY *Electro-Reliable* A.C. TIMING MOTOR

Thinner... Quieter...
More Reliable... More Versatile

FINGER-THIN...

Only $\frac{9}{16}$ Inches Short... Only $\frac{1}{4}$ Inches in Diameter... very compact... reduces the size of your equipment.

WHISPER-QUIET...

Strictly an electrical motor... practically noiseless... no rattling of gears or ratchets.

HIGH TORQUE...

$\frac{1}{4}$ oz. inch at the rotor with an instantaneous start and stop... requires only $2\frac{1}{2}$ watts... can replace larger motors in recorders, controls and telemetering equipment.

HIGHEST RELIABILITY...

Longer life... no one-way gears or ratchets to fail... provides millions of operations without any trouble.

Send for Special Illustrated
Bulletin AWH MO-806

© 1959



The **A.W. HAYDON Company**

227 NORTH ELM STREET
WATERBURY 20, CONNECTICUT

Custom Design & Manufacture of Electronic
And Electro-Mechanical Timing Devices

CIRCLE 285 ON READER-SERVICE CARD

SPECIFICATIONS

Standard Voltage Ratings:
6, 12, 24, 115, 230 Volts
Frequency:
60 CPS Standard
25, 50 CPS Available
Power Input: 2.5 Watts
Maximum (60 CPS)

BASIC MOTOR

Weight: 4 ounces
Speed: 300 RPM
Torque: $\frac{1}{4}$ oz.-in.
Length: $\frac{9}{16}$ inch

WITH INTEGRAL GEAR TRAIN

Weight: 5 ounces
Speed: 300 RPM to $\frac{1}{6}$ RPH
Torque: 30 oz.-in. @ 1 RPM
Length: $\frac{7}{8}$ inch



WITH
INTEGRAL
GEAR TRAIN



HOPKINS

multiple capacitors
—time saving,
space saving,
cost less to assemble

You save a lot of trial-and-error, because Hopkins units come to you already matched... built to any value you specify.

Save chassis space—a Hopkins multiple capacitor is compact. You'll find it hard to beat our specialists in designing to save space.

Cut costs. In buying only one unit, you spend less on purchasing and testing. Rejects are fewer, and less assembly time is needed. Overall cost to you is lower.

Call Hopkins for any combination of capacitors, packaged to your specifications. Send us a print, or a detailed description. Our representative will be glad to assist you on your special requirements.



HOPKINS Engineering COMPANY

12900 Foothill Blvd., San Fernando, Calif. Tel. EMpire 1-8691
CIRCLE 287 ON READER-SERVICE CARD

*a company
is known by
the company
it keeps*



Just 3 years ago, POWER SOURCES, INC., was founded on the premise that in most critical applications all vacuum tube, rotary and vibrator power supplies must be superseded by completely transistorized supplies in order to provide the ultimate in reliability, efficiency and miniaturization. The truth of this premise is proven daily in performance by POWER SOURCES equipment currently being used in major missile and space programs. One of the more recent dramatic proofs is the discovery of two POWER SOURCES Model PS-2008 Converters found still operating after the recovery of a THOR-ABLE nose cone from the Atlantic. Tests revealed that the converters continued to function perfectly after the ordeal of the launching and flight, the tremendous shock and temperature of re-entry, and the great pressure generated by the impact of the re-entry vehicle with the sea.

Continued specialization in transistorized supplies will soon result in the announcement by POWER SOURCES of a completely new line of regulated power supplies for Ground Support Equipment and Computer applications, and a new line of sine-wave inverters for industrial applications.



Specify **POWER SOURCES**
BY
POWER SOURCES, INC.

Burlington, Massachusetts
CIRCLE 288 ON READER-SERVICE CARD

IDEAS FOR DESIGN

PC Peg Boards Speed Breadboard Layout

TEMPORARY circuits on "breadboards" have become a standard means of checking and adjusting new devices using conventional components. Miniaturization of components has reduced many breadboards to the appearance of a collection of terminals. In view of this trend, a "peg board" array of terminals and connections has been devised to provide an easy and flexible method of inter-connecting standard circuit elements.

The board for this model was constructed of 10" x 15" x 1/4" thick copper clad epoxy glass laminate mounted on an enclosed base. Modular type construction was used.

Three types of modules have been built: a left end, a right end, and a center module. The left-end module is shown in Fig. 1. The right-end module is the mirror image of the left-end module, and the center module is similar except it has no connectors along the left edge but has a greater number of pegs.

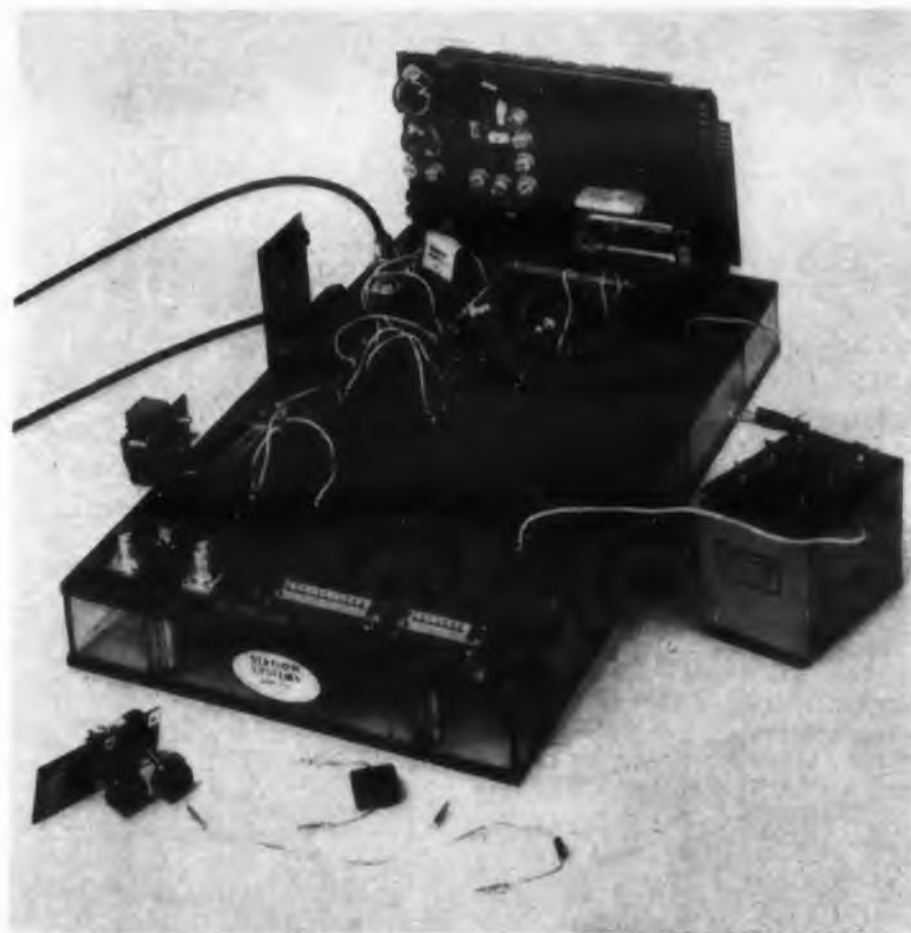


Fig. 1. PC peg board cuts hook-up time down to seconds.

When a circuit grows too large for one board, another module may be placed alongside and the circuit continued on the second unit.

Printed circuits are used to connect the page and the connectors. This has the advantage of providing a permanent visual indication of all connections on the face of the board. A numbering system, Fig. 2, is used whereby each multiple group and connector terminal is identified. A circuit can be rebuilt at some future time, if component locations are recorded before dismantling.

The reverse side of the board, Fig. 3, shows the pegs soldered into place and the method of mounting the connectors. The pegs are simply mounted in holes that are drilled through the board to provide a snug fit. After the pegs have been positioned in place they are soldered either by dipping or manually.

Continental connectors are mounted in slots and are flush with the board. The first row of connector terminals are bent over and soldered directly to the board. An overlay card is then dropped into place and the second row of terminals is bent over and soldered to the card. The row of pegs marked "B" are made slightly longer than the rest and only the overlay card is soldered to these pegs. The pegs are made of brass in the shape of blunt brads and are gold plated. Plating provides a low resistance connection that is non-tarnishing.

A sleeve must be provided on each component lead to allow connection to the pegs. The center terminals of UG-22/U type "N" rf connectors are suitable for this purpose. A supply of components can be quickly made up, used, and stored for future use.

Building a circuit merely involves selecting the desired components and pushing them into place on the pegs. If a change is necessary, a component may be removed and a new one inserted in a matter of seconds. Since all wiring is done on one side, the circuit may easily be checked.

Meters, oscilloscopes, oscillators, etc. can be connected to the coaxial connectors, pin jacks and banana jacks provided along the edge of the board.

Fig. 1 also shows the use of the auxiliary plug-in cards. These cards are made of etched copper clad phenolic to provide a means for mounting switches, transistors and potentiometers. The cards illustrated show the mounting of two miniature potentiometers, four toggle switches, and four transistors. The transistors are mounted on the cards by means of flea clips and can easily be changed.

A layout board which is useful in determining the proper layout of a circuit on a P-C card is shown inserted into the larger connector.

R. Morley, Bell Telephone Laboratories, Murray Hill, N.J.



Fig. 2. Numbering system allows recording of temporary circuit for duplication later.

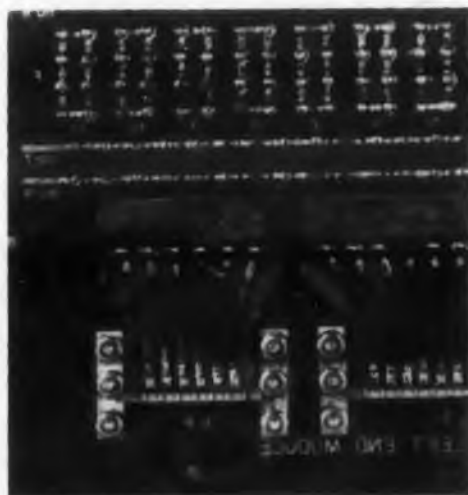


Fig. 3. Reverse side of peg board shows how pegs and second row connector terminals are soldered in place.

HOW BENDIX SPARK GAPS CAN PROTECT YOUR RADAR EQUIPMENT



Bendix Red Bank "Spark Gap" Tubes are specially designed to do two big jobs in electronic circuits.

First, to act as a "triggering" switch—as on jet ignition systems. Here, Bendix* Spark Gaps pass high currents with relatively low voltage drop and have the advantage of being able to handle high voltages in small space. Further, these tubes can be made insensitive to ambient temperature variations and are not normally affected by pressure, altitude, or humidity changes.

The second function of Bendix Spark Gaps is as a *protective element*—guarding radar equipment against voltage overload, to name one example. Here, Bendix Spark Gaps keep high voltage surges from getting through to damage circuit components.

Our design and manufacturing experience with spark gap tubes is extremely broad. If our extensive line of these tubes . . . ranging from 750V to 50KV in DC breakdown voltages . . . does not already contain a type to fit your needs, we are in a position to design one to handle the job with the exact degree of efficiency that you require.

To find out more about what we can do to help you with your spark gap problems, get in touch with RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

* TRADEMARK

West Coast Sales and Service: 117 E. Providence Ave., Burbank, Calif.
Canadian Affiliate: Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ont.
Expert Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

Red Bank Division



CIRCLE 289 ON READER-SERVICE CARD

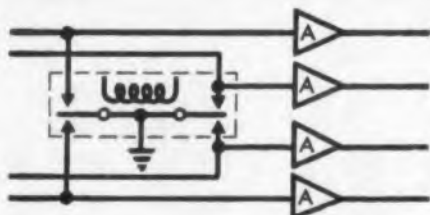
NEW

twin contact miniature DC-AC choppers



Eleven types, both single and double pole.
Long life.
Low noise level.
Extreme reliability.

DPDT
LOW COST
FULL ISOLATION



Write for Catalog 515-B

STEVENS INCORPORATED ARNOLD

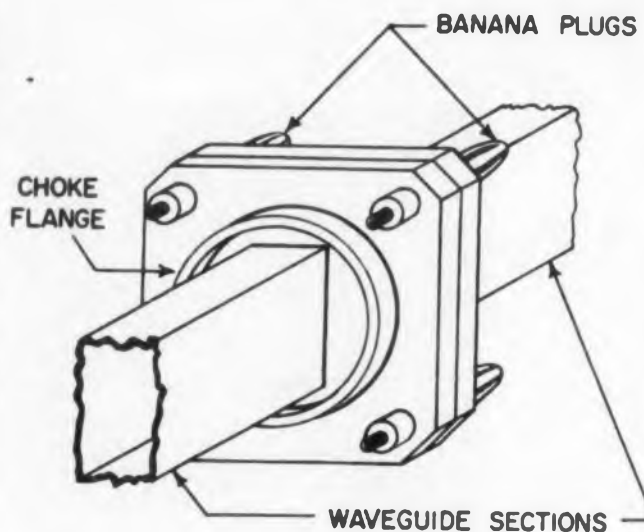
QUALITY SINCE 1943

7 ELKINS ST., SOUTH BOSTON 27, MASS.

S/A 16%

IDEAS FOR DESIGN

Banana Plugs Cut Microwave Breadboarding Time



Setting up a microwave breadboard and making frequent circuit changes can consume a major portion of an experimenter's time. The lowly banana plug is made to order as a quick disconnect fastener for waveguide.

The use of these plugs for holding a waveguide properly aligned is seen in the figure. Note that one of the flanges is a choke. While the spring tension of the plug is sufficient to hold the joint together, some leakage will occur if both flanges are flat faced. This is particularly true at the higher frequencies above about 9 kmc.

Vincent J. Kaneski, Senior Engineer, Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va.

Braided Shield Doubles for Transistor Heat Sink

It is sometimes necessary during the breadboard stage of designing transistorized circuitry to stabilize the temperature of transistors. At other times it's necessary to match temperature drifts in groups of transistors. These precautions prevent transistor parameter variation from affecting circuit performance.

A simple solution to the problem is to form a heat sink from braided shield as shown. The shielding is doubled back on itself to enclose the transistors. Strips of shield may be inserted in the space between transistors. Solder is applied while the transistors are temporarily replaced by metal rods of the same diameter.

The resilience of the braid permits the heat sink to snugly grip the transistors provided care is taken to prevent solder from flowing to the portions of the braid alongside the transistor positions. This scheme has the following advantages:

new source . . .
fine Seamless Tubing
of RODAR*, 52ALLOY
for

GLASS-TO-METAL HERMETIC SEALS



Miniature tubular parts like these are being made from Uniform Seamless Tubing in alloys of copper and nickel, offering coefficients of expansion from 1×10^{-6} to 11×10^{-6} , suitable for sealing with a wide range of glasses—to meet single and multiple conductor seal requirements.

Seamless Tubing, in these alloys, has been proven to provide a better fabricated part.

Tubing Sizes: range from .375" O.D. to .010" O.D. Wall thickness from .035" to .001"

Tolerances: $\pm .0005"$ to $\pm .00025"$ as required.

Delivery: Normally 5 to 6 weeks.

Write for information on your requirements in tubing or tubular parts, "fabricated at the mill," made from these alloys . . . latest additions to the Uniform line which includes many alloys of aluminum, copper, nickel, steel and the precious metals.

*Trademark, Wilber B. Driver Co.
†Trademark, Driver-Harris Co.

UNIFORM TUBES, INC.

1200 Level Rd., Collegeville 2, Pa.
HUxley 9-7276



Chicago, Ill., HARRison 7-2215
Mishawaka, Ind., Blackburn 5-6439
St. Louis, Mo., PArkview 1-7784
Pasadena, Cal., RYan 1-9534
St. Paul, Minn., Midway 5-4637
Ramsey, N.J., DAVis 7-5527
Cleveland, Ohio, WYoming 1-7900
Kansas City, Mo., WEstport 1-2323
Clearwater, Fla., 32577

CIRCLE 291 ON READER-SERVICE CARD

BASIC BUILDING BLOCKS FROM KEARFOTT



20 Second Synchro

This synchro, just one of a broad line offered by Kearfott, provides the extreme accuracy required in today's data transmission systems. Kearfott synchro resolvers enable system designers to achieve unusual accuracy without the need for 2-speed servos and elaborate electronics. By proper impedance matches, up to 64 resolver control transformers can also operate from one resolver transmitter.

| TYPICAL CHARACTERISTICS | SIZE 25 | |
|-------------------------|-------------|---------------------|
| | Transmitter | Control Transformer |
| Type Resolver | Z5161-001 | Z5151-003 |
| Part Number | | |
| Excit. Volts (Max.) | 115 | 90 |
| Frequency (cps) | 400 | 400 |
| Primary Imped. | 400/80° | 8500/80° |
| Secondary Imped. | 260/80° | 14000/80° |
| Transform. Ratio | .7826 | 1.278 |
| Max. Error fr. E.Z. | 20 seconds | 20 seconds |
| Primary | Rotor | Stator |

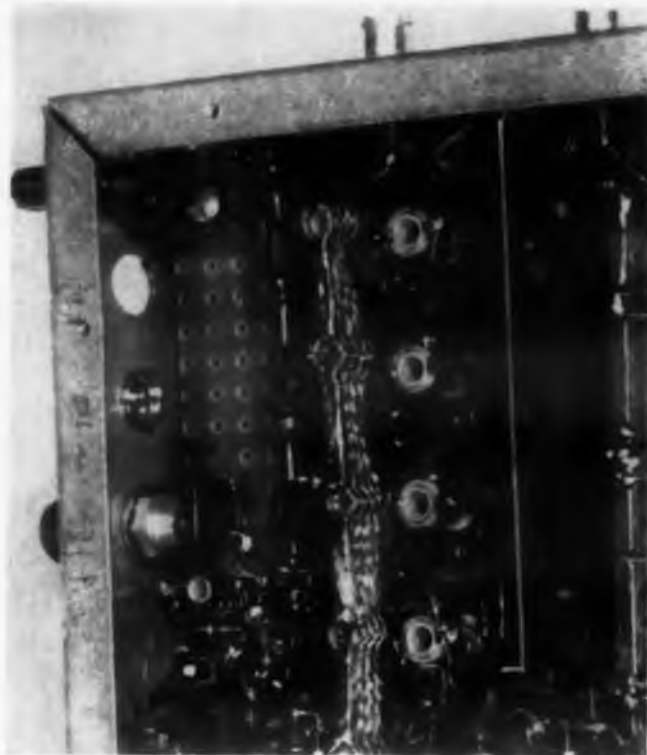
Write for complete data.

Kearfott

A
**GENERAL
PRECISION
COMPANY**

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.
A subsidiary of General Precision Equipment Corporation
Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vineland Avenue, Pasadena, Calif.

CIRCLE 292 ON READER-SERVICE CARD



Transistor heat problems are neatly licked by a braided shield heat sink.

This arrangement provides excellent thermal conductivity and large thermal capacity. Assembly requires only a soldering iron and pliers. It is unnecessary to construct metal bars with mounting provisions as might be required using other methods.

R. L. Forgacs, Sr. Research Engineer, Scientific Laboratory, Ford Motor Co., Dearborn, Michigan.

Boosted Heater Voltage Ups Thyatron Reliability

A 2D21 thyatron was required to conduct a peak current near its peak rating, from 30 to 60 seconds after turning on the heater. As soon as fired the heater was turned off for 20 minutes to an hour. The tubes failed after only 10 or 20 operations at normal heater voltage, (6.3 v). The cathodes were observed to be severely pitted. Each operating cycle had dislodged a bit of the oxide coating. Spaces would not permit a larger thyatron.

Knowing that thyatrons operate at a high temperature in normal continuous operation, the heater voltage was raised to 10 v. The thyatron now gives very little trouble and usually operates for several hundred cycles—sometimes many more. The excess heater voltage brings the tube up to normal temperature and permits rated peak current loads after the short heating time.

Laurence G. Cowles, The Superior Oil Co., Bellaire, Tex.

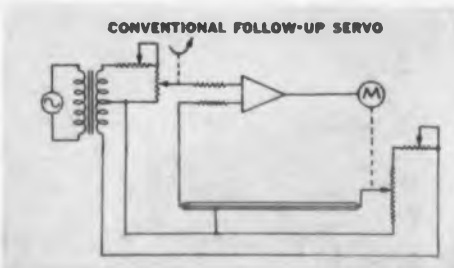
DESIGN IDEAS FOR ELECTRONIC ENGINEERS:

How to improve servo performance with Vernistat* a. c. potentiometers

Typical example shows how they increase servo reliability and accuracy, reduce system complexity and cost

Servos which utilize resistance potentiometers must also include several other components to achieve high accuracy. In addition, these components may increase cost, create added problems in design, and add an element of unreliability.

FOR EXAMPLE, a simple follow-up servo:



Here, to position a remote shaft in accordance with the position of the input shaft, resistance potentiometers and summing resistor networks are used. This requires an accurate center-tapped voltage source, so that the two potentiometers will be excited by equal voltages of opposite phase. When the shafts of the two potentiometers correspond, the input to the amplifier will be zero.

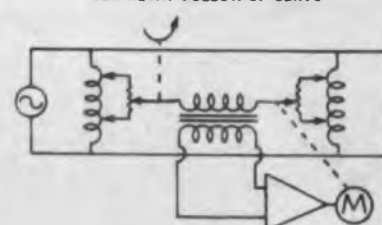
THIS TYPE OF CIRCUIT has inherent difficulties:

- 1) With usual high potentiometer impedances, pickup from stray electrostatic fields may necessitate shielding of the remote signal leads. Shielding and its capacitance increases phase shift.
- 2) In the summing resistor network, half of the error voltage appears across each resistor, so that only half of the error voltage appears at the amplifier input. This means a loss of gain of one-half, which must be made up by the amplifier.
- 3) To achieve terminal linearity and resulting servo accuracy, it is often necessary to end-trim conventional potentiometers.

CONTRAST THIS CIRCUIT WITH one which includes the Vernistat a.c. Potentiometer—a fundamentally new, compact device which combines several desirable features not available in standard potentiometers.

*vernistat®—a design concept that unites in one compact device the best features of the precision autotransformer and the multiturn potentiometer

VERNISTAT FOLLOW-UP SERVO



Here, a null transformer provides gain and transmits the error signal directly to the amplifier. Because of this, the amplifier gain requirements are reduced. The error signal is zero when the two Vernistat shafts correspond.

IN THE VERNISTAT CIRCUIT, all signals are transmitted over low impedance leads. This reduces the circuit's susceptibility to pickup and quadrature due to stray capacity. This is particularly important in high gain servo systems.

FEWER COMPONENTS ARE NEEDED with the Vernistat approach, and this reduces the system's complexity. Summing resistors are not necessary. Where conventional potentiometers must be end-trimmed to achieve terminal linearity, the Vernistat inherently provides terminal linearity by means of its design.



IN SOLVING DESIGN PROBLEMS like these, the Vernistat a.c. Potentiometer offers such major features as: low output impedance (as low as 45 ohms) with high input impedance (as high as 200,000 ohms) — high resolution (up to 0.004%) — low phase shift (as low as 0.2 minutes) — and high terminal linearity (to 0.01%). Vernistat a.c. Potentiometers meet the requirements of MIL E 005272-B, and will operate at 125°C without derating.

WRITE TODAY for full description and specifications on Vernistat a.c. Potentiometers, Adjustable Function Generators, and Variable Ratio Transformers.



765 Main Ave., Norwalk, Conn.

Perkin-Elmer Corporation

CIRCLE 293 ON READER-SERVICE CARD

FILTERS for scatter systems



WHATEVER your requirements for large size filters, D. S. Kennedy can meet your most exacting specifications. Here are two recent developments for quadruple diversity scatter systems: *top* — a tunable low band duplexer for the 755-985 mc range. *Bottom* — a fixed-tuned double notch filter.

ANTENNA EQUIPMENT

D. S. KENNEDY & CO.

CONASSET, MASSACHUSETTS EVergreen 3-1200

West Coast Affiliate

SATELLITE KENNEDY, INC. of CALIFORNIA
P. O. Box 1711, Monterey, California—FRontier 3-2481

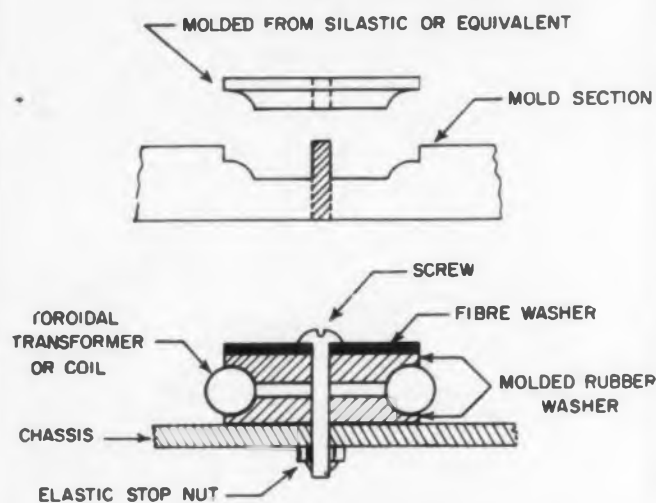
Down-to-earth SOLUTIONS to lot-of-odd-world PROBLEMS
Tracking Antennas—Radio Telescopes—Radar Antennas
"Trans-Horizon" Antennas—Tropospheric Scatter
Ionospheric Scatter



CIRCLE 294 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Toroidal Mount Made From Molded Rubber Washers



Mounting a toroidal choke or transformer to a chassis can consume a good deal of time. No special hardware is available to simplify the job. With a wide range of sizes and cross-sections, what is needed is a method of quickly making up a mount to secure the toroid snugly onto the chassis.

The solution involved developing a simple rubber washer. The washer is approximately the size of the wound inner diameter of the toroid. The mold is easily made in a model shop. A rubber composition such as Corning's "Silastic" is ideal. As can be seen in the illustration, the toroid is sandwiched between two rubber washers. These in turn fit between an additional washer and the nut head on one side and the chassis on the other. Use of locking-type nuts is recommended because of the limited holding force that can be applied to the assembly.

Harry Star, Research Engineer, Applied Science Corp. of Princeton, Box 44, Princeton, N.J.

Solder Spots Nuts in Tight Spots

Placing a small machine nut in a relatively inaccessible location to mate with a free screw is always a problem. Sometimes a special flexible gripping tool is not available. Even these will not work in really tight corners. What is really needed is a low cost device that is always available and universally applicable. A coil of ordinary wire solder does the job every time.

Place the solder so that it lays over the diameter of the nut and its end just laps beyond the flat of the nut. Then using a medium grip on pliers, (too strong a pressure will shear the solder) crimp the solder against the face of the nut. This will force the solder into the first one or two nut

from **MESA**

NOW! NEW!

Flame
Resistant
Heat
Resistant

DIALL[®]
MOLDING
COMPOUNDS

*Faster Flame Out than
Any Other Flameproof
Molding Compounds*
Heat Resistance
to 500° F

New Diallyl Phthalates
52-70-70 . . . Short Glass Fiber
52-40-40 . . . Long Glass Fiber
51-60 Asbestos Filled
50-52 Dacron[®] Filled
DUPONT TRADE NAME

New Diallyl Iso-Phthalates
FS-10 Short Glass Fiber
FS-80 Long Glass Fiber
FS-60 Asbestos Filled

Write TODAY for Data Sheets...
Just Off the Press!

When you Mold Parts Like These...



Remember **DIALL**...

Easy to Mold
Easy to Machine
No Post-Mold Shrinkage
Resistant to Solvents
and Corrosives
Unaffected by Moisture
Fungus Proof
Does Not Corrode Metals
All Colors Available

Please address all inquiries regarding
Diall molding compounds to

MESA PLASTICS COMPANY...
12270 Nebraska Avenue
Los Angeles 25, California
Dept. 14

DIALL

MESA

CIRCLE 295 ON READER-SERVICE CARD

BASIC BUILDING BLOCKS FROM KEARFOTT



Analog- to-Digital Converters

Kearfott's rugged shaft position-to-digital converters are resistant to high shock and vibration and high and low temperature environments. Ideally suited for missile applications, these converters are available for many uses, including latitude, longitude, azimuth or conventional angular shaft displacement conversion and decimal count conversion. Exclusive drum design provides large conversion capacity in smallest size. Combination counter converter assemblies for both visual and electrical readout also available.

TYPICAL CHARACTERISTICS

| | |
|---|-----------------------------|
| Kearfott Unit No. | PI241-11A |
| Code | Cyclic Binary |
| Range | 0-32,768 (2 ¹⁵) |
| Bits per Revolution | 16 |
| Revolutions for Total Range | 2,048 |
| Volts D.C. | 10.5 |
| Current (ma.) | 20 |
| Inertia (gm. cm. ²) | 20 |
| Unit Diameter (in.) | 1 1/8 |
| Unit Length (in.) | 3 |
| Life 10 ⁶ Revolutions or 10 ³ hours | |
| Static Torque (in.-oz.) .. | 2 (break) |
| | 1 (running) |
| Weight (oz.) | 5 |
| Maximum Speed (RPM) | 600 |

Write for new ADAC brochure.

Kearfott

A
**GENERAL
PRECISION
COMPANY**

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.
A subsidiary of General Precision Equipment Corporation
Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinado Avenue, Pasadena, Calif.

CIRCLE 296 ON READER-SERVICE CARD



Ordinary wire solder crimps onto the nut face with a simple press of pliers.

threads, firmly supporting the nut.

Use as long a piece of solder as needed, and put compound bends in the length to fit the application. Then you can spot the nut at just the right location for pick-up by the screw. After starting, you can easily pull the solder from the nut, or wait for the screw to force the solder from the nut. Most any improvised tool (or a finger) will then block the nut for tightening.

Chester B. Shapero, Research Engineer, Cupertino, Calif.

Drill Makes Handy Cable Twist Jig

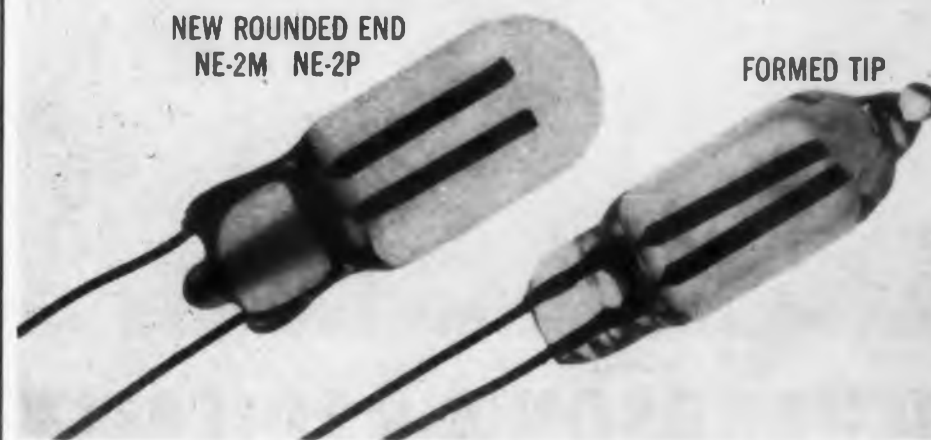
Occasionally it is necessary to twist two or more insulated conductors together to form interconnection of filament cabling. If the twisting is attempted by hand, it becomes a long tedious process. Here's a handy method that's often overlooked.

Merely clamp the insulated conductors into the drill chuck. Secure the other ends of the conductors together in a vise or clamp. Then pull the conductors taut and operate the drill. The tightness of the finished cabling can be adjusted as desired by controlling the number of turns of the drill.

Leland Hogue, Staff Assistant, Sandia Corp., Albuquerque, New Mexico.

SMOOTHIE!

NEW! G-E Indicator Glow Lamps with rounded ends for better viewing!

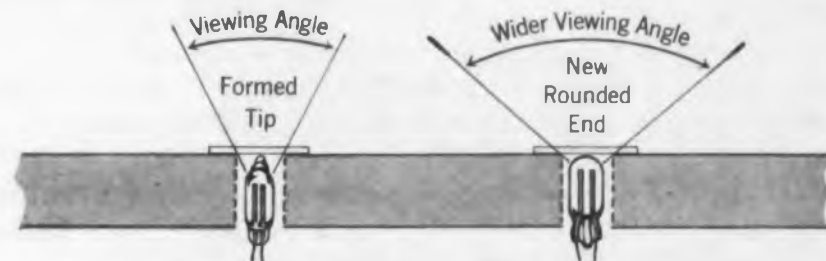


Approximately 3 Times Actual Size

General Electric NE-2M and NE-2P permit easier wide angle viewing

The new General Electric NE-2M (standard brightness) and NE-2P (high brightness) Glow Lamps are real smooth indicators.

1. The rounded end gives you a clear, distortion-free lamp when viewed end-on.
2. The new shape permits the lamp's electrodes to be placed extremely close to the end of the bulb, thus providing a wider viewing angle. (See diagram)
3. "Hot or cold", both types dress up appliances, electronic equipment, and indicator panels.
4. When placed beneath translucent material, the lighted area produced has a more uniform appearance.



Improved viewing angle . . . a primary advantage of having electrodes nearer the end of the lamp.

The General Electric NE-2M and NE-2P are currently available in limited quantities. Both lamps are described more completely in the engineering data sheet, #3-9289 Want one? Write: General Electric Co., Miniature Lamp Dept. M-911, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC





Typical part punched from
"MARK TEN" at 60 F

- True cold punching
- High resistance to organic cleaning compounds
- Excellent blister resistance (500 F, 40-60 sec.)

RICHARDSON'S RADICALLY NEW LAMINATE

MARK TEN*

Combined Properties Ideal for Copper-Clad

Here is a radically new and different series of laminated insulating materials known as the "MARK TEN" series. This series of laminates has unique properties which are *chemically built-in* and are not degraded during normal manufacturing processes. Rigidity and flexural strength are high as compared with other cold punch laminates. Intricate shapes can be punched at room temperatures and lower.

As a copper-clad laminate, "MARK TEN" 10-01 introduces the most unusual combination of properties ever known to the laminated plastics field. Besides being a true cold punch material it has unusual resistance to organic cleaning compounds . . . it withstands blistering in solder at 500°F for 40-60 seconds or at 550°F for 10-20 seconds . . . and it averages 7-9 lbs. bond strength.

This "MARK TEN" laminate is chemically engineered with the printed circuit manufacturing process in mind and is designed for most efficient production of printed circuits as well as other products.

"MARK TEN" 10-01 is Richardson's latest addition to its well known line of INSUROK® laminates. As the first grade in this series, it is available both plain and copper-clad. Exceeding NEMA XXXP and MIL-P-3115B Type PBE-P requirements, "MARK TEN" 10-01 has excellent stability in both dimensions and electrical properties over a wide temperature range.

You are invited to request further information and a sample. Write . . . or phone today . . . Chicago phone MA 6-8900.

*A Trademark of The Richardson Company.

THE RICHARDSON COMPANY

LAMINATED AND MOLDED PLASTICS

FOUNDED 1858

DEPT. 43 • 2682 LAKE ST. • MELROSE PARK, ILL. • SALES OFFICES IN PRINCIPAL CITIES

CIRCLE 297 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Power-Saving Shutoff for Mobile Radiotelephone

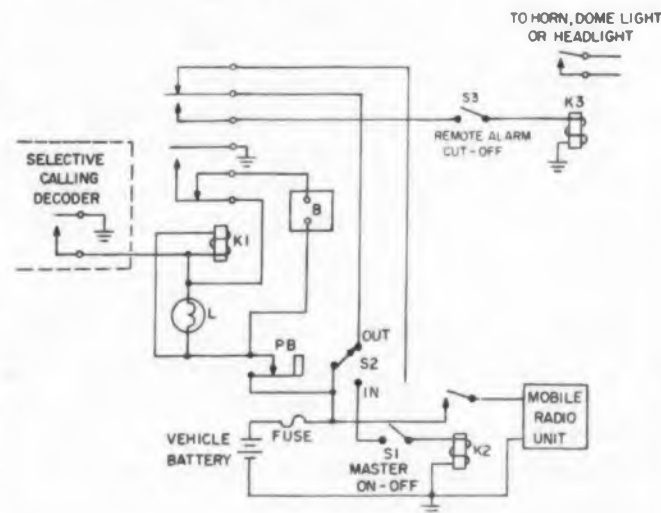
Mobile radiotelephones are used in private systems with selective signaling or in common carrier service, when selective calling is employed. They are usually left on at all times in order to intercept calls. This is true even when the vehicle is unattended. Hence, the vehicle battery must supply power whenever the receiver is turned on.

However, when an unattended vehicle has been called, a call indicator lamp is lighted. It remains on until turned off by operation of an indicator-release switch or removal of a hand-set from its hanger. The receiver is ordinarily left turned on after a call has been received. It continues to draw current even if further unanswered calls cannot relight the lighted lamp.

As shown in the figure, means can be provided for automatic shutoff of the receiver after a call has been intercepted by the receiver in an unattended vehicle.

When the contacts of the selective calling decoder or of a carrier operated relay close momentarily, relay *K1* and buzzer *B* are energized. As soon as relay *K1* pulls in, the buzzer is disconnected. Relay *K1* is held closed by a pair of electrically latched contacts; it is not released until the indicator release pushbutton *PB* is opened momentarily. Lamp *L* also lights when relay *K1* is first energized and remains lighted until *PB* is opened.

In many mobile systems, the battery is connected to the equipment through a relay, such as *K2*, so that the full current does not have to flow through the contacts of on-off switch *S1*. When the vehicle is unattended, switch *S2* is set to the "out" position. When relay *K1* is energized, a pair of relay contacts opens, de-energizing the normally energized relay *K2*.



Simple relay circuit conserves battery power for mobile radio units.

NOW produce up to
6,000 welds per hour . . . automati-
cally . . . with one operator.

TWEEZER WELD



Precision
Resistance Welding
Equipment



model
DC80

BENCH MOUNTED STORED ENERGY WELDER

- New TWS low friction welding head
- Stored energy panel of 80 Watt second capacity
- Discharge time of 0.0008 to 0.0012 second
- Permits welding of difficult materials, i.e.: copper, silver, tungsten, etc.
- Reliable welds without discoloration, deformation, metallurgical change



COMPACT
SYNCHRONOUS
WELDING
TIMER
6" wide
10 1/2" high
8 1/2" deep
model T-3

TRANS-SYNC WELD-TIMER

- 1 KVA capacity utilizing semi-conductors.
- Also ideally suited with high speed automatic machinery.
- Operates at a rate up to 1200 welds per minute . . . welds partially oxidized materials with ease.
- Welding time: 1/2 cycle (8 milliseconds) to 10 cycles (160 milliseconds).

FEDERAL TOOL ENGINEERING CO.
1400 Pompton Ave.
Cedar Grove, New Jersey



WRITE FOR
INFORMATION

CIRCLE 298 ON READER-SERVICE CARD

BASIC BUILDING BLOCKS FROM KEARFOTT



Integrating Tachometers

Kearfott integrating tachometers, special types of rate generators, are almost invariably provided integrally coupled to a motor. They feature tachometer generators of high output-to-null ratio and are temperature stabilized or compensated for highest accuracy integration and rate computation. Linearity of these compact, lightweight tachometers ranges as low as .01% and is usually better than $\pm .1\%$.

TYPICAL CHARACTERISTICS

| | |
|--------------------------------|-------------------|
| | Size 11 (R860) |
| Excitation Voltage (400 cps) | 115 |
| Volts at 0 rpm (RMS) |020 |
| Volts at 1000 rpm (RMS) | 2.75 |
| Phase shift at 3600 rpm | 0° |
| Linearity at 0-3600 rpm |07 |
| Operating Temperature Range | -54° +125° |

Write for complete data.

Kearfott

A
GENERAL
PRECISION
COMPANY

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.
A subsidiary of General Precision Equipment Corporation
Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vineta Avenue, Pasadena, Calif.

CIRCLE 299 ON READER-SERVICE CARD

At the same time, another pair of contacts closes, actuating the horn, a dome light or headlights of the vehicle. This occurs only if switch S3 is closed. When the vehicle is attended, switch S2 is set to the "on" position to disable the automatic shutoff feature. When set to "off" relay K2 is released and cuts off power to the receiver whenever relay K1 is energized.

Leo G. Sands, Technical Director, Graf-Tek, Inc., Ridgewood, N. J.

Three Measurements Determine Mechanical Time Constant

It is often necessary to experimentally determine the mechanical time constant of a motor and load combination which satisfies the following differential equation:

$$T (dw/dt) + w = K$$

Where:

- T = system time constant or inertia divided by viscous damping
- w = velocity
- K = driving function

An easy method for determining T involves three simple laboratory steps.

First, apply a minus K_1 driving source to the system; second, when the system has attained a constant velocity corresponding to the minus K_1 , switch the driving source with a fast acting relay to plus K_2 ; and third, note the increment of time between the switching of the relay and the reversal of the motor.

If the motor has a tachometer attachment, the last step can be accomplished by triggering the sweep of a scope with the relay and by noting the increment of time corresponding to zero tachometer voltage at the vertical input of the scope.

The solution of the differential equation of the system with the initial conditions introduced by this procedure is

$$w(t) = K_2 - (K_2 + K_1)e^{-t/T}$$

where t equals increment of time from the instant of relay switching. At time t_0 , the increment of time measured experimentally, $w(t)$ equals zero. Therefore, letting "a" equal K_1/K_2 ,

$$0 = 1 - (1 + a)e^{-t_0/T}$$

or
$$T = t_0 / \ln(1 + a)$$

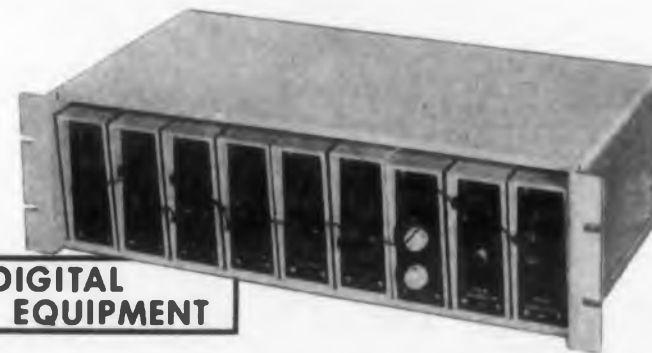
In order to achieve maximum accuracy when measuring t_0 , "a" should be made as large as possible. The magnitude of "a" is restricted, however, in that both K_1 and K_2 must be in the linear range of the system.

Donald A. Pierre, Hughes Aircraft, Los Angeles 45, Calif.

digital offers all the advantages
of the

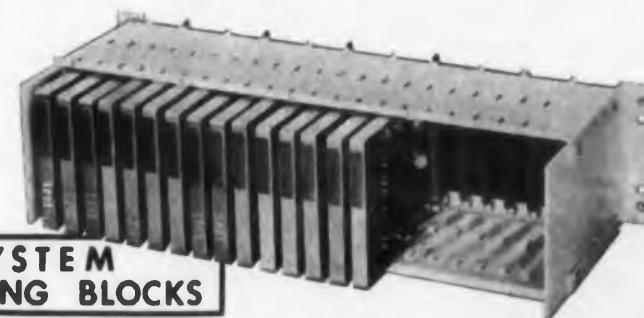
BUILDING BLOCK CONCEPT

- Full selection of transistorized logic packages
- Complete freedom and flexibility of application
- Time-saving ease of assembly and reassembly
- Speeds up to 5 megacycles per second
- Economy in slow-speed applications



DIGITAL
TEST EQUIPMENT

Packaged in convenient building block form, DEC Test Equipment units can be assembled quickly and easily by means of banana-jack patch cord interconnections to form custom digital test instruments such as signal generators, counters, pattern generators, etc.



SYSTEM
BUILDING BLOCKS

Featuring saturated circuits with wide operating margins, DEC System plug-in units provide the designer complete flexibility in formulating the logic for permanent or semi-permanent digital systems.

Write or call for complete technical information.

digital | EQUIPMENT
CORPORATION

MAYNARD, MASSACHUSETTS
TWINOAKS 7-8822 • TWX 818

WEST COAST FIELD OFFICE • 690 NORTH SEPULVEDA BOULEVARD • EL SEGUNDO, CALIFORNIA • EASTGATE 2-5707

CIRCLE 300 ON READER-SERVICE CARD

A topper in any language



It's better than the best XXXP grade,
it's lighter and more economical than G-10,
it's Taylor XY-1 Paper-Base Epoxy Laminate

When you want extremely high reliability in printed circuits, with the additional advantages of flame retardance, chemical resistance, good solderability and high bond strength—specify Taylor XY-1 copper-clad laminate. It is self-extinguishing in 1 second, has excellent resistance to alkalis, acids and solvents, has a solder time resistance at 500°F. of 30 seconds in 1-oz. copper and 50 seconds in 2-oz., and a bond strength of 10 lb. in 1-oz. copper and 13 lb. in 2-oz. Sheets available with copper on one or both sides.



Unclad Taylor XY-1 has many advantages, too. It can be substituted for glass-base epoxy laminates to reduce cost and weight. It has excellent electrical, mechanical and machining properties. Contact us for complete technical data and expert guidance in applying this new material. TAYLOR FIBRE CO., Norristown 48, Pa.

Taylor

LAMINATED PLASTICS VULCANIZED FIBRE

CIRCLE 301 ON READER-SERVICE CARD

IDEAS FOR DESIGN

RC Network Exaggerates Distortion for Easy Spotting

Qualitative measurements of harmonic distortion are often made with an oscilloscope during the design of amplifiers and oscillators. Adjustments are made to the circuit until the waveform as viewed on the oscilloscope looks as close to a pure sinusoid as the eye can tell. Unfortunately, the eye can tell a minimum distortion of approximately five per cent.

By coupling the signal to the scope through a simple RC differentiating network, small amounts of distortion are made much more discernible. The signal emerging from the differentiator will be much more distorted than is the signal applied to it, providing, of course, that the applied signal contains distortion. On the other hand, if the applied signal is a pure sinusoid, then the differentiator will have no effect on the waveform.

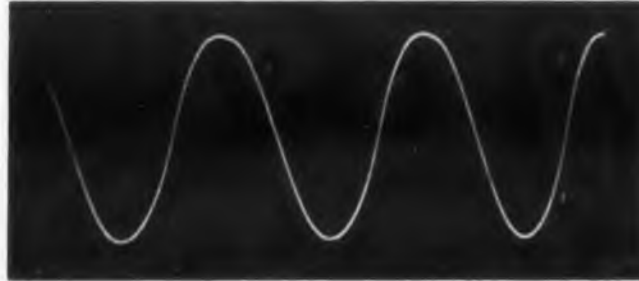


Fig. 1. Directly-coupled waveform exhibits very little distortion.

Fig. 1 is the slightly distorted signal applied directly to the scope. Fig. 2 shows the same signal after passing through the differentiating network ($RC = T/30$). Where the distortion was only slightly visible in Fig. 1, it has become quite distinct in Fig. 2.

Care must be taken to ensure that the differentiating circuit does not excessively load the amplifier or oscillator to which it is attached, thus further distorting the signal applied to it. It may be desirable, when working in high impedance circuits, to interpose a cathode-follower

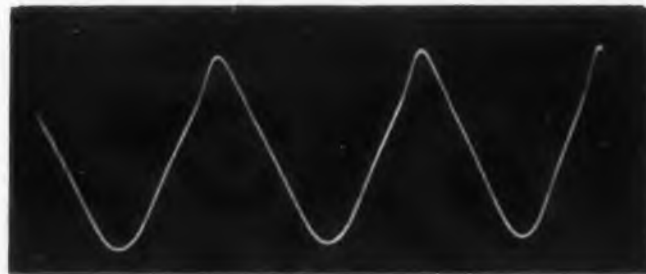


Fig. 2. When passed through RC coupling network, distortion is easy to spot.

Headquarters for HIGH POTENTIAL Testing

INSULATION BREAKDOWN DIELECTRIC STRENGTH

Every over-potential test need from the generator to the appliance motor . . . is met by a HYPOT®



150 KV Testing Mobile HYPOT®

Non-destructive testing of power cables, generators, and insulators with AC or DC test potentials to 150 KV. New DC Mobile HYPOT® is easier to handle, cuts costs. Write for bulletin "Mobile HYPOT®"

Model 5500

Typical Mobile HYPOT® provides 0 to 120 kv d-c at 5 ma. More compact and easier to use than equivalent a-c test sets. Lower in cost, too.

30 KV Testing Bench HYPOT®

Models available with AC or DC test potentials from 5 to 30 KV. Widely used for insulation testing of cables, distribution equipment and heavy duty motors.

10 KV Testing Portable HYPOT Jr.®

The advanced over-potential tester that enables anyone to make high potential breakdown tests. Separate lights indicate excess leakage current and insulation breakdown. Available with test voltages from 1500 v a-c to 10000 v a-c.



Model 412

INSULATION Materials Tester

Model 4501

Materials Tester



New materials testing AC HYPOT® meets ASTM dielectric strength test requirements. Features automatic rate of test voltage rise, transparent test cage that is safely interlocked and complete line of plug-in materials testing fixtures. Write for new bulletin . . . "HYPOT® Insulation Tester"

VIBROTEST® measures FIVE MILLION Megs

Direct reading a-c operated megohmmeter for resistance measurement to five million megohms. Drift free, stable and accurate on all ranges.

VIBROTEST® Model 2570 has six megohm ranges: 1-50, 10-500, 100-5000, 1,000-50,000, 10,000-500,000 and 100,000-5,000,000 megohms. Write for bulletin.



Write for Bulletins 10-35-16

ASSOCIATED RESEARCH, Incorporated

3769 W. Belmont Avenue • Chicago 18, Illinois

CIRCLE 302 ON READER-SERVICE CARD

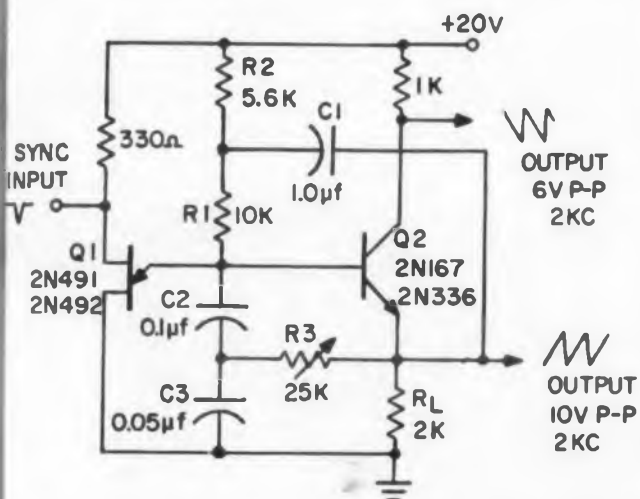
between the source and the differentiator.

Horace T. Jones, Atlantic Research Corp., Alexandria, Va.

Sawtooth Generator Displays High Linearity

Two major problems are involved in the design of linear sawtooth generators using transistors: (a) a constant charging current must be supplied to the capacitor, (b) the waveform must be compensated for the loading of the transistor output stage. The circuit shown provides both of these features with the use of only two extra capacitors and two extra resistors.

In the circuit shown, the unijunction transistor forms a simple relaxation oscillator with R_1 , R_2 , C_2 and C_3 . The npn transistor Q_2 serves as an emitter follower output stage to the load R_L . Capacitor C_1 serves as a bootstrap circuit, maintaining a constant voltage across R_1 and thus furnish-



Two-transistor sawtooth generator includes several linearity compensation provisions.

ing a constant charging current to C_2 and C_3 . Resistor R_3 and capacitor C_3 serve as an integrating network which compensates for the loading of the transistor output stage. Resistor R_3 is adjusted to give the optimum linearity. Linearity is improved by using transistor Q_2 with high beta.

Test results with a transistor having beta of 40 at 6 ma were:

- (1) linearity of circuit as shown = 0.3%
- (2) linearity with integrator compensation only (C_1 removed) = 1.0%
- (3) linearity with bootstrap compensation only (R_3 removed) = 2.5%
- (4) linearity with no compensation (C_1 and R_3 removed) = 11%

T. P. Sylvan, Application Engineer, General Electric Co., 1224 W. Genesee St., Syracuse, N.Y.

BASIC BUILDING BLOCKS FROM KEARFOTT



Data Logging

Kearfott's broad line of test equipment includes the Scanalog 200-Scan Alarm Logging System which monitors, logs and performs an alarm function of up to 200 separate temperature, pressure, liquid level or flow transmitters. This precise data handling system is equipped with manual controls for scanning rates, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights correspond to specific points being maintained and provide a visual "off normal" display for operator's warning. System can be expanded to 1024 points capacity and 2000 points per second scanning rate.

Write for complete data.

BASIC BUILDING BLOCKS FROM KEARFOTT



Floated Rate Integrating Gyros

Specifically designed for missile applications, these Kearfott miniature gyros operate efficiently at unlimited altitudes. Their outstanding accuracy and performance make them superior to any comparably-sized units on the market. Hermetically sealed within a thermal jacket, these gyros are ruggedly designed and completely adaptable to production methods. Performance characteristics that are even more precise can be provided within the same dimensions.

TYPICAL CHARACTERISTICS

Mass Unbalance:
 Along Input Axis: 1.0°/hr maximum untrimmed
 Standard Deviation (short term):
 Azimuth Position: 0.05°/hr
 Vertical Position: 0.03°/hr
 Drift Rate Due to Anisotropy:
 Steady Acceleration:
 .015°/hr./g² maximum
 Vibratory Acceleration:
 .008°/hr./g² maximum
 Damping:
 Ratio of input angle to output angle is 0.2
 Characteristic Time:
 .0035 seconds or less
 Weight: 0.7 lbs.
 Warm-Up Time:
 10 minutes from -60°F
 Life: 1000 hours minimum

BASIC BUILDING BLOCKS FROM KEARFOTT



Electrohydraulic Servo Valve

Kearfott's unique approach to electrohydraulic feedback amplification design has resulted in a high-performance miniature servo valve with just two moving parts. Ideally suited to missile, aircraft and industrial applications, these anti-clogging, 2-stage, 4-way selector valves provide high frequency response and proved reliability even with highly contaminated fluids and under conditions of extreme temperature.

TYPICAL CHARACTERISTICS

Quiescent Flow 0.15 gpm
 Hysteresis ... 3% of rated current
 Frequency Response
 3 db @ 100 cps
 Supply pressure... 500 to 3000 psi
 Temperature-Fluid & Ambient
 -65°F to +275°F
 Flow Rate Range3 to 10 gpm
 Weight 10.5 ounces

Write for complete data.

Analog Digital Converter



20 Second Synchro



Integrator Tachometer



Engineers: Kearfott offers challenging opportunities in advanced component and system development.

CIRCLE 303 ON READER-SERVICE CARD

Kearfott

A GENERAL PRECISION COMPANY

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

A subsidiary of General Precision Equipment Corporation
 Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
 Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
 South Central Office: 4211 Denton Drive, Dallas, Texas
 West Coast Office: 253 N. Vineland Avenue, Pasadena, Calif.



now to prove moisture resistance!

Up-up! It's just not worth housemaid's knee to prove you *might* have a pot that can pass Procedure 106-A! Oh, it might take the steamin', alright — but just wait 'til it "breathes" when it's cold! And if you want the acid test — add a dash of polarizing voltage!

But you can count on one pot to withstand the moisture and temperature cycling of MIL-STD 202A: — ACEPOTS have had the engineering design to pass 106-A with ease, even with polarizing voltage! For example, the terminal header is of our exclusive epoxy-impregnated fibreglass, with special case locking to keep out moisture. The shaft end is sealed with high-temperature silicone rubber O-rings bearing seals. Inside, special bronze bearings and precious anti-oxidizing winding and contact metals guard against corrosion. So if moisture-resistance tests make you damp and dour — see your ACErep!



This 3/8" ACEPOT®, as with all our pots, incorporates these exclusive moisture- and corrosion-resistant features.

ACE ELECTRONICS ASSOCIATES, INC.
99 Dover Street, Somerville 44, Mass.
SOMERS 6-5130 TMX SMVL 181 West. Union WUX

Acopot® Acotrim® Acoret® Acoohm® *Reg. App. for

CIRCLE 304 ON READER-SERVICE CARD

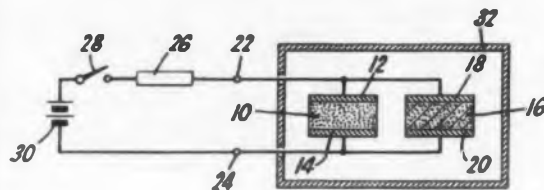
PATENTS

Oscillator

Patent No. 2,898,556. John Matarese. (Assigned to Sylvania Electric Products, Inc.)

Electroluminescence and photoconduction are combined in a system to generate an oscillating voltage waveform.

In a practical embodiment, the electroluminescent layer 10 is in shunt with the photoconductive layer 16, the combination in series with the load 26. Closing switch 28 causes layer 10 to emit light to illuminate layer 16. Photoconduction in-



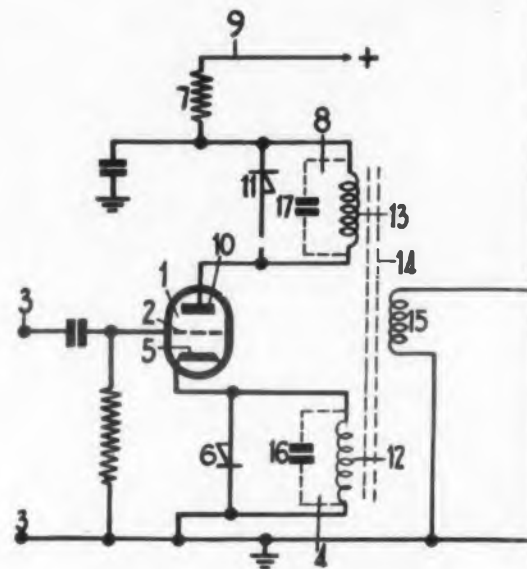
creases and thereby the overall shunt resistance decreases until the voltage across layer 10 is insufficient for electroluminescence. The light source extinguishes, the resistance of the photoconduction layer increases until useful light again is emitted.

The output voltage is substantially sinusoidal.

Electric Pulse Generating Apparatus

Patent No. 2,899,552. Gordon P. French (Assigned to the General Electric Co. Ltd.)

In response to a triggering pulse, the circuit shown in the figure generates two



Platinum

479

ALLOY
POTENTIOMETER
WIRE

Potentiometers wound with our #479 Platinum Alloy Wire have exceptionally low noise level, even after extended periods of shelf life . . .

They can be depended upon for excellent wear characteristics.



SIGMUND COHN CORP.

121 SOUTH COLUMBUS AVENUE,
MOUNT VERNON, N. Y.

CIRCLE 305 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

pulses of the same polarity which are separated in time equal to the duration of the triggering pulse. Diodes in shunt with the ringing networks allow the tuned circuits to respond alternately to the leading and lagging edges of the control pulse.

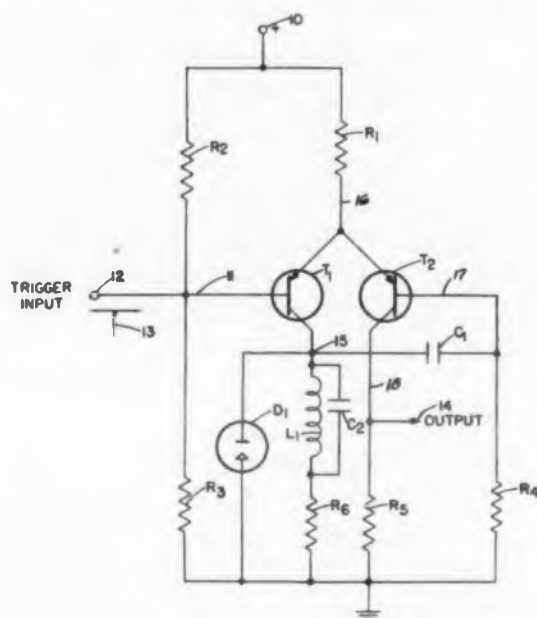
A negative voltage waveform applied to the control grid 2 causes inductance 12 to ring for one half cycle and a positive output is induced in coil 15. When the applied pulse goes positive, inductance 13 rings for one half cycle so that a second positive pulse couples to the output.

Reduction of Multivibrator Recovery Time

Patent No. 2,898,478. Glenn L. Haugen. (Assigned to Bendix Aviation Corp.)

In the quiescent state of a monostable multivibrator, T_1 is cut off while T_2 is conducting to saturation. A negative impulse to terminal 12 causes the circuit to flip. Capacitor C_1 charges in series with resistor R_6 but the resistor is effectively

bypassed by inductance L_1 which rapidly charges capacitor C_1 . The recovery time is effectively reduced and the circuit rapidly flops back to the initial condition having T_1 cutoff. Typical components are specified in the original patent paper.



New UNION readout instruments withstand shock, vibration and extreme temperature changes

Union Switch & Signal's new READALL* readout instrument replaces complicated systems of lights and relays for reading, storing or transferring all types of information for industrial and military applications. It is not to be confused with conventional indicating devices.

Designed to meet requirements of MIL-E-5422D. The new READALL readout instrument is precision-built and provides instantaneous and continuous operation under conditions of shock, vibration and extreme ranges in temperature. The digital display includes characters in numerical sequence from 0 to 9 plus two blank spaces. $\frac{7}{32}$ -inch characters can be illuminated red or white as desired; when not illuminated, they appear white against a black background.

Reliability. Performance through one million random operations is an inherent feature of the new READALL instrument. Each module is gasket-sealed in its case to exclude moisture and seal out foreign particles. An especially thin enclosed DC motor, containing ball bearings, permits more efficient operation.

Modular Construction. A unique feature of the readout instrument is its modular construction. It can be used individually or in groups to display multiple characters in a single case.

Direct Code Translation. The operation of the READALL readout instrument is based on a positioning system using a four-bit code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a decimal read-out. There is no need for additional conversion equipment. Separate code and motor circuits permit the use of the readout instrument in low-level circuitry.

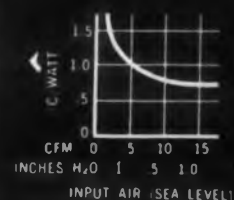
Electrical and Visual Data Storage. Once positioned, the information is displayed until a new code is transmitted to the instrument. No power is consumed while the information is retained. This data may be stored or read-out electrically for further transmission or recording.

Operate Time. The operate time varies from 0.1 second to 1.0 second depending on character position.

Weight and Size. Maximum weight including case is seven ounces; without case, four and one-half ounces. Size encased is $5\frac{13}{64}$ inches long, $1\frac{47}{64}$ inches high and $\frac{39}{64}$ inch wide. The new READALL instrument is designed for operation over a temperature range of -54°C to $+71^{\circ}\text{C}$ in humidities up to 100% and altitudes up to 70,000 feet. For more information, write for Bulletin 1019. *Trademark

NEW-COOLS TRANSISTORS

GETS 46 WATTS AT ROOM TEMPERATURE



NEW HEAT EXCHANGER FOR POWER TRANSISTORS, MODEL LF-101 FITS DELCO TRANSISTORS

46 watts at room temperature are obtained under these conditions: 95°C junction temperature; thermal impedance of $.8^{\circ}\text{C}/\text{W}$ from junction to stud root, and $.7^{\circ}\text{C}/\text{W}$ between stud root and input air caused by the LF-101 (see above graph).

Send for complete data and informative paper, "Temperature Control in Electronic Equipment."

Gasket manufacturing company, inc.
DEPT. E 319 W. 17TH STREET, LOS ANGELES 15, CALIF.

This product featured in May 27, 1959 issue, pg. 122.

CIRCLE 306 ON READER-SERVICE CARD

"Pioneers in Push-Button Science"
UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY —
PITTSBURGH 18, PENNSYLVANIA
CIRCLE 307 ON READER-SERVICE CARD

NEW! Hi-Power CALORIMETER BRIDGE



2% ACCURACY
COAXIAL or
WAVEGUIDE

50 watts, 250 watts, 1000 watts full scale.
Designed for continuous operation at 1000 watts.
Direct reading on all scales.
Simple operation.
All this in one self-contained package of 22" x 17" x 18".

In this Calorimeter Bridge the power dissipated in the R.F. Load is compared to the accurately metered AC power dissipated in a standard load resistor. Two thermopiles connected in opposition to each other indicate balance on a galvanometer. This Calorimeter Bridge is continuously self-calibrated electrically by a bridge-type circuit rather than by mechanical means.

- Provisions for external galvanometer and external wattmeter.
- Uses no thermometers, no flow meters.
- Self-compensating for wide changes in ambient temperature.
- Frequency range DC—4 KMC. (Coaxial)
- Overall Accuracy 2%.
- Accuracy of internal wattmeter 1%.
- Completely self-contained with R.F. Load.
- Connector—1 1/2".

Model CB-25

PRICE: \$3,200.00

Delivery: 60 Days.

WRITE FOR COMPLETE INFORMATION

ELECTRO IMPULSE Laboratory

208 River Street

Red Bank, New Jersey

Phone: SHadyside 1-0404

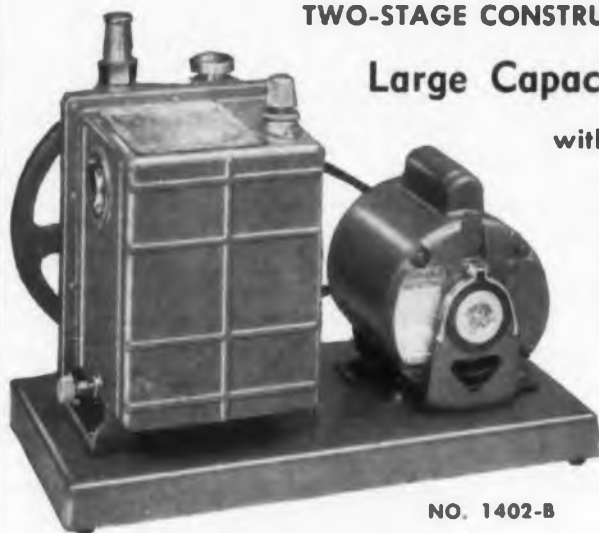
CIRCLE 308 ON READER-SERVICE CARD

Performance-Proved Welch DUO-SEAL VACUUM PUMP

TWO-STAGE CONSTRUCTION

Large Capacity—High Vacuum

with VENTED-EXHAUST
PATENT 2,885,143



NO. 1402-B

EXCELLENT DESIGN
ENDURING
DEPENDABILITY
VERY QUIET RUNNING

GUARANTEED VACUUM
Vent closed, 0.1 micron.

FREE AIR CAPACITY
140 liters/minute
(5 cubic feet)

PAT. NO. 2,337,849

1402B. DUO-SEAL VACUUM PUMP,
Motor Driven. For 115 Volts, 60
Cycles, A.C. Each, \$310.00

1402C. DUO-SEAL VACUUM PUMP,
Motor Driven. For 230 Volts, 60
Cycles, A.C. Each, \$310.00

1402D. DUO-SEAL VACUUM PUMP,
Motor Driven. For 115 Volts, D.C.
Each, \$418.50
For attached Belt Guard, add \$17.50
to above price.

1402. DUO-SEAL VACUUM PUMP,
Unmounted. With pulley, but without
motor, belt, or base. Each, \$240.00

W. M. WELCH SCIENTIFIC COMPANY
DIVISION OF W. M. WELCH MANUFACTURING COMPANY

ESTABLISHED 1880

1515 Sedgwick Street, Dept. ED, Chicago 10, Illinois, U. S. A.

CIRCLE 309 ON READER-SERVICE CARD



BOOKS

Safe Handling of Radioisotopes

International Publications, Inc., 801 Third Ave., New York 22, N.Y., 99 pp., \$1.00

An essential guide to safety standards for all who deal with radioactive materials: exposure levels, medical supervision, monitoring, storage, transportation, decontamination, waste disposal. Available in English, French, Spanish and Russian language editions.

Effects of Nuclear Radiation on Men and Materials

T. Charles Helvey, John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N.Y., 64 pp., soft cover, \$1.80

Nuclear power for propulsion of mili-

tary and civilian vehicles has become a reality. However, the application of nuclear energy in mobile units has presented a great many unexpected and unheard of technological and biological problems. This book discusses the basic nature of nuclear radiation and its physicochemical and biochemical effects. The author has gathered from the huge field of nuclear physics and radiation biophysics as well as from his own research work all pertinent information which is necessary as a background for basic understanding of nuclear radiation. The book is written for persons who are directly or indirectly involved in the numerous aspects of nuclear propulsion and powered vehicles or who have a general

NEW! ENGRAVED Deep-Kut[®]

PIN & PEG STAMPS
are better than
ordinary rubber
3 ways

★ ENGRAVED Deep-Kut is Acid-Proof

★ ENGRAVED Deep-Kut Stamping gives Razor-Sharp impressions every time

★ ENGRAVED Deep-Kut has cushion-like resilience

Engraved Deep-Kut stamp faces are adaptable to any marking device. They can be used to stamp on every surface, metal, wood, fabric, paper, plastic, etc.



THE KRENGEL
INSPECTION POCKET STAMP

THE PIN & PEG

KRENGEL MANUFACTURING CO., INC. Tel. CO 7-5714
227 Fulton St., New York 7, N. Y.

Dept. ED

Please check the following:
FREE ENGRAVED Deep-Kut
Sample & Price List
Please have salesman call
for appointment

NAME
COMPANY
STREET
CITY ZONE STATE

CIRCLE 310 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

interest in this topic.

The prime motive of the author in writing this book is to bring to all who are concerned with nuclear-powered vehicles and those who have an interest in nuclear propulsion the most modern data as well as recent research results in the field called Radiobiology and the effects of nuclear radiation on men and materials. All of this is done without the application of mathematics.

Radar Meteorology

Louis J. Battan, University of Chicago Press, Chicago 32, Ill., 161 pp., \$6.00.

For practicing meteorologists who must keep abreast of radar theory and technique, for teachers who must recommend reading matter to their students, for electronic engineers interested in the effects of weather on microwave propagation, and for researchers who must know what has already been accomplished by their colleagues—here are the advances of the last 15 years summed up and systematized for the first time in book form.

Louis J. Battan, directly acquainted

with the needs of teachers and researchers, provides a concise, well-organized, scientifically sound book to meet those needs. He covers the meteorological use of radar instruments, the meteorological quantities measured by radar, and the relationship of such measurements to more conventional meteorological parameters. The usefulness of the book is enhanced by 76 illustrations.

Printed Circuits

Morris Moses, Gernsback Library Book No. 81, Gernsback Library, Inc., 154 W. 14th St., New York 11, N.Y., 224 pp., \$2.90.

This latest Gernsback Library Book is a virtual encyclopedia on the subject of printed circuits. It traces the development of printed circuits, tells how they are made commercially, how the reader can make them, how they are used in modern electronic equipment, what tubes, transistors, resistors, capacitors and other components are used with them, and how to repair, maintain and apply them in home entertainment, industrial and test equipment.

Complete **LACING CORD** line

designed by

**Electronic
Specialists**

for

ELECTRONICS



Who knows better about lacing cord than the leader who has been designing and manufacturing electronic wire and custom cables for 38 years?

- round cords and flat-braided tapes
- nylon, dacron and teflon-fiberglass
- finishes: micro-crystalline wax, synthetic rubber-like resin, teflon resin, synthetic rubber
- meets industrial specifications and MIL-T-713A
- each spool individually packaged in boxes



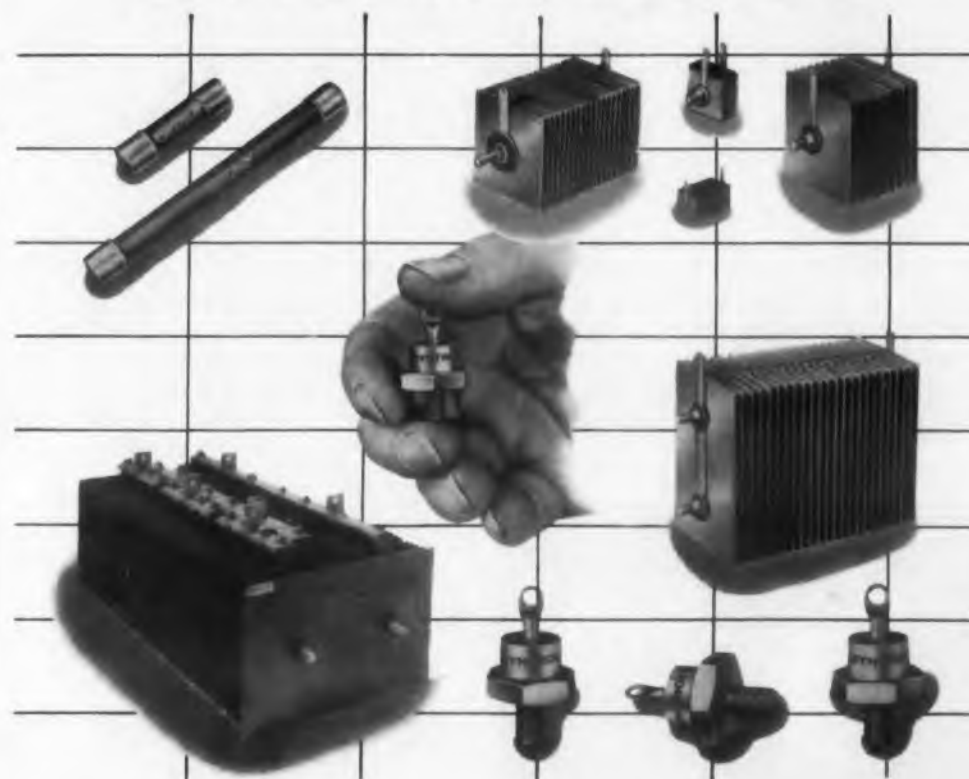
ALPHA WIRE CORPORATION • 200 Varick Street, New York 14, N. Y.

CIRCLE 311 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

SYNTRON

SILICON OR SELENIUM RECTIFIERS



efficient, dependable, low cost a-c to d-c conversion —
for all your d-c needs

SYNTRON provides engineers with the advantages of either silicon or selenium semiconductor materials.

SYNTRON Vacuum Processed Selenium Rectifiers offer the widest range of cell ratings in the industry.

High Voltage Cartridge Selenium Rectifiers are designed for dependability and long life. With direct current ratings up to 10 ma and 13,200 volts. Hermetically sealed and phenolic tube type.

Industrial Power Rectifiers are light weight, dependable and economical: High efficiency, i.e.—ratio of power output to power input for wide range of loads—low forward drop—high reverse voltages—voltages upward to 52 volt R.M.S. Plate sizes range from 1 inch square to 12 x 16 inches.

Silicon Power Rectifiers are designed for use in intermediate power level applications. Diodes are all-welded construction, hermetically sealed. Exceptional thermal efficiency—less than 2 C per ampere of forward current. Supplied as stud mounted units with rigid positive leads.

The illustration above suggests SYNTRON'S complete line of Selenium and Silicon Rectifiers available for all your d-c needs.

Write for detailed literature and Specifications

SYNTRON COMPANY

283 Lexington Avenue

Homer City, Penna.

CIRCLE 312 ON READER-SERVICE CARD

MICRO-MINIATURE RESISTORS

precision wire-wound

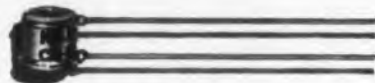
fixed, noninductive

newly developed Kelvin "RELAXED WINDING" techniques practically eliminate resistance drift with age and "shorts" or "opens" due to thermal shock.



PLASTIC ENCAPSULATED SERIES "EP"

The 0.05W micro-miniature type EP-00 is .080" dia. x .325 long, 50K ohms max. resistance. Available with radial and axial lead wires. ALL CONNECTIONS ARE WELDED. High temperature epoxy plastic is used in an exclusive vacuum encapsulation process. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -65°C to +125°C.



CERAMIC SERIES "CB"

The 0.15W miniature type CB-05 is 1/4" dia. x 1/4" long, 00 K ohms max. resistance. Available with radial and axial lead wires. Standard resistance tolerances to 0.1% (specials to 0.01%). Environmental temperature range: -55°C to +85°C.



send for complete literature

KELVIN

ELECTRIC COMPANY

TRiangle 3-8430 • STate 2-6662

5907 Noble Avenue, Van Nuys, California

CIRCLE 313 ON READER-SERVICE CARD



Vitramon[®] CAPACITORS

will help you build

WIDE TEMPERATURE RANGE

... into your circuit systems

VITRAMON capacitors . . . fine-silver electrodes fused to pure porcelain enamel dielectric . . . operate predictably over a range of more than 300°C and come back from the extremes — unaltered.

WIDE TEMPERATURE RANGE?

YES! PLUS . . .

RUGGED LOW LOSS STABLE

VAPORPROOF

LOW NOISE MINIATURE

The biggest names in electronics use VITRAMON capacitors in guided missiles, jet ignition, proximity fuses and in radar, servo, guidance, fire control, telemetering and carrier telephone systems.

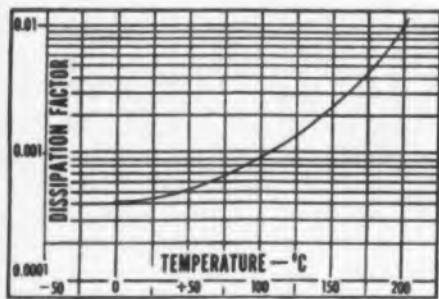
If substitutes are not good enough . . . if you need the best . . . write today!

Vitramon[®]

Incorporated

BOX 544 A • BRIDGEPORT 1 • CONN.

VITRAMON capacitors have low dissipations from -55°C to 250°C.



Two materials — a monolithic block of porcelain enamel and fine-silver electrodes — fused into one strong, stable, efficient and effectively homogeneous **RELIABLE** unit.

CIRCLE 314 ON READER-SERVICE CARD

BOOKS

Shortwave Propagation

Stanley Leinwoll, John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N.Y., 160 pp, soft cover, \$3.90

All present-day radio communication is accomplished by the propagation of radio waves from a transmitter to a receiver. In general, long distance radio communication is carried on almost exclusively in the short wave bands, at frequencies ranging from 3 to 30 mc sec, or wavelengths from 100 to 10 meters.

The purpose of this book is to present in the most useful manner the basic principles of short wave radio propagation, and the way in which they can best be applied in solving the problems of long distance transmission of radio, television, in general the transmission of intelligence. Every subject considered pertinent to an understanding of short-wave propagation is treated in the book, with emphasis on those significant items which the author, in his many years of experience, has found

to be of great concern.

The practical approach is used throughout the book. In particular the chapters on circuit analysis, (a circuit being the communication link between widely separated transmitter and receiver); MUF curves, and forecast ionospheric conditions are highlights of practical usefulness.

Directory of Nuclear Reactors

International Publications, Inc., 801 Third Ave., New York 22, N.Y. 214 pp., \$3.50

The first publication anywhere with detailed, concise, authentic information on the 36 power reactors that will be in operation by 1962: 15 in the U.S.A.; 8 in the U.K.; 4 each in the U.S.S.R. and in France; one each in Belgium, Canada, Czechoslovakia and Sweden. Dimensions and data; fuel elements; flow diagrams; controls.

deep drawn aluminum boxes and covers

11,600 Standard Sizes and Shapes

WITH NO TOOLING COST!



Choose from more than 11,600 sizes, shapes and heights of square, round, rectangular boxes and covers — pay no tooling charge! All can be trimmed and modified to your specification . . . brackets and fasteners can be installed, holes and louvers punched, etc. Complete facilities for welding and painting too! Send print or contact your Zero Representative for quote on custom deep drawn parts using the exclusive Zero-Method tooling.

WRITE FOR
NEW ZERO STOCK
BOX CATALOG



ZERO
MANUFACTURING CO.

1121 Chestnut Street, Burbank, California
Telephone Victoria 9-5521 • TWX 9362

representatives in 26 key cities covering the U.S.
factories in Burbank, California and Palmer, Massachusetts

CIRCLE 315 ON READER-SERVICE CARD

Inventions, Patents, and Their Management

Alf K. Berle and L. Sprague de Camp, D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J., 616 pp, \$12.50

The authors discuss principles and procedures that apply to working with patents in all fields of technology—electrical, mechanical, chemical, nuclear—from hearing aids, can openers and meters to trains, from printing presses, welders and photographic processes to solid fuels.

The theme of this work is that inventing is a business, and he who would work in this field must, to succeed, know its rules and conditions, as in any other business. The inventor who knows the right procedure to follow, and the mistakes to avoid, saves himself much expense, grief, and time.

Non-technical but covering a highly technical subject, this book accurately teaches the language of the business of inventing as used by attorneys, engineers and executives working extensively in this field. By giving a logical grasp of the legal, technical and commercial terms having to do with the subject, it enables

the inventor to understand the people he must work with and to make himself understood by them.

Kaiser Aluminum Forging

Kaiser Aluminum & Chemical Sales Inc., Kaiser Center, Oakland 12, Calif., 322 pp.

The outline of this book is similar to others in the library of Kaiser Aluminum technical volumes. 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.

Forging engineering data presented includes alloy selection, mechanical and physical properties under various conditions, die and forging design recommendations, types of forging and availability and metallurgical quality control. The book also contains a section on forging magnetism and titanium. An extensive glossary of forging terms, to aid the reader in gaining a more comprehensive understanding of the subject, is included.

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 CERAMICS & FERRITES to meet Defense Requirements

Three types of Lead Metaniobate, a new piezoelectric ceramic suited to wide bandwidth applications, provide high operating temperatures and negligible aging. Advantageous in accelerometers, flaw detectors, thickness gauges.

Each of four different compositions of Barium Titanate provides distinctive characteristics especially suitable for transducer use in sonar, missile systems, acoustic mines and ultrasonic particle agitation.

Five Microwave Ferrites, for S, C and X-Band applications, and both low and high power requirements; suited to use in isolators, phase shifters and microwave switches.

A Special Delay Line Ferrite operates in a narrow band at low frequencies and a wide band at high frequencies.

Now available for military applications. For specifications on characteristics, shapes, sizes and for terms of sale, write to Defense Industries Sales, Section 227-29A.

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT, SYRACUSE, NEW YORK

CIRCLE 316 ON READER-SERVICE CARD

RUSSIAN TRANSLATIONS

J. George Adashko

Thermoelectric Cooling of Photomultipliers

E. A. Kolenko, Kh. V. Protopopov, D. G. Fleyshman, and V. G. Yur'yev

THE MOST effective means of reducing photomultiplier dark current is to suppress the thermionic emission from the cathode and the first dynodes. When a photomultiplier with an antimony-cesium cathode is cooled to 0 C, -10 C, and -30 C, the dark current is reduced by a factor of 3, 5, and 30 respectively. Further cooling leads to an even more substantial reduction in the dark current. Cooling a photomultiplier also reduces noticeably the leakage current; this is due to the migration of the cesium atoms from the interelectrode gaps into the cooled portion of the tube.

Various methods, such as liquid air, cryostatic mixture, air blast, dry ice, etc., are used to cool photomultipliers. These are cumbersome. An attractive possibility is the use of semiconductor thermocouple piles for small and simple cooling devices.

Several types of such devices have been developed and produced at the Institute of Semiconductors of the USSR Academy of Sciences.

A cross-section of a thermoelectric cooler with an FEU-19M photomultiplier is shown in Fig. 1. The thermoelectric pile 11 consists of 80 series-connected thermocouples, which are potted in epoxide tar to form a single block. The cold junctions of the pile are in contact with part 3, which touches the glass bulb of the photomultiplier near the photocathode through a system of spring contacts 2. Between the outer case of the cooler, 10, and the inner vessel 8 is a layer of thermal insulation 9 made of foam plastic. The upper removable cover 5 has a panel 6 in which the photomultiplier and socket 1 are placed. Heat from the hot junctions of the thermopile is carried away by the chassis 4. The light reaches the photocathode through a hole in the chassis and in the thermo-

pile. The device described is intended for use in automatic servomechanisms used in astronomic observation.

To cool photomultipliers used in scintillation counting (crystal or liquid types), another thermocouple cooler was developed and produced. Particular attention was paid to the cooling of the FEU-11 multiplier. In this device the heat from the hot junction is removed with running water. There is provision in the cooling chamber, which differs little in its principal details from those shown in Fig. 1, for the placement of cells with the liquid scintillator.

The coolers consume 20 or 25 w of dc power. A temperature drop below room temperature of 30 to 35 deg C was obtained in a volume of 800 cc. Steady state is established in the chamber

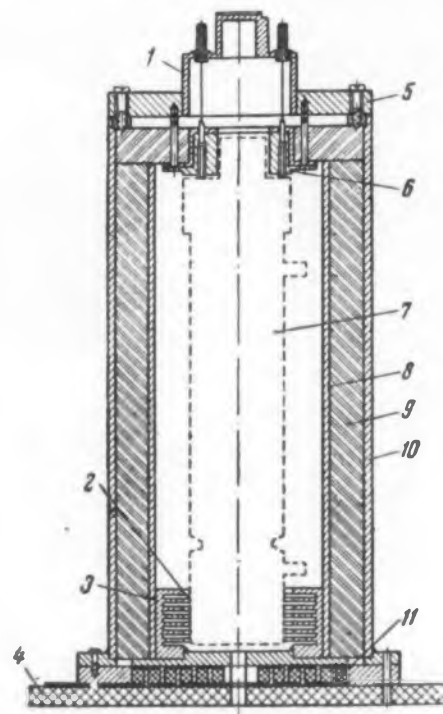


Fig. 1. Cross-section of a thermoelectric cooler with an FEU-19M photomultiplier.

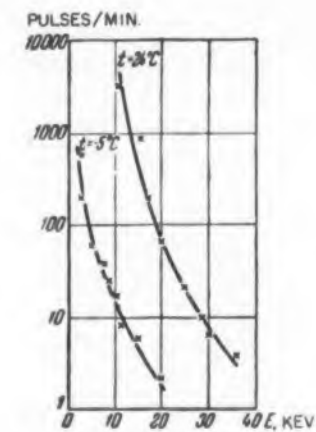


Fig. 2. Effect of cooling on the amplitude distribution of noise pulses of the FEU-11 photomultiplier.

Photomultipliers may be cooled using semiconductor thermocouple piles. In this translation such cooling devices are described and test results using an FEU-11 photomultiplier are given. The noise amplitude was reduced by a factor of 2.5 as the temperature was reduced from +24 to -5 C.

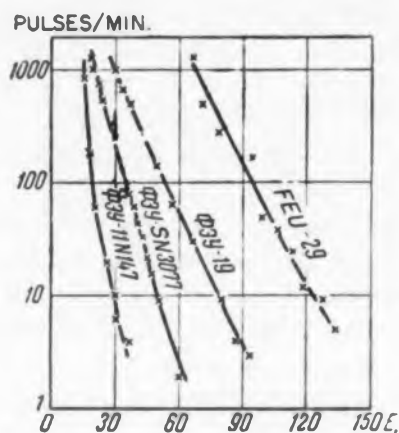


Fig. 3. Integral energy distribution of noise pulses of photomultipliers relative to a standard scintillator.

the anode and grounding the photocathode lead to the cooler, the noise level of the photomultiplier was no longer increased when the cooler was used.

As was to be expected, the condensation of moisture on the bulb of the photomultiplier increased the noise count considerably. To eliminate this, the bulb was thoroughly washed with alcohol, dried, and coated with a thin layer of paraffin. The air in the cooled space was kept dry with a desiccant such as silica gel or phosphorous pentoxide. It was found that the use of the semiconductor cooler reduced the noise of the FEU-11 multiplier from 29 kev at +24 C to 12 kev at -5 C—almost a factor of 2.5 (see Fig. 2). The failure of the FEU-19 multiplier in the setup for the measurement of weak illumination may be due to the negative potential applied to the cathode and to the fact that the FEU-19 has a higher intrinsic noise level than the FEU-11 and the FEU-S (Fig. 3). Another contributing factor is that the thermionic emission does not furnish the principal component of noise and dark current—a decisive role in the production of the noise pulses is played by phenomena that occur in the residual gas in the tube. It has also been pointed out (see I. Pelchowicz, *Rev. Scien. Instruments*, 1955, 26, 470) that noise pulses are also produced by the radioactive K^{40} in the glass of the bulb. Thus, a successful application of the dark current in the photomultiplier is closely related to the improvements in the technology of photomultiplier production. The major problem is to improve the vacuum and to eliminate radioactive contaminations in the materials used in the photomultiplier. At the present time, a new cooler has been developed at the Institute of Semiconductors of the Academy of Sciences, by which a temperature of -25 C can be produced on the mirror of a photocathode.

This article was translated from the Soviet Journal *Instrument and Measurement Engineering*, No. 3, May-June, 1959.

World's smallest
bushing-type chain .1475" pitch

NEW
DIAMOND

Micropitch

for miniature
and sub-miniature devices . . .

Precision-built of non-magnetic
Stainless Steel

DIAMOND *Micropitch* is the first extremely fine pitch bushing chain (.1475") made especially for small-space applications such as cameras, computers, recorders, data processors and many other devices using miniaturized movements. It is ideal for power transmission, synchronization or conveying . . . and conforms to the same high standards of quality that have characterized all DIAMOND chains for more than 69 years.

You are invited to utilize DIAMOND's wealth of roller chain experience. Write for engineering recommendations for your project. Please supply complete details.

DIAMOND CHAIN COMPANY, INC.

A Subsidiary of American Steel Foundries

Dept. 541 • 402 Kentucky Ave., Indianapolis 7, Indiana

OFFICES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

DIAMOND ROLLER CHAINS

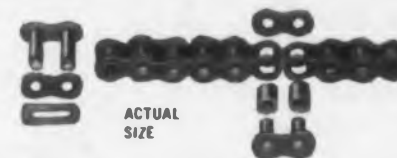


ACTUAL SIZE

SPECIFICATIONS

Pitch1475"
Overall Width210"
Weight per Foot (Approx.)½ oz.
Chain length+.051" to -.000/ft.
Operating Temp.-65°F. to +400°F.
Tensile Strength180 lbs. Average
Material18-8 SS non-magnetic grade
Available also in ¼" Pitch, ASA No. 25 in stainless steel or standard steel.

SPROCKETS—Made to your specifications in regular or stainless steel, bronze, aluminum, nylon or other materials.



CONSTRUCTION

FEATURES—Large joint bearing areas
• High order press fits • Precise chain length control
• Corrosion resistant, non-magnetic stainless steel.



ADAPTABILITY

Permits wide variety of shaft centers.
• Multiple shaft drives can be accurately timed
• Sprockets may engage both sides of chain
• Connecting links easily assembled or disassembled without removing sprockets.

ACTUAL SIZE

CONVEYOR CHAIN

On special order, DIAMOND *Micropitch* chain can be supplied for small conveyors in elongated pitch construction and with special attachments.

CIRCLE 317 ON READER-SERVICE CARD

Reeves
INSTRUMENT CORPORATION

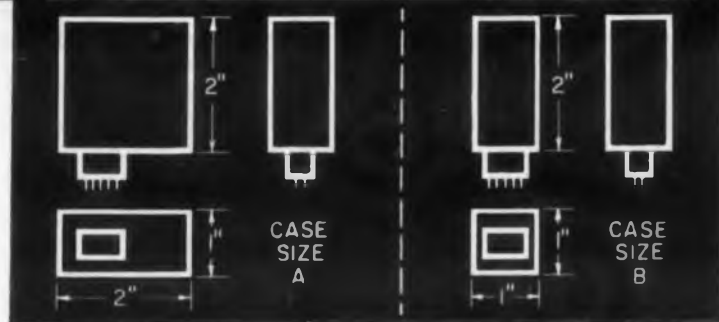
Subminiature Computers

MODULAR DESIGN

- COMPUTER AMPLIFIERS
- COMPUTER CONTROL SYSTEMS



Actual Size



AVAILABLE TYPES

| AMPLIFIER | Case Size | AMPLIFIER | Case Size |
|--------------------------|-----------|-------------------------|-----------|
| Resolver Drive Amplifier | B | A-C Amplifier | A |
| A-C Summing Amplifier | A | D-C Amplifier | A |
| A-C Isolation Amplifier | A | Pulse Amplifier | A |
| AGC Amplifier | A | ADC Drive Amplifier | B |
| Relay Amplifier | A | Pulse Power Amplifier | A |
| Servo Preamplifier | A | Accumulator Amplifier | A |
| Servo Power Amplifier | A | Electronic Differential | A |

Diode Synchro Signal Selector

COMPLETE COMPUTER SYSTEM PACKAGES

- Mid-Course Missile Computers
- Inertial Reference Packages
 - Stable Platforms
 - Rate Loops

REEVES' contributions to such advanced missile programs as DISCOVERER, TITAN and REGULUS are your assurance of proven reliability and performance.

REEVES INSTRUMENT CORPORATION

A Subsidiary of Dynamics Corporation of America • Roosevelt Field, Garden City, N. Y.

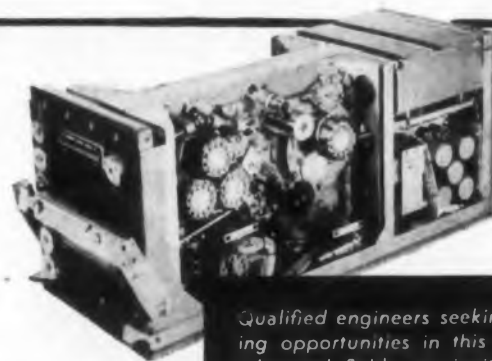


MISSILE-PROVEN
AND TESTED

FULLY DESIGNED AND
DEVELOPED TO MEET
APPLICABLE MILITARY
SPECIFICATIONS

DESIGN FEATURES

- Completely encapsulated for continued reliability under extreme environmental conditions
- Plug-in modular design for rapid assembly and ease of maintenance
- Fully transistorized — Minimum Weight and Volume
- Cadmium-plated steel casings for electrical shielding
- Meet MIL specifications: MIL-E-8189 and MIL-E-5400, Classes I and II



12RV59

Qualified engineers seeking rewarding opportunities in this and other advanced fields are invited to get in touch with us.

REPORT BRIEFS

Simulation Study

The research program conducted under this contract has centered on problems related to radar system analysis, synthesis and design in the broad sense. The program has considered problems in search radar stimulation, search radar angular accuracy, continuous and sampled control system theory, hypothesis testing and estimation. *Simulation Study*, H. Dern, Electronics Research Laboratory, Columbia University, New York, Sept. 1958, 20 pp, Microfilm \$2.40, Photocopy \$3.30. Order PB 140412 from Library of Congress, Washington 25, D.C.

Backward-Wave Amplifier

Results of investigations of the Hughes low noise gun have been published. The noise performance of four tubes constructed during the past quarter is discussed. The construction and performance of the first coupled helix tube are described. Initial work on ruggedization of the tube and studies of possible focusing schemes are presented. *S-Band Low-Noise Backward-Wave Amplifier*, W. M. Mueller, Hughes Aircraft Co., Culver City, Calif., Apr.-June 1958, 20 pp, Microfilm \$2.40, Photocopy \$3.30. Order PB 140247 from Library of Congress, Washington 25, D.C.

Microwave Electronics

Two rectangular waveguide circulators are being constructed in order to test the feasibility of several circulator-filter partition arrays. Each circulator consists of a short-slot hybrid junction and a folded magic T junction separated by a double 90 deg differential phase shift section. The analysis of the operation of this device leads to the conclusion that of all the circulators employing standard components this arrangement offers the most broadband operation. A maximally flat strip line filter having a 2 per cent bandwidth centered at 5 kmc has been constructed. By the use of a simple tuning adjustment the performance of this filter has been optimized. The present model exhibits the desired passband but presents a midband insertion loss of 10 db. Other designs for narrow band filters in the vicinity of 5 kmc presented a lower insertion loss, but do not approach the design performance as closely. Methods of reducing the insertion loss of the maximally flat filter are being investigated. *Microwave Electronics*, Microwave Research Institute, Polytechnic Institute of Brooklyn, N. Y., July 1956, 43 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 136600 from Library of Congress, Washington 25, D. C.

ES

Helitron Oscillator

This study is concerned with a new type of electron beam injection for the helitron oscillator. The helitron, which was invented in 1954 by D. A. Watkins, is a voltage-tuned, backward-wave oscillator in which focusing of the electron beam depends upon a balance between centrifugal force of helical motion and a radial electrostatic field. The new injection mechanism is called slalom injection since the beam is first launched into a path like that of Slalom-Focusing and then injected from the slalom path into the concentric-cylinder geometry of the helitron. The design of a new electron gun to produce a convergent strip beam is discussed in some detail. *Slalom Injection For the Helitron Oscillator*, J. L. Jones, Stanford Electronics Laboratory, Stanford University, Calif., July 1958, 79 pp, Microfilm \$4.50, Photocopy \$12.30. Order PB 140678 from Library of Congress, Washington 25, D.C.

Traveling Wave Tubes

Existing slow-wave circuits which are suitable for use in high peak or average power traveling-wave amplifiers tend to have considerably less bandwidth than that exhibited by low-power traveling-wave tubes. This study relates to two new circuit configurations which are suitable for use at high power levels and which have bandwidths greater than those exhibited by existing high-power circuits. *High Power Applications of the Connected Ring Structure In Traveling-Wave Tubes*, Walter Revis Ayers, Microwave Laboratory, Stanford University, Calif., Dec. 1958, 183 pp, Microfilm \$8.40, Photocopy \$28.80. Order PB 140614 from Library of Congress, Washington 25, D.C.

Variable Capacitor Diodes

The design theory for the afc and fm modulator type variable capacitance diode is presented in detail while the design theory for the electronic tuning type is deferred for later discussion. Small processes have been developed and units have been successfully fabricated that have capacitance in the range of 7 to 70 μf , and Q at 50 mc of 50 or greater. The characterization has proceeded based on capacitance and internal series resistance measurements. These measurements are difficult and cumbersome, since no single instrument will measure the variable capacitance diodes over the required capacitance and Q range. The program for the next interval is based on the investigation for a lower internal series resistance unit coupled with a larger breakdown voltage. *Variable Capacitor Diodes*, L. S. Chase and H. D. Frazier, Pacific Semiconductors, Inc., Culver City, Calif., Apr.-June 1958, 45 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 140253 from Library of Congress, Washington 25, D.C.



TO ENGINEERS

concerned with inner space

When there's no space to spare in your design, consider AE Class S relays. A basic Class S measures only $1\frac{1}{16}'' \times 1\frac{3}{8}'' \times 1\frac{1}{16}''$ and weighs only 2 ounces.

Or, if you need a stepping switch, we have one no larger than a pack of king-size cigarettes.

Relay or switch, they're as uncompromising in quality and ability as their larger brothers.

As an example: the Class S miniature has many of the features of the premium-quality Class B—including sure-footed independent twin contacts.

There's another way we can help on the space problem. AE engineers have had years of experience in devising simplified circuits

with complex capabilities for automatic telephone exchanges. Could be we could show you how to save a relay or two in your design. No harm in asking.

Or, if you'd like to put the switching end of the operation in our hands, we're equipped to supply completely wired and assembled, custom-built control units or help you develop systems to handle anything from sequential programming to... you name it.

Want to get together? Just write the Director, Control Equipment Sales, Automatic Electric, Northlake, Illinois. If you'd like literature ask for our Circular 1702-E: *Relays for Industry*, and the new 32-page booklet on *Basic Circuits*.



AUTOMATIC ELECTRIC

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS



CIRCLE 318 ON READER-SERVICE CARD

REPORT BRIEFS

Cathode Materials For Pulse Modulators

During the program both cold cathodes and hot or thermionic cathodes were investigated. The cold cathode phase of the work included experiments with fine wire ignition, sponge cathodes, ion starting devices, gallium cathodes, dielectric starters, excitrons, semiconductor, ignitors and arc track studies. The hot cathode phase included studies of conventional oxide cathodes in basic thyratron structures and in large and small test diodes. Several sample tubes employing the more promising cold cathode designs were built and the test results are reported. *Investigation of Cathode Materials for Pulse Modulators*, Donald L. Schaefer and James A. Murphy, General Electric Co., Schenectady, N.Y., Sept. 1956, 72 pp, Microfilm \$4.50, Photocopy \$12.30. Order PB 140435 from Library of Congress, Washington 25, D.C.

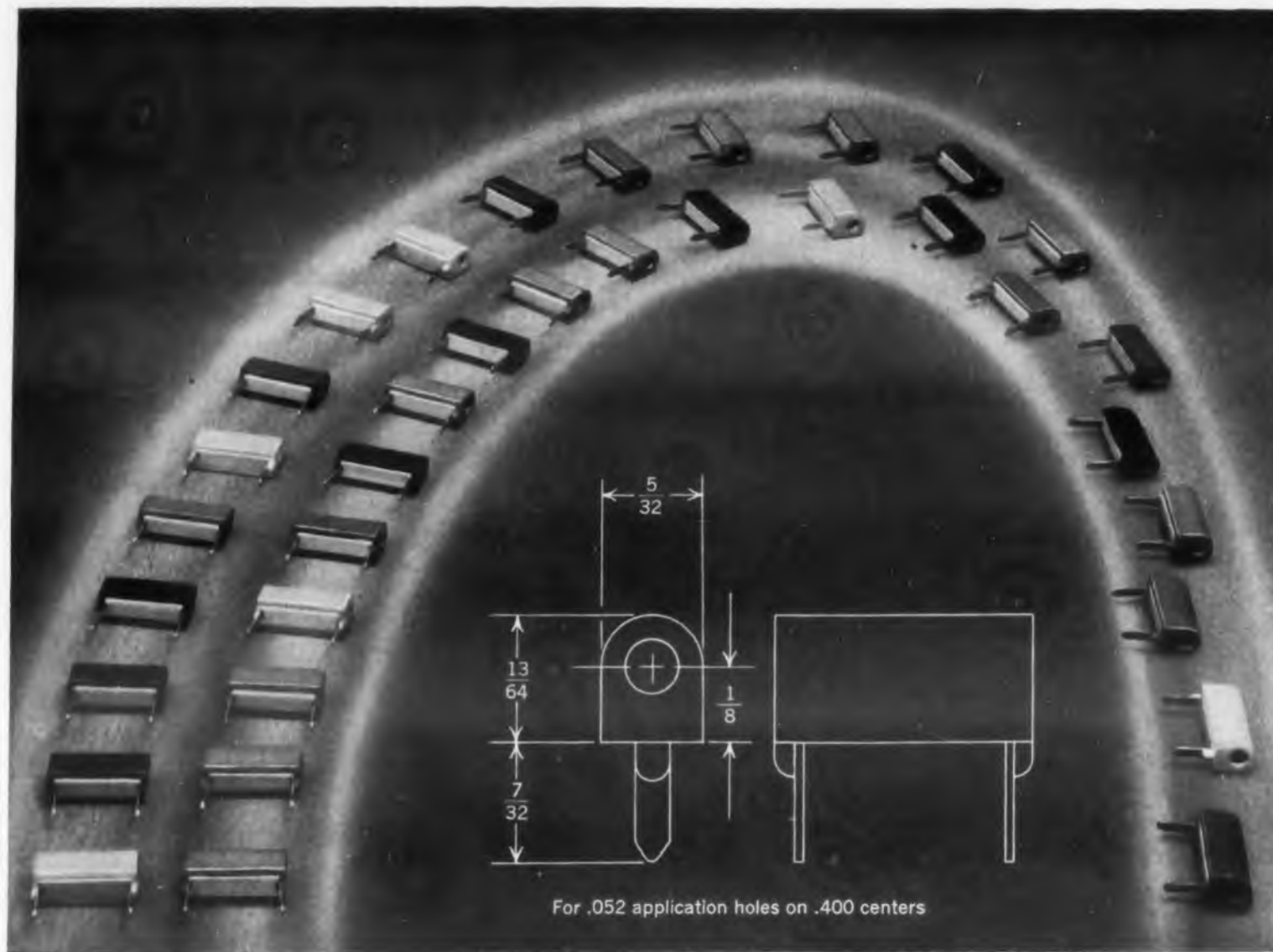
Semiconductor Comparator Circuits

An actual circuit will possess errors in its measurement of amplitude and/or its indication of time because of noise and drift effects. Comparison can only be defined for a finite field of measurement consisting of a prescribed range of time and amplitudes. A certain minimum power is required to meet given specifications on the field and accuracy of comparison; the circuit requiring no greater power is an optimum comparator and is the best realizable circuit.

Comparison is a nonlinear operation and a criterion is presented to indicate the degree of nonlinearity, or sharpness, of comparators. This sharpness criterion reveals definite advantages in the use of semiconductor circuits. The same criterion indicates that regenerative circuits should perform comparison better than non-regenerative circuits. *Semiconductor Comparator Circuits*, G. L. Hoehn, Jr., Stanford Electronics Laboratory, Stanford University, Calif., July 1958, 94 pp, Microfilm \$5.40, Photocopy \$15.30. Order PB 140688 from Library of Congress, Washington 25, D.C.

Pacore Antenna

As part of the program for developing lightweight antennas for air search radars, four scale models and one full-sized version of the PACORE antenna were constructed and tested. The full size antenna was designed for the uhf range and has side and back radiation more than 24 db down over the 400-to-450 mc band. It does not meet the air search radar requirements for low secondary lobe levels, but may be useful for wide-band directional communication. The antenna and pedestal weigh less than 500 lbs., and are rugged and compact. *Development of Pacore (Parabolic)*



Patent Pending

New Test Jacks for Printed Circuits

Designed for permanent assembly to printed circuit boards, these new test jacks by Ucinite are easily accessible to standard .080 test probes and eliminate the need for individual adaptor boards.

Simple, economical construction ensures reliability and reasonable cost. Gold-over-silver-plated beryllium copper contacts provide dependable, low-resistance connections. Nylon bodies are available in eleven standard code colors specified as follows: Part number (119437) plus letter suffix . . . A-Opaque

White, B-Red, C-Black, D-Brown, E-Green, F-Orange, G-Blue, H-Yellow, J-Gray, K-Violet, L-White translucent.

With an experienced staff of design engineers plus complete facilities for production of metal and plastic parts and assemblies, Ucinite is capable of supplying practically any requirement for fasteners, connectors, switches and other small metal and metal-and-plastics assemblies. Call your nearest Ucinite or United-Carr representative for full information or write directly to us.

Manufactured by

The UCINITE COMPANY

Division of United-Carr Fastener Corporation, Newtonville, Mass.



Corner Reflector) Antenna, J. H. Jensen, Navy Electronics Laboratory, San Diego, Calif., Jan. 1955-July 1958, 31 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 140554 from Library of Congress, Washington 25, D.C.

Y-Type Circulator

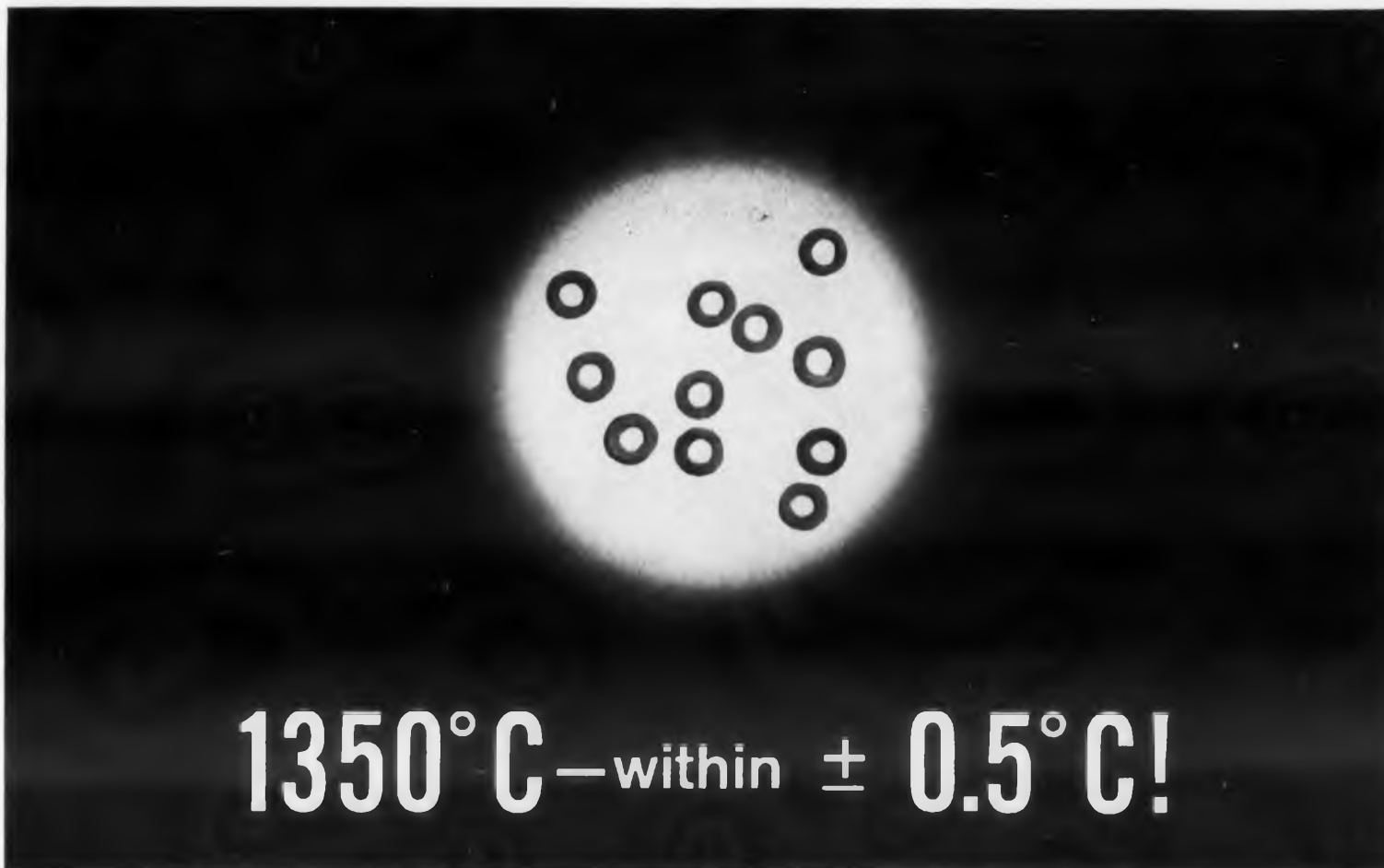
It is well known that the field distribution in a rectangular waveguide containing a magnetized ferrite can be asymmetrical even though the physical configuration is symmetrical. By properly choosing the ferrite, its shape, and location, it is possible to concentrate the energy on one side of the waveguide. Reversing the field or changing the direction of propagation will cause the energy to concentrate on the other side of the waveguide. This phenomenon has been utilized to construct a new type of circulator. *The Y-Or Junction-Type Circulator*, H. N. Chait and T. R. Curry, Naval Research Laboratory, Washington, D.C., May 1959, 9 pp, \$0.50. Order PB 140554 from OTS, Washington 25, D.C.

Pulse-Doppler Radar

While conventional pulsed radar effectively accomplishes the functions of range measurement and range resolution, it is unable to separate targets that occur within the same space element but have different velocities (e.g., it cannot distinguish between moving targets and fixed clutter). The new radar, which was developed to allow velocity discrimination, does not give range information, although various schemes such as amplitude or frequency modulation have been devised to allow useful range determination. Of course, either scheme has angular resolution determined by its antenna array.

A pulse-Doppler radar combines the range measuring and resolving advantages of the pulsed radar with the velocity discrimination capabilities of the cw radar. The combination of the two principles leads to an increase in equipment complexity over that which would be required for either system alone, but the advantages of the pulse-Doppler system often justify the added complexity.

The range-measuring and velocity-measuring capabilities of a pulse-Doppler system are interrelated, and one purpose of this report is to discuss their relationship. The information presented herein was collected in conjunction with the development of a tracking radar. The same general considerations also apply to search radars, however, and some of the dissimilarities are noted. *Some Pulse-Doppler Radar Design Considerations*, Robert E. Richardson, Lincoln Laboratory, Massachusetts Institute of Technology, Cambridge, Mass., Aug. 1957, 33 pp, Microfilm \$3.00, Photocopy \$6.30. Order PB 140422 from Library of Congress, Washington 25, D.C.



1350°C—within $\pm 0.5^\circ\text{C}$!

...another example of unequalled "in-process" controls for

RCA MEMORY CORES

Unusually stable temperature during "firing" of RCA Cores makes possible extremely high uniformity of electrical characteristics... provides you with RCA Cores to meet your most rigid specifications!

The electrical characteristics of a memory core are directly determined by the temperature at which the ferrite material is fired. The more constant the temperature, the more uniform the electrical characteristics. And the electrical furnaces in use at RCA's Needham Heights materials lab are controlled to within $\pm 0.5^\circ\text{C}$ at temperatures as high as 1350°C . This precise control means not only high uniformity from core to core...but the tightest production controls on your cores

from order to order.

This extremely efficient firing technique is still another example of "in-process" controls employed by RCA in every stage of manufacture from the selection of raw materials to the inspection of finished product. For Ferrite Cores, Planes, and Stacks to meet your specific design requirements, contact your local RCA Field Representative. For technical data, write RCA Commercial Engineering, Section J-18-NN-2 Somerville, New Jersey.



Unique memory-plane and stack tester dynamically tests every RCA core in every RCA plane while the entire stack is being driven under actual use conditions...provides 100% testing at actual computer frequencies.

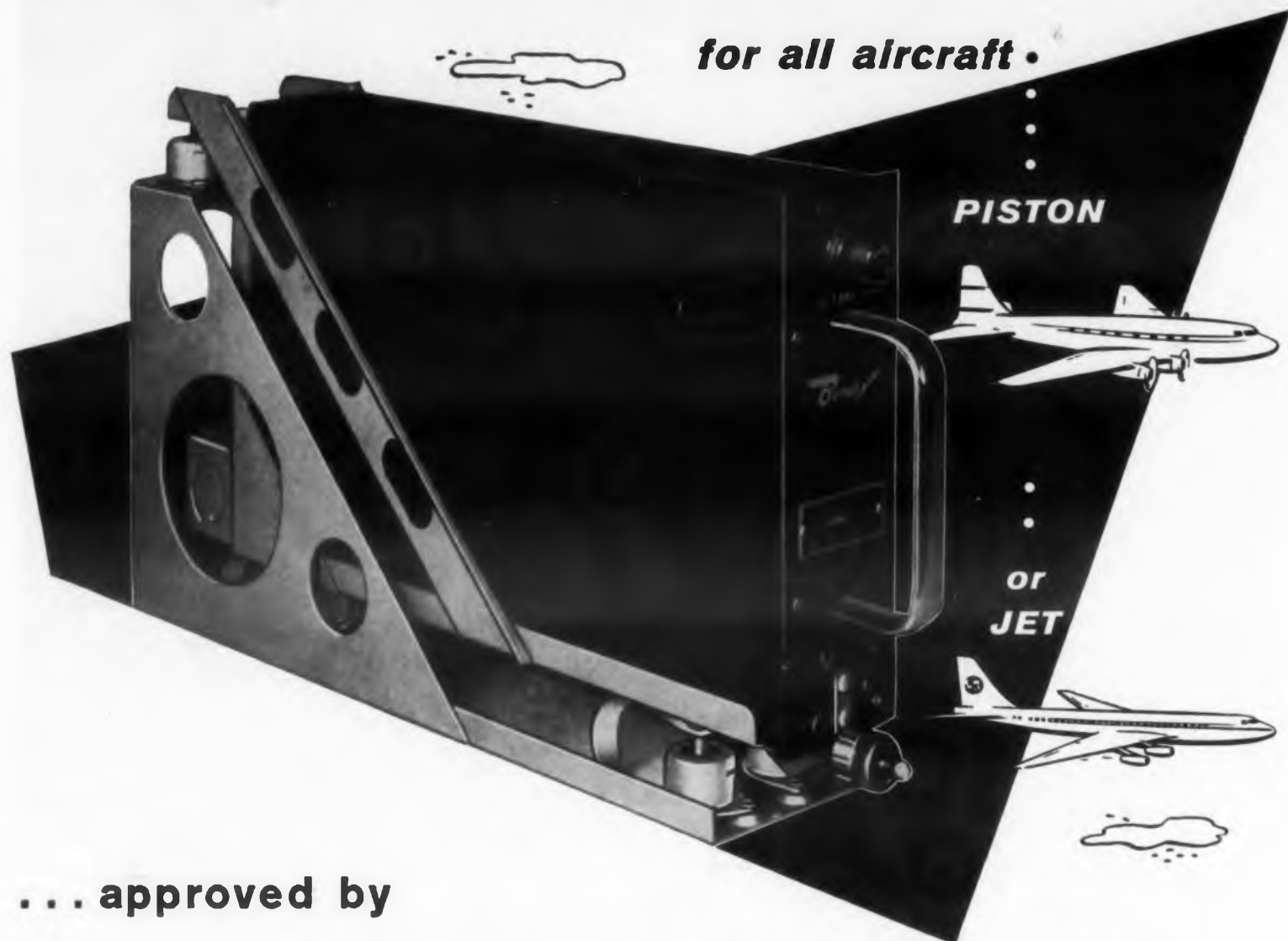


RADIO CORPORATION OF AMERICA
SEMICONDUCTOR AND MATERIALS DIVISION • SOMERVILLE, N. J.

East: 744 Broad Street, Newark, N. J.
Humboldt 5-3900
Northeast: 64 "A" Street, Needham Heights 94, Mass.
Hillcrest 4-7200
East Central: 714 New Center Bldg., Detroit 2, Mich.
Trinity 5-5600
Central: Suite 1154, Merchandise Mart Plaza
Chicago, Ill. Whitehall 4-2900
West: 6355 E. Washington Blvd.,
Los Angeles, Calif. RAymond 3-8361
Gov't: 224 N. Wilkinson St., Dayton, Ohio
Baldwin 6-2366
1625 "K" Street, N.W., Washington, D.C.
District 7-1260

MOUNTING SYSTEMS

for all aircraft •



... approved by
electronic equipment manufacturers for aircraft use

Here's why LORD is your best source for electronic mounting systems:

Complete line of ATR bases for both piston and jet aircraft . . . plus special systems.

Superior performance results from LORD's 35-year background in vibration/shock/noise control. This assures positive protection for radio transmitters and receivers, radar, Doppler, Loran, ILS, antennae, controls and other equipment.

Good delivery is insured by proved designs, qualified components and complete modern facilities for engineering, production and testing.

Why not prove it to yourself? Contact the nearest LORD Field Engineering office or the Home Office, Erie, Pa.

FIELD ENGINEERING OFFICES

ATLANTA, GEORGIA - Cedar 7-9247
BOSTON, MASS. - Hancock 6-9135
CHICAGO, ILL. - Michigan 2-6010
DALLAS, TEXAS - Riverside 1-3392
DAYTON, OHIO - Baldwin 4-0351
DETROIT, MICH. - Diamond 1-4340
KANSAS CITY, MO. - Westport 1-0138
LOS ANGELES, CAL. - Hollywood 4-7593
NEW YORK, N. Y. - Circle 7-3326
PHILADELPHIA, PA. - PEnnypacker 5-3559
SAN FRANCISCO, CAL. - EXbrook 7-6280
WINTER PARK, FLA. - Midway 7-5501

"In Canada - Railway & Power Engineering Corporation Limited"

LORD MANUFACTURING COMPANY • ERIE, PA.

CIRCLE 319 ON READER-SERVICE CARD

SPECIFY LORD MOUNTING SYSTEMS:

Standard ATR systems for piston aircraft. Available in ¼, ⅓, ½ and full sizes, short and long versions. Meet all applicable specifications including ARINC-404 shock and vibration requirements. Utilize proved Temproof Mountings.

Standard ATR systems for jet aircraft. Available exclusively from Lord with BTR (Broad Temperature Range) elastomeric mountings. Excellent all-altitude control of high-frequency vibration from -65° to +300°F.

Special mounting systems. Custom designed on complete systems basis to meet specific needs. Integrated bases can be furnished which combine equipment, connectors, components on a common structure. Extensive experience assures system will meet cost and performance goals.

LORD®

REPORT BRIEFS

Iterative Network Synthesis

This report is intended to introduce and demonstrate some properties of the iterative method of zero-pole network synthesis in the frequency domain, as well as to extend its applications. Maximally flat or equal ripple frequency response approximation is used in illustrations and applications. The philosophy of the iterative method consists of the choice of reasonable starting poles or zeros of a network function corresponding to a designated circuit configuration, and the repeated computation of zeros from poles, and vice versa through the use of the realization and frequency response constraints, alternately, until it converges within the desired accuracy. *A Study of the Iterative Method of Network Synthesis*, C. Y. Chang, Stanford Electronics Laboratory, Stanford University, Calif., July 1958, 98 pp, Microfilm \$5.40, Photocopy \$15.30. Order PB 14068 from Library of Congress, Washington 25, D.C.

Traveling Wave Tubes

Two sample low-noise traveling wave tubes were studied to determine their performance suitability and limitations as microwave amplifiers. Noise figure as a function of electrode voltage, solenoid current and frequency were measured as well as the cold vswr gain-frequency and gain-helix voltage characteristics of the tubes. Well regulated voltage and current supplies were found to be needed for stable operation of the narrow band tubes. Measurement techniques were laborious, and automated procedures are clearly called for. *Investigation of Low Noise Traveling Wave Tubes*, Bernard Kilimnik, Material Laboratory, New York Naval Shipyard, Brooklyn, N.Y., Mar. 1959, 43 pp, Microfilm \$3.30, Photocopy \$7.80. Order PB 140498 from Library of Congress, Washington 25, D.C.

Meteor-Burst Communications

A meteor-burst communications system has been established between Stanford, Calif., and Bozeman, Mont. In one typical three-day study of errors in teletype transmitted over this burst system, 73 percent of the errors occurred in the last character of bursts of usable signal. A technique for identifying and measuring the end-of-burst errors is briefly described. Erasing the last character of each burst and retransmitting it at the start of the next burst is suggested as one remedy for these end-of-burst errors. *End-of-Burst Errors in Meteor-Burst Communications*

B. M. Sifford and Irwin Roth, Stanford Research Institute, Menlo Park, Calif., Feb. 1959, 10 pp, Microfilm \$1.80, Photocopy \$1.80. Order PB 140408 from Library of Congress, Washington 25, D.C.

Power Sources

The theoretical and practical limitations and capabilities of generating electrical power by means other than rotating machinery and conventional batteries are discussed. Data and theory on the oscillating generator utilizing permanent magnet excitation, the variable reluctance oscillating generator, metal thermopiles, semiconductor thermopiles, thin film thermopiles, the fuel cell, junction silicon solar cell, and nuclear converters are presented.

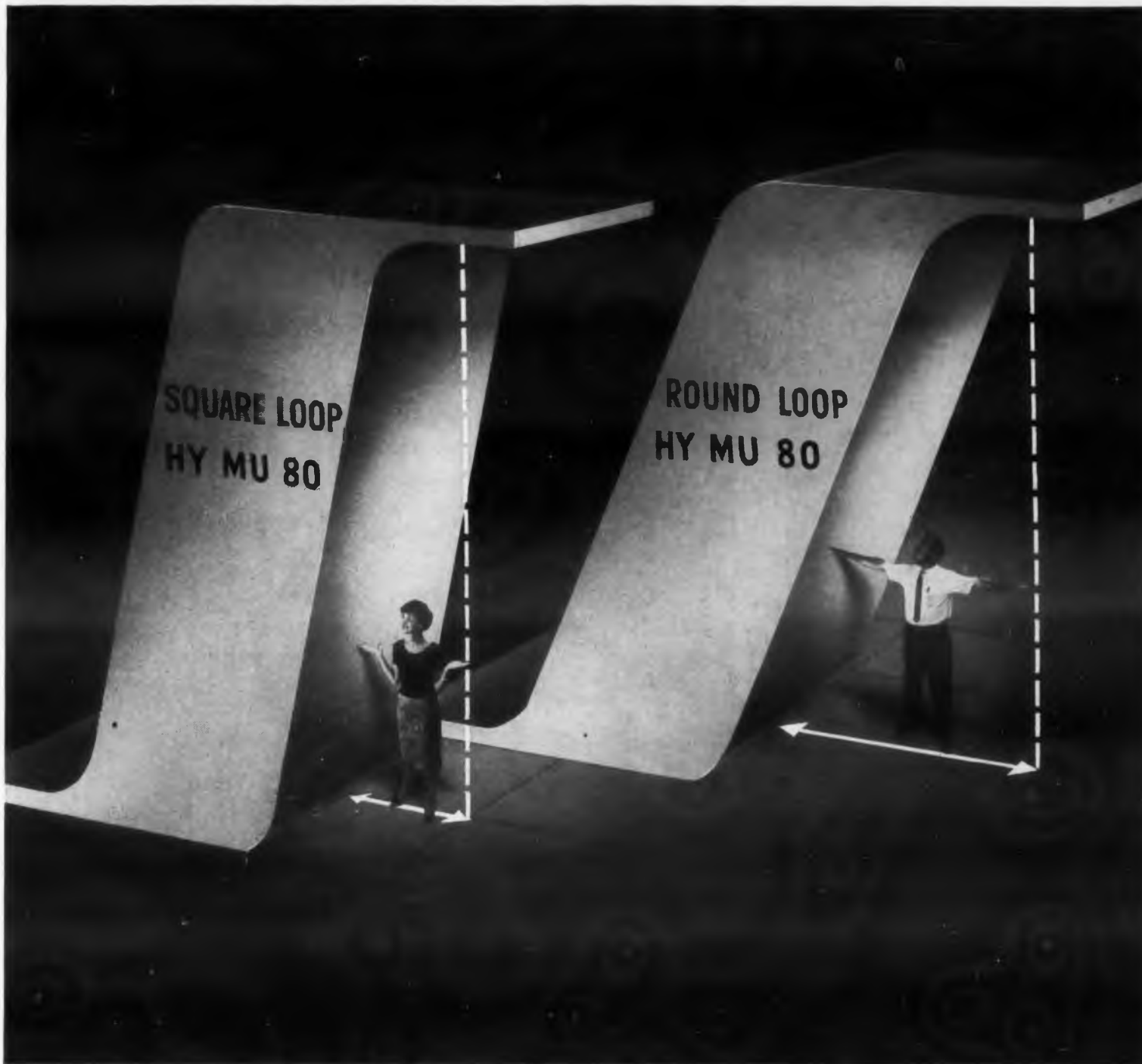
Results of laboratory experimentation are presented on the permanent magnet oscillating generator, the variable reluctance generator, metal thermopiles, and the silicon solar cell. Objectives of the study and experimentation included the determination of efficiency of energy conversion, weight and size per unit power output, range of voltage and current, life and reliability. *Unconventional Electrical Power Sources*, Paul A. McCollum, Oklahoma A and M College School of Electrical Engineering, Stillwater, Okla., Sept. 1956, 112 pp, \$2.50. Order PB 151726 from DTS, Washington 25, D.C.

Design of A Summing Circuit

After an introduction and an outline of the ionization chamber as a source of input to the proposed circuit, the design approach is explained. The functions to be performed by the circuit are defined and components to perform them are selected. This leads to a derivation of generalized transfer functions for high frequency transistors, an investigation of 2N384 unit capabilities, and to a determination of the requirements for a linear pulse amplifier.

A series AND-gate circuit employing saturated transistors has been chosen as coincidence circuit. To control this gate a mono-stable multivibrator is designed. After an integration of the design components, capabilities of passive peak-summing circuit and of diode shunt-gate are experimentally demonstrated. *Design of a Triple-Coincidence-Gated Summing Circuit*, D. B. Harris, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, Mar. 1959, 86 pp, Microfilm \$4.80, Photocopy \$13.80. Order PB 140730 from Library of Congress, Washington 25, D.C.

PUTTING MAGNETICS TO WORK



Vive la différence in Hy Mu 80!

For greater sensitivity—Magnetics, Inc. makes Round Hy Mu 80 for more output at low flux densities
For greater gain—Magnetics, Inc. makes Square Hy Mu 80 for more voltage amplification

There's an important difference in the two basic kinds of Hy Mu 80, Round Loop and Square Loop. By taking advantage of it, you design magnetic amplifiers with better performance and efficiency characteristics. We stock standard tape wound cores made of both, to be sold at non-premium prices. We want you to order the right kind.

Round Hy Mu 80 is demanded when flux densities are down around the 10 to 50-gauss level. Its high initial permeability results in great sensitivity. It also means fewer windings, thus smaller sizes. Combine higher inductance, great sensitivity and small size, and if you are a designer of devices like low level transformers or thermocouple amplifiers, then you want Round Hy Mu 80 tape cores.

On the other hand, if you design sensitive high gain magnetic amplifiers you need Square Hy Mu 80. The transfer curve is so

linear and so nearly vertical that a minute change in input produces an extremely sharp response. When only a small bias supply is available, you get a lot more amplifier per dollar. Preamplifier designers are among our best customers.

So *vive la différence!* Order the right Hy Mu 80 for your needs. We'll supply either, and what's more, we'll supply them quickly. Want the full story? Write Magnetics, Inc., Dept. ED-71, Butler, Pennsylvania.

MAGNETICS inc.

CIRCLE 320 ON READER-SERVICE CARD

REPORT BRIEFS

Strip Transmission Lines and Components

In the introduction to this report, the background of strip-line techniques is presented briefly, and the advantages and disadvantages of strip line compared to waveguide and coaxial line are discussed. The two major types of strip line, the shielded type and the unshielded type, are described, and it is explained why the Stanford Research Institute program was devoted solely to the first of these.

Formulas and design graphs are given for the characteristic impedance, attenuation, and Q of a shielded-strip transmission line. A theoretical analysis is given of the coupling between coplanar strips. Formulas and nomogram charts are presented for the characteristic impedances of the basic even and odd modes of propagation on the strips. The information on coupled strips is applied to the design of strip-line directional couplers. Formulas are derived for the design of coupled-transmission-line directional couplers that are rigorous for any value of coupling. A general analysis is given for flat-plate resonators between parallel ground planes.

A standing-wave meter for shielded strip line was designed and constructed. An experimental study of strip-line T-junctions was begun during this program, and experimental data are presented for a series of symmetrical junctions having a through-arm characteristic impedance of about 50 ohms and stub-arm characteristic impedance ranging from about 35 to 100 ohms. A typical strip-line network containing a number of different strip-line components was constructed, and described in this report. A low-power oscillator was developed using strip-line elements and pencil-type triode. *Strip Transmission Lines and Components*, S. J. Cohn, P. M. Sherk and others, Stanford Research Institute, Menlo Park, California, Feb. 1957, 217 pp, Microfilm \$9.60, Photocopy \$33.30. Order PB 137860 from Library of Congress, Washington 25, D.C.

Microwave Measurement Techniques

Fundamental methods relating to the measurement of basic microwave quantities such as voltage, impedance, power, attenuation, frequency, and noise are described as well as multimode measuring techniques. Following a brief introduction to the evolution of microwave theory with stress on modal representations and reflection coefficient concepts, slotted-line techniques involving crystal diode detectors are evaluated for measuring voltage, wavelength, and impedance under cw and pulsed excitations. Sources of errors are considered.

MYCALEX® 410 glass-bonded mica

the world's most nearly perfect
precision-molded electronic insulation



“gives high impact strength . . . superior insulating value,” in ITT's TACAN beacon

Latest achievement in air navigation and traffic control is TACAN, an advanced radio air navigation system developed by ITT LABORATORIES, DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, for the U. S. Navy and Air Force.

Prominently featured in the 12 KV discharge switch of TACAN's ground beacon transmitter is MYCALEX 410 glass-bonded mica insulation. Here and in other applications, this precision-molded insulation shows exceptional mechanical strength and superior electrical resistance. It will withstand operating temperatures to +600°F . . . and has total dimensional stability!

Why was MYCALEX designed into this item? Says ITT: “MYCALEX was selected because of its high impact strength and excellent insulating properties, which we found to be as good as or better than grade L-4B in ceramic. In addition, the good molding properties of MYCALEX made it possible to design the insulator with convolutions which increased the creepage path to ground.”

MYCALEX 410 is one of a wide variety of glass-bonded mica and ceramoplastic insulation materials created and perfected by MYCALEX CORPORATION OF AMERICA. Whatever insulation characteristics you require, there is a MYCALEX material to meet your need. For example, SUPRAMICA® 560 precision-molded ceramoplastic offers a maximum operating temperature of +932°F . . . and SUPRAMICA 620 machinable ceramoplastic offers a maximum operating temperature of +1550°F. Write today for specifics.

General Offices and Plant: 121-H Clifton Blvd., Clifton, N. J.
Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.

WORLD'S LARGEST MANUFACTURER OF GLASS-BONDED MICA AND CERAMOPLASTIC PRODUCTS
CIRCLE 321 ON READER-SERVICE CARD

TACAN Polar Co-ordinate Navigation

SYNTHAMICA®
SYNTHETIC MICA

MYCALEX®
SINCE 1919
ELECTRICAL INSULATION

SUPRAMICA®
CERAMOPLASTIC

MYCALEX
CORPORATION OF AMERICA

well as techniques for realizing precision data. Power measuring methods involving thermal and electronic elements known as calorimeters, barethermometers, thermistors, film bolometers, thermocouples, and crystals are discussed and evaluated. An analysis is made of errors present in measuring pulse power with thermal elements. Coaxial and waveguide cavity resonators for measuring wavelength are described with emphasis on constructional details. Additional topics include direct and indirect procedures for measuring attenuation, calibration of noise sources, multimode measuring techniques, and measurement of network parameters. *A Survey of Microwave Measurement Techniques*, Anthony B. Giordane, Microwave Research Institute, Polytechnic Institute of Brooklyn, N.Y., May 1956, 58 pp, Microfilm \$3.60, Photocopy \$9.30. Order PB 140920 from Library of Congress, Washington 25, D.C.

Fixed, Power, Wirewound Resistors

Studies were conducted to determine the effects of hf (55 to 2000 c with a 10-g constant-peak acceleration) and lf vibration (10 to 55 c with a 0.03-in. amplitude), mechanical shock (30 impacts at a 10-g peak acceleration), and constant acceleration (50 g for 5 sec) on the mechanical and electrical properties of fixed-power wirewound resistors. The following categories of specimens were studied: (1) cylindrical body with lug terminals and brackets for mounting; (2) elliptical body with lug terminals and brackets; (3) cylindrical body with axial terminal leads; (4) cylindrical body with axial lug terminals and a band at each end; and (5) cylindrical body with axial terminal leads and one band at the center. Results showed that only one mechanical and 3 electrical failures occurred in 47 specimens as a result of lf vibration. Mechanical-shock forces caused 2 electrical and no mechanical failures in 137 specimens. Constant-acceleration forces caused 1 mechanical and 4 electrical failures in 140 specimens. No transient electrical conditions were observed during stress-measuring of the specimens. Measured electrical-resistance changes were less than 0.2%. Hf vibration was the most damaging of the stresses. *Component Evaluation and Specification Engineering Final Report on Task XVIII. High-Frequency Vibration and Shock Testing on Fixed, Power, Wire-Wound Resistors*, E. G. Lebre, Jr. and P. G. Perry, Battelle Memorial Institute, Columbus, Ohio, Feb. 1955, 71 pp, Microfilm \$4.50, Photocopy \$12.30. Order PB 137080 from Library of Congress, Washington 25, D.C.

MOTOROLA TEMPERATURE COMPENSATED ZENER DIODES TO .0005% / °C

NEW silicon diffused junction
precision components
for applications demanding
extreme stability... reliability

ELECTRICAL CHARACTERISTICS, at 10.0 ma

| Type Number | Voltage Range @ 10.0 ma (25°C Ambient) Volts | Voltage-Temperature Coefficient %/°C | Temperature Range °C |
|-------------|--|--------------------------------------|----------------------|
| 1N2620 | 8.9-9.7 | .01 | 0 to +75 |
| 1N2620/A | 8.9-9.7 | .01 | -55 to +100 |
| 1N2620/B | 8.9-9.7 | .01 | -55 to +150 |
| 1N2621 | 8.9-9.7 | .005 | 0 to +75 |
| 1N2621/A | 8.9-9.7 | .005 | -55 to +100 |
| 1N2621/B | 8.9-9.7 | .005 | -55 to +150 |
| 1N2622 | 8.9-9.7 | .002 | 0 to +75 |
| 1N2622/A | 8.9-9.7 | .002 | -55 to +100 |
| 1N2622/B | 8.9-9.7 | .002 | -55 to +150 |
| 1N2623 | 8.9-9.7 | .001 | 0 to +75 |
| 1N2623/A | 8.9-9.7 | .001 | -55 to +100 |
| 1N2623/B | 8.9-9.7 | .001 | -55 to +150 |
| 1N2624 | 8.9-9.7 | .0005 | 0 to +75 |
| 1N2624/A | 8.9-9.7 | .0005 | -55 to +100 |
| 1N2624/B | 8.9-9.7 | .0005 | -55 to +150 |

* Maximum Dynamic Impedance: 15 ohms at 10 ma (all types)

IMMEDIATELY AVAILABLE
FROM STOCK

Contact your nearest Motorola
Semiconductor distributor
for off-the-shelf delivery.

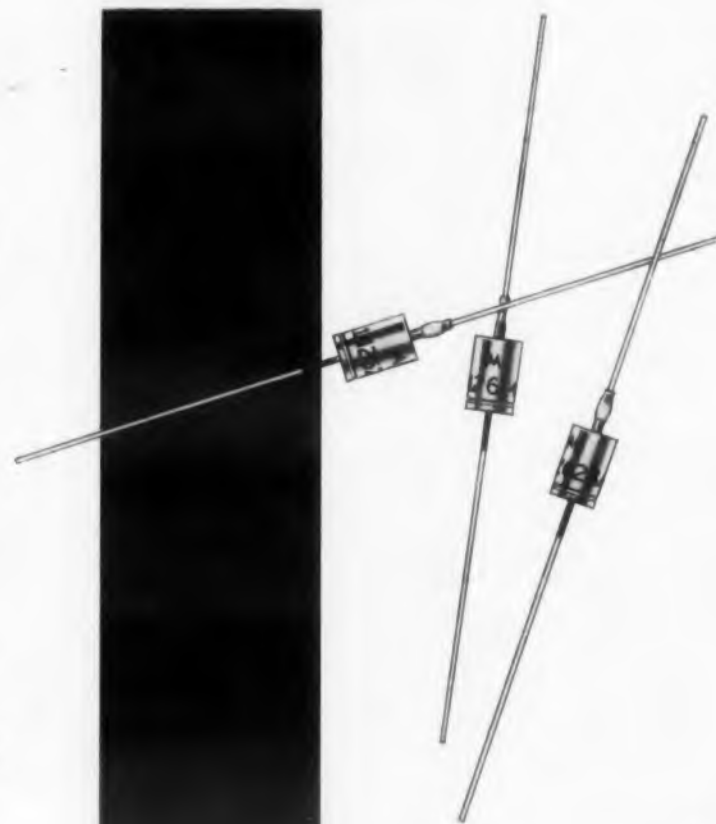
REGIONAL OFFICES:

RIDGEFIELD, NEW JERSEY
540 Bergen Boulevard
Whitney 5-7500
from New York WI 7-2900

CHICAGO 30, ILLINOIS
5234 West Diversy Avenue
Avenue 2-4300

HOLLYWOOD 20, CALIFORNIA
1741 Ivar Avenue
Hollywood 2-0821

OUTSIDE U.S.A. AND CANADA WRITE: MOTOROLA INTERNATIONAL, S.A.
4545 West Augusta Boulevard
Chicago, Illinois



Offering temperature coefficients as low as .0005% per °C and temperature ranges as wide as -55 to +150°C, these new Motorola devices provide an extremely stable 9.3 volt reference source. The new axial-lead, flangeless package (only .22" x .35") is ideal for automatic insertion in printed circuit boards and simplifies connections to terminal strips. Units meet or exceed mechanical and environmental requirements of MIL-S-19500 providing the same reliable operation as Motorola's standard zener diodes.

These new Motorola diodes are designed for such voltage reference applications as digital voltmeters, precision high-stability oscillators, frequency meters, analog to digital converters and precision DC power supplies. And, they are available, now, from your Motorola Semiconductor Distributor.

NEW MIL SPEC ZENERS ALSO AVAILABLE

Three new Motorola 10 watt zeners (1N1353-1N1358-1N1361), the first ever produced to military specifications, are now available. Contact your nearest regional office for complete information.



"DEPENDABLE QUALITY—IN QUANTITY"

**MOTOROLA
SEMICONDUCTORS**

MOTOROLA, INC., 5005 E. McDOWELL, PHOENIX, ARIZONA

CIRCLE 322 ON READER-SERVICE CARD

SEVEN TUBES FOR STEREO



EF86 6267

High gain AF input pentode with exceptionally low noise, low hum and low microphony.



ECC83 12AX7

Double triode, low hum, low microphony, low noise, high gain tube.



ECL82 6BM8

Miniature triode pentode for use as audio amplifier and output tube. Two tubes in ultralinear push-pull can supply up to 7 watts of stereo power per channel.



EL84 6BQ5

Miniature 12 watt high slope pentode. A medium power high fidelity tube particularly suitable for compact stereo circuits, up to 17 watts per channel.



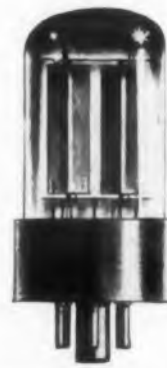
EL34 6CA7

Highly sensitive 25 watt pentode. Two tubes in ultralinear push-pull providing up to 34 watts output, particularly suited for compact integrated stereo amplifiers.



EZ81 6CA4

Miniature full wave cathode type rectifier with high voltage and with good regulation supplying up to 150mA.



GZ34 5AR4

Bantall full wave cathode type rectifier, supplying high voltage with good regulation for currents up to 250mA.

Mullard

ELECTRONIC TUBES

used throughout the world



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

Supplies available from:
In the U.S.A.

International Electronics Corporation
81 Spring Street, New York, 12, N.Y.
U.S.A. Worth 6-0790.

In Canada

Rogers Electronic Tubes & Components
116 Vanderhoof Avenue, Toronto 17,
Ontario, Canada. Hudson 5-8621.

**MULLARD OVERSEAS LTD., MULLARD HOUSE,
TORRINGTON PLACE, LONDON, ENGLAND**



STANDARDS AND SPECS

Sherman H. Hubelbank

Tube Capacitance Measurements

IEC No. 100, RECOMMENDED METHODS FOR THE MEASUREMENT OF DIRECT ELECTRODE CAPACITANCES OF ELECTRONIC TUBES AND VALVES

Covered in this publication are receiving tubes and valves; phototubes, photocells, and multiplier types; and high-power vacuum tubes and valves. The measurements and descriptions of methods of measurements of electrode connections are included. Standard sockets, shields, and cap connections to be used are specified. Copies of this publication may be purchased from ASA.

Fittings

MIL-F-3922, FLANGES, WAVEGUIDE, AND ASSOCIATED FITTINGS, AMENDMENT 1, 24 APRIL 1958

Quality assurance provisions have been modified to incorporate the standard paragraphs on responsibility for inspection.

Capacitors

MIL-C-18312A(NAVY), CAPACITORS, FIXED, PAPER (OR MYLAR) DIELECTRIC METALLIZED D-C HERMETICALLY SEALED, AMENDMENT 1, 6 MARCH 1958

It is now possible to produce all capacitors meeting this spec that are impregnated with wax or oil. The qualification submission requirements have been modified.

MIL-C-19321(SHIPS), CAPACITORS, FIXED, CERAMIC DIELECTRIC STANDOFF, AMENDMENT 3, 11 MARCH 1959

The power factor has been corrected to read 2.5% at 25 C, 1 kc per sec. The list of referenced publications has been completely changed. Two new styles for type CK81 capacitors have been added. The packaging requirements have also been changed.

Receptacles

CSA C22.2 No. 42-1959, RECEPTACLES, PLUGS AND SIMILAR WIRING DEVICES

The spec applies to attachment plugs (caps and adaptors), receptacles, cord connectors, motor-attachment plugs, and current taps of the general-use types. These items are rated at 60 amp or less and 250 v and less. For industrial types the rating is 200 amp or less and 600 v and less. Copies of this standard are available from the Canadian Standards Association, 235 Montreal Road, Ottawa 2, Canada, for \$1.75 per copy.

Waveguides

MIL-W-85C, WAVEGUIDE, RIGID, RECTANGULAR, AMENDMENT 4, 12 JUNE 1959

Quality assurance provisions have been modified to include the standard paragraphs on responsibility for inspection.

Resistors

MIL-R-10509C, RESISTORS, FIXED, FILM (HIGH STABILITY), AMENDMENT 2, 26 JUNE 1959

The supersession data is corrected to reflect that MIL-R-10509B is superseded in its entirety, but that MIL-R-19074B(SHIPS) is only superseded in part.

Power Supplies

MIL-STD-7, POWER SUPPLY VOLTAGES FOR ELECTRONIC EQUIPMENT, 22 DECEMBER 1958

Nominal values for regulated dc power supply voltages within the range of 100 to 500 v are established by this standard. Of particular importance is the requirement that the nominal values of all regulated dc voltages within the range of 100 to 500 v, positive or negative shall be selected from the following list: 100, 150, 250, 300, and 450 v. These values shall be used for internal power supplies used in subassemblies, assemblies, major units, or accessories.

Drawings

MIL-STD-7, TYPES AND DEFINITIONS OF ENGINEERING DRAWINGS, 18 FEBRUARY 1959

This standard defines types of engineering drawings prepared by the Departments of the Army, the Navy, and the Air Force, and by contractors. The following major types of drawings are covered: arrangement, assembly, book form, construction, detail, diagram, standards, elevation, envelope, erection, installation, plan, and tabulation, to name a few. Examples of the drawing are also shown.

Now 4 CHR High Temperature TEFLON® Tapes



Pressure-Sensitive TEFLON Tapes

easy to apply in both electrical and mechanical applications

The electrical uses of Temp-R-Tape include slot lining, interlayer and interphase insulation, harness bundling, wrapping for microwave components, transformer coils, capacitors and high voltage cables, etc.

As a low friction, non-stick facing, Temp-R-Tape applications range from facings for film guides in sensitive electronic instruments to the facing for heat sealing bars, forming dies, chutes, guide rails, etc.

Chemical resistant facing applications include masking tape in high temperature dipping operations.

All four of these pressure-sensitive Teflon tapes are available from stock in rolls and in sheet form. In addition to Teflon tapes, CHR also makes a fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape GV) and silicone rubber coated fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape SGV).

FREE SAMPLES and folder — write, phone or use inquiry service.

- -100°F to 500°F applications
- Class H and Class C insulation
- Non-stick and low friction facing
- Chemical resistant facing

TEMP-R-TAPE T is a .006" pressure-sensitive Teflon tape with -100°F to 400°F (-70°C to 200°C) temperature range. It has high dielectric strength, low power factor, negligible moisture absorption, high elongation, is non-corrosive and non-contaminating. Meets Class H Temperature requirements.

TEMP-R-TAPE TH is a .013" pressure-sensitive Teflon tape with -100°F to 400°F temperature range. It is similar to Temp-R-Tape T except that it is made of .010" Teflon film to which .003" silicone polymer adhesive has been added. Often used where a single, thicker dielectric barrier is desired or where a more rigid, abrasion resistant wrap is required.

TEMP-R-TAPE C is a .002" pressure-sensitive, thermal curing Teflon tape with -100°F to 500°F temperature range. It is made with a cast Teflon film which provides dielectric strength (2750 v/m) higher than any other type of Teflon film. When cured in place, it will operate at temperatures up to 500°F and will withstand much higher temperatures for short periods. Meets Class H and Class C temperature requirements.

TEMP-R-TAPE TGV is a thermal curing, pressure-sensitive Teflon impregnated fiberglass tape with -100°F to 500°F temperature range. Although it is used extensively for mechanical and electrical applications, its dielectric strength is lower than other Temp-R-Tapes.

CHR products include:

COHRLastic Aircraft Products — Airframe and engine seals, firewall seals, coated fabrics and ducts

COHRLastic Silicone Rubber Products — Silicone rubber moldings and extrusions, silicone rubber sheets, silicone sponge rubber

Temp-R-Tapes — Pressure sensitive, thermal curing Teflon and silicone tapes

Allied Products — COHRLastic silicone cements and conductive gasketing

CHR

Leader In Fabrication of Silicone Rubber

CONNECTICUT HARD RUBBER COMPANY

Main Office: New Haven 9, Connecticut

CIRCLE 324 ON READER-SERVICE CARD

ANALYZE COMPLEX WAVEFORMS

30 CPS TO 50 KC
WITH THE **DONNER 2102**



FEATURES

- * Wide Frequency Coverage
30 cps to 50 kc
- * 160 μ v to 500 v
Full Scale Range
- * Narrow Band Crystal Selectivity Filters
- * Convenient Operation
- * Mechanically and Electrically Rugged

APPLICATIONS

The Model 2102 is used to analyze fundamentals and harmonics in vibrating systems and to analyze intermodulation products in sub-audio, audio, and carrier systems. It speeds analysis of hum, noise and distortion in recorders, amplifiers and filter networks.

CONVENIENT OPERATION

The fundamental frequency component is tuned with the large calibrated dial, and the amplitude of the fundamental is adjusted to a 0 db, or reference level. Tuning the dial to the frequency of each component of interest gives the relative amplitude of that component

Basically a frequency selective vacuum tube voltmeter, Donner's Model 2102 Wave Analyzer accurately measures the amplitude and frequency of each component of a complex input wave form, whether or not the components are harmonically related.

on the panel meter. The mirror-scale panel meter reads the relative amplitude directly in percentage of the fundamental, or in db below the reference level.

BRIEF SPECIFICATIONS

| | |
|-----------------------|---|
| FREQUENCY RANGE | 30 cps to 50 kc |
| FREQUENCY CALIBRATION | ± 3 percent plus 10 cps |
| VOLTAGE RANGE | Full scale deflection from 160 μ v to 500 v |
| VOLTAGE ACCURACY | ± 5 percent |
| INPUT IMPEDANCE | 200,000 ohms |
| SELECTIVITY | 3 db down at ± 9 cps, 40 db at ± 40 cps |
| DOMESTIC PRICE | \$645 f.o.b. factory |

Write for complete technical specifications. Address Dept. 1010

DONNER SCIENTIFIC
COMPANY
CONCORD, CALIFORNIA

CIRCLE 325 ON READER-SERVICE CARD



Education For Education's Sake Not Enough

Dear Sir:

I agree with your editorial (*ED*, June 24, p. 21), that an engineering education is a good education for today's world, but isn't salary also important? It seems to me a case of the laws of supply and demand at work. Apparently college freshmen have balanced the "years of hard study" against salary prospects and have decided not to buy.

Remember that in a free economy, a shortage is only relative. You can buy any quantity of a commodity if you pay enough!

Jerome Mendel, Sr. Engineer
Stavid Engineering Inc.
Plainfield, N.J.

Answer to Problem Needed

Dear Sir:

There is a widespread need for a way to control the gain of a transistor amplifier. We would like an 80 db reduction in gain in which the db reduction is proportional to the avc voltage or current. A 40 db reduction that is logarithmic would be a great help. Simplicity is important so the circuit should require only 2 or 3 transistors.

Laurence G. Cowles
Electronic Design Engineer
The Superior Oil Co.
Bellaire, Tex.

Let's Try These Again!

The equations of the article "New Approach to Transistor DC Bias," which appeared in the July 22 issue, seemed to have lost a few pieces in transcription. The author, Mr. J. P. White of Leeds & Northrup Co., Philadelphia, Pa. was kind enough to call our attention to our errata.

LETTERS

Eq. (1) lost a multiplier β , and should read $I_c = \beta (I_{CBO} + I_B)$.

Closing brackets were omitted in Eqs. (5) and (7).

In the denominator of equation (5), the quantities of U_{k2} , L_{k1} and U_m should read U_{k2} , L_{k1} and U_m , respectively

With these few changes and with the symbol V restored to the battery in Fig. 2, the article is as good as new.

Beware of Agencies

Dear Sir:

I read with interest your article "Can An Employment Agency Help You Find the Right Job?" The presentation, however, is rather one-sided. The views of Messrs. Davis and Duffy present the brighter side of job placements. I believe that you owe it to your readers to emphasize the other side as well.

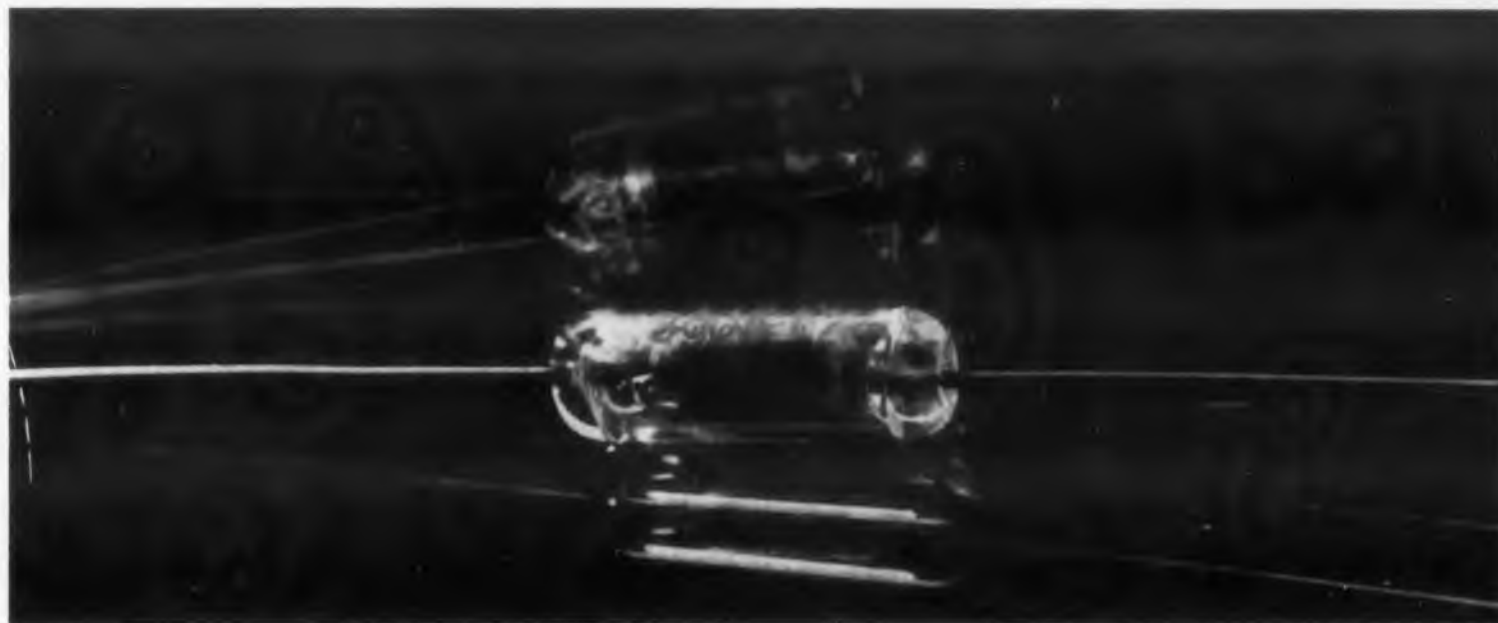
Many engineers are lured into contracts with these agencies by advertisements of well-defined "fee-paid" jobs. These jobs, however, do not materialize. Poorly placed referrals are made to any and all employers that might hire the applicant with the hope that when the applicant does change positions, he will select one of the companies to which he was referred.

In my own case, I was referred to a so-called "job shop" engineering firm by a reputable employment agency. Here I was offered a non-existent position on a fee paid basis. The job and written contract never did materialize. Subsequently, I was offered a position in another state through another agent for the same job shop firm. Before starting work, I asked all parties involved for a clarification of the fee issue of the old referral. I was assured that it was not applicable in this instance, that it was also illegal, and that no claim would be made for same. A week later I received a bill from the first agency for securing me a "permanent" position with the job shop firm. I'm now embroiled in a lawsuit that has yet to see a

(Continued on p. 124)



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 $\frac{1}{4}$ -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 326 ON READER-SERVICE CARD

an infinite variety
STANDARD PLASTIC PARTS
 knobs, handles, feet, pulls,
 pointers etc. in a thou-
 sand and one varia-
 tions . . . all avail-
 able without
 tooling costs.

FREE
 CATALOG
 samples on request

HARRY DAVIES MOLDING COMPANY
 1428 N. Wells St., Chicago 10, Ill.

CIRCLE 327 ON READER-SERVICE CARD

specify . . .
G-E 85C
TANTALYTIC*
CAPACITORS

for low-voltage a-c and d-c applications
 requiring superior performance, small
 size.

- Dependable operation over a tempera-
 ture range of -55C to +85C.
- Longer shelf life and operating life
 than previous units.
- Polarized, non-polarized, etched, or
 plain foil Tantalitic capacitors are avail-
 able.

SPECIFYING INFORMATION on G-E's
 complete Tantalitic line is available from
 your nearest Apparatus Sales Office, or
 write for GEC-808D, to General Electric,
 Section 449-12, Schenectady 5, N. Y.

*Registered Trademark of General Electric Co.

GENERAL ELECTRIC

CIRCLE 328 ON READER-SERVICE CARD

LETTERS

(Continued from p. 123)

courtroom but have already spent more time and money on the case than any job is worth.

I hope to enter as many of the "shyster" activities used against me into the proceedings so that all of the details will be available for publication without any danger of libel to publishers. Until then, this sketchy outline is all that I can submit.

Gus Kandaric
 Cincinnati, Ohio

▶ Although most employment agencies dealing with engineers are reputable in so far as we know, it is certainly true some engage in questionable practices. We have an article in the works on how to select an employment agency. This article is being written by an authoritative personnel manager in the field of engineering recruitment.

Wanted: More and Better Output, Less Work in Engineering

In "Wanted: Fewer Dreamers, More Doers in Engineering," in a recent issue of *ELECTRONIC DESIGN*, Mr. Bernard Gordon argued that through full responsibility over a project our engineering shortage would be reduced. He states that a "back to engineering" movement is necessary to balance out the heavy drain of manpower now devoted to theoretical or "systems thinking" as he calls it.

Mr. Gordon, president of Epsco Inc., states that the highly departmentalized-service type group organization kills both the will to create and to succeed.

The success of Epsco has made it possible for him to advance these concepts with a justifiable degree of authority. However, we must examine this success and see whether it can qualify for the extensive conclusions he has reached.

In a project involving up to four or five engineers, it is conceivable that the project engineer will understand each problem encountered, and, being the most capable of his group, will have supplied a large proportion of the answers. As the organization expands and many such engineers are performing similar functions, the situation becomes confused, with many individuals trying to accomplish the job that should have been the function of one man.

In his discussion, Mr. Gordon has dealt with the small product line where a man can see all



Versatile Rollpin®

simplifies design, speeds production

ROLLPIN can be used in place of taper pins, solid straight pins, set screws, hinge pins, dowels, clevis pins . . . and in some cases as a rivet.

ROLLPIN is a slotted, cylindrical spring pin deliberately oversized in relation to standard production drilled holes . . . compressive forces lock it in place. Reaming or secondary safety operations such as peening are eliminated.

ROLLPIN is easy to install, easy to drive out with a drift pin or punch, yet will "stay put" indefinitely.

ROLLPIN is available for immediate off-the-shelf delivery—comes in sizes from .062" diameter to .500" in carbon steel, corrosion resistant steel or beryllium copper.

For a free bulletin detailing Rollpin applications and installation methods, write to Dept. R53-1057.



**ELASTIC STOP NUT CORPORATION
 OF AMERICA**

2330 Vauxhall Road, Union, New Jersey
 CIRCLE 329 ON READER-SERVICE CARD

One of a series

Say Engineer, When You Mean Engineer

Somehow it's become popular to speak of science and technology—popular, that is, with everyone but engineers.

Engineers are in a partnership with scientists in this great industrial nation of ours—designing its products, constructing its communications, and even producing its missiles.

The U. S. is reaping fruits of a highly developed technology—a vast body of engineering and scientific know-how. And the fellows with that know-how are scientists and engineers.

So when you speak of these fellows—or write of them—call them what they call themselves. Call them engineers.



Engineers Joint Council
 29 West 39th St., N. Y. 18, N. Y.

For information, call Pennsylvania 6-9220

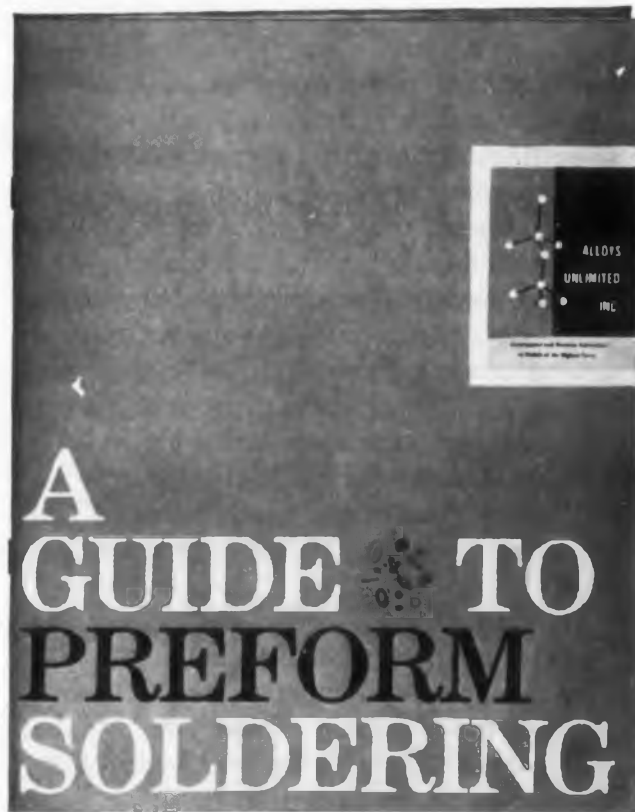
New Cold Cathode Thyratrons Stable, Rugged, Subminiature



The KP-96 is a high gain, grid controlled cold cathode tube for time delay, trigger, counter and energy transfer circuits. New design features include small size (T-2) subminiature envelope, only 0.3" in diameter, rugged construction and stable anode hold-off and grid-firing voltages. Within the anode supply voltage range of 100-300 v, the firing of the tube is controlled by application of voltage to the grid (95v). The transfer current is far lower than previously available, equalling less than 1.0 micro-ampere. The KP-96 offers a higher ratio of anode hold-off voltage to grid-firing voltage than available before, smaller size, rugged structure, operation in both light and total darkness, high efficiency energy transfer. Since it requires no filament power supply, the KP-96 stands by at full sensitivity consuming no power. Radioactivity is included for operation in total darkness. Another model, type KP-96A, is available without radioactivity for use under ambient light conditions. For details on this and other special purpose electron tubes, write

KIP ELECTRONICS CORPORATION

Dept. 915, STAMFORD, CONNECTICUT
CIRCLE 331 ON READER-SERVICE CARD



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 332 ON READER-SERVICE CARD

ELECTRONIC DESIGN • October 28, 1959

the facts of the job and where he can do the work. However, much or most of today's work involves much larger systems than can be handled by one, 10, or even 100 engineers. It is the organization with this type of project which cannot afford to design the smaller pieces of hardware, and thus is the best, and probably the major customer of the smaller, specialized firms like Epsco.

The "systems" thinking which Mr. Gordon deplores is responsible for the bulk of today's electronic projects. Without it, the large computers, communication nets, etc., would not exist. Try to conceive of the Bell Telephone System organized along the lines suggested by Mr. Gordon.

However, we should recognize that Mr. Gordon was trying to emphasize the point that larger responsibility can result in more work output per engineer. In doing so he has greatly exaggerated the faults of the departmentalized service groups.

Milton Collins

(Company name withheld by request)

► Mr. Gordon declines to comment.

Meet Foreign Competition with Creative Sales

Dear Sir:

It was interesting reading your editorial "We need a Radio to Export to Japan" in the July 8 issue 1959. In concurring with the requirement of men, brain power, engineering and automation, I think creative sales, advertising and astute merchandising should also be added.

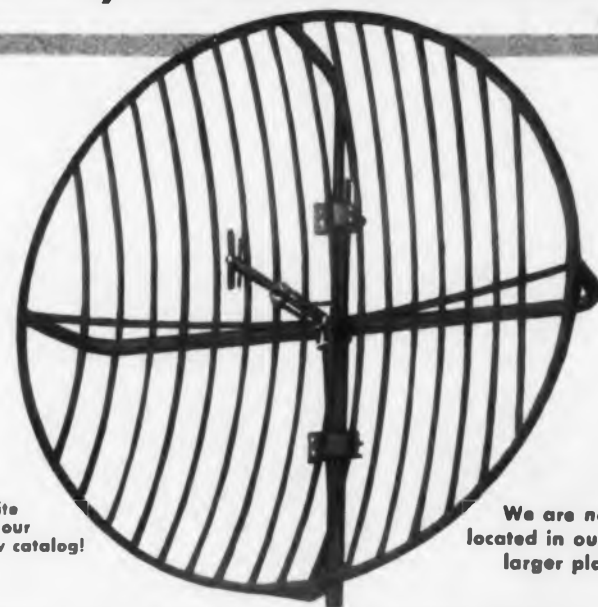
The Canadian editor of Electronics and Communications in the July 1959 issue suggests remedial tax relief, legislative action and interest-free loans to reduce the sale of Japanese radios in Canada. . . .

Thank goodness our electronics industry does not subscribe to a completely controlled government protection program to maintain sales and reduce the democratic right of all of us to freely compete on the open market by using engineering, automation and creative sales to bridge the gap of competition.

Fred Kluhsman, Manager
Sales Promotion and Merchandising
W. H. Brady Co.
Milwaukee 9, Wis.

► Ed. Note: Had our editorial been directed to salesmen and merchandising men, we most certainly would have remembered to stress the role of sales!

Outstanding Design in UHF, VHF, 2-Way and Microwave Antennas



Write for our new catalog!

We are now located in our new, larger plant

Engineered and manufactured for peak efficiency, maximum mechanical stability, simple installation and long trouble-free life.

PARABOLAS and Point to Point
For 450, 900, 2000 and 6000 MC. Up to 15' diameter. Rugged HELLIARC welded aluminum construction.

RAILWAY and VEHICULAR
New low profile R R antenna a brand new Mark development!

2 WAY COMMUNICATIONS
Mark High Gain patented Fiberglass Construction omnidirectional base station antennas provide gains up to 10 db.

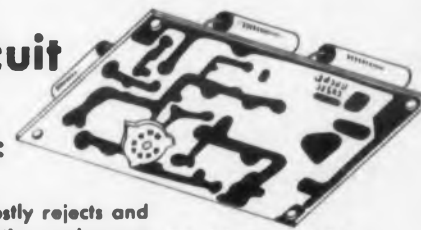
SPECIAL DESIGN
Mark offers a complete engineering and research service in antenna design and manufacture . . . now supplemented with greatly increased plant facilities.

MARK PRODUCTS

5439 Fargo Avenue Orchard 5-1500, Skokie, Illinois

CIRCLE 333 ON READER-SERVICE CARD

Avoid circuit failures with KPR*



KPR helps you avoid costly rejects and make-overs. It saves you time and money because it is simple to use. Your operators can make etched electrical-electronic circuits with a minimum of training and experience. Here's why.

There are just six basic steps in using KPR:

- (1) Cleaning the metal is fast and sure with a power brush.
- (2) With a quick acid rinse, you're sure of good adhesion of the KPR coating.
- (3) Choose the coating method that suits you best—spraying, whirling, dipping. You can coat safely months in advance (during slack periods, for example), then store KPR coated plates till you need them. KPR is stable, does not change.
- (4) Exposure times are short with high-intensity arc or ultraviolet light. Exposure time never varies with atmospheric changes. Heat, humidity, and long storage do not affect KPR coated plates.
- (5) Developing is fastest in a vapor-spray degreaser on large runs. Small runs can be developed in trays or tanks.
- (6) KPR protects the circuit image during assembly of components. "Skate" the coated circuit board on solder bath, when assembly is completed, and KPR disappears leaving strong, clean solder joints.

No statement or suggestion in this advertisement is to be considered a recommendation or inducement of any use, manufacture, or sale that may infringe any patents now or hereafter in existence.

EASTMAN KODAK COMPANY

Rochester 4, N. Y.

Kodak

CIRCLE 334 ON READER-SERVICE CARD

'How to Invent'

A review of a new book by Forrest E. Gilmore.



Avoid a negative attitude toward new things.

There is no magical way to become an inventor . . .

YOU DONT have to be born an inventor. Forrest E. Gilmore, author of a new book, "How to Invent," discusses the mental processes necessary to put you into the inventing frame-of-mind.

Most engineers, he claims, would welcome some magical way by which they might become inventors. There is no magical way. But what Gilmore discloses here are the fundamentals of the inventive processes and some of the techniques used by successful inventors. If engineers can understand these, they can, with diligent practice, become inventors.

One of the pitfalls in the path of a potential inventor is the trial and error method of inventing. This tends to produce the "crackpots" and give the inventor a reputation for being untrustworthy. Thus management tends to be unwilling to place such a person in a position of authority. For this reason many engineers shy away from being classed as inventors.

Management is also reluctant to take chances on anything that isn't proven. If a new idea doesn't work, the engineer is often charged with creating a costly "folly." And if it does work, the engineer often doesn't get the special recognition he feels that he deserves.

Some of the common mental blocks that retard the creative process include:

"There are no problems in my work."

"I tried submitting a few patent ideas but they were turned down, so I guess I don't have any inventive ability."

"I tried to improve a piece of machinery but the engineers up above laughed at me."

"I do not feel that I am paid for inventing."

"I think science fiction and speculation are a waste of time."

On the management side are comments like these:

"I am always suspicious that any engineer under me who turns in patent ideas is neglecting his regular duties."

"Some of these fellows are always trying to fig-

ure out some way of getting out of work, making some contraption to do the work for them; I think they are just plain lazy and they shouldn't be paid for it."

Obviously the road to invention isn't easy. Intelligent, creative engineers have no difficulty in surmounting the previously mentioned pitfalls. They generally appreciate the need for inventing and realize the benefits to be derived from patentable ideas.

Preparation is the first practical step toward invention. Gilmore lists a number of steps that must be observed. He recommends that the engineer:

- Be highly skillful in at least one field of industry.

- Be skillful in more than one field.

- Understand the inventive process.

- Think his own thoughts.

- Avoid a negative attitude toward new things.

- State the problem in writing.

- Master accumulated knowledge on the subject.

- Gather new facts and keep a written record.

Following preparation, there is an incubation period in which the inventor discontinues conscious work on the thing to be invented. He waits patiently for inspiration and illumination. If illumination does not come within a definite time, he should then return to more intense concentration, reviewing all the knowledge he has thus accumulated.

The engineer is cautioned to be on the alert for any ideas on the subject. Often an idea that seems unusual or ridiculous may be worth consideration. Usually ideas revealed by illumination are incomplete and need more conscious revision and experimentation.

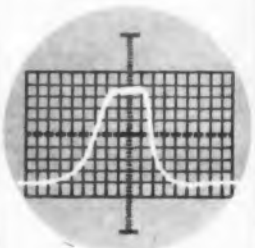
Even though most inventions come from the subconscious, it is the conscious mind that supplies the materials. Intense thought and observation produce greater impressions in the subconscious, so they are easier to recall.

Knowledge of the patent laws is advantageous to the would-be inventor. This is the last link in putting his invention into the hands of the public with proper protection. After all, Gilmore points out, there is no point in inventing something that is not patentable. Certainly a knowledge of the procedure is necessary to obtain a patent. A knowledge of legal proof, requirements for invention, selling and licensing, and how to deal with your own company are essential.

Gilmore closes his book with a short quiz to determine your "Ingenuity Quotient." It gives a very general indication of your interest in invention, your keenness of perception and other factors that might determine your inventive skill.

"How to Invent" by Forrest E. Gilmore, is published by the Gulf Publishing Co., P.O. Box 2608, Houston 1, Texas, 89 pp, \$2.50 ■ ■

CAREER
OPPORTUNITIES
AT TI



CIRCUIT DEVELOPMENT ENGINEER



your future: a challenging opportunity with an industry leader

At Texas Instruments, your future is filled with specific, stimulating growth assignments in evaluating and characterizing transistors and special semiconductor devices. You'll participate in such transistorization projects as:

- AM, FM, and TV receivers
- audio and video, i-f and r-f amplifiers
- hi-fi and electronic organs
- nonlinear and switching circuits
- computer system logic
- servo and power amplifiers

With TI... receive liberal company-paid benefits, including profit sharing (last year 15% of base salary) ... enjoy premium living in a moderate climate with excellent neighborhoods, schools and shopping facilities... work in a plant selected as one of the 10 outstanding U. S. industrial buildings of 1958.

Interviews will be held in your area soon. If you have an Electrical Engineering degree and/or knowledge of transistor circuitry, please send a resume to

C. A. Besio, Dept. 200-ED

TEXAS




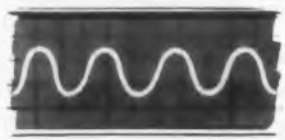

INSTRUMENTS
INCORPORATED

SEMICONDUCTOR - COMPONENTS DIVISION
POST OFFICE BOX 312 • DALLAS, TEXAS

For
immediate
Eastern
appointment,
contact
H. C. Laur
Dept. 200-E-ED
1141 E. Jersey St.
Elizabeth, N. J.

ON YOUR COMMAND



the satellite reports scientific data back to earth.  At the ground station, special communications equipments receive and demodulate space telemetry signals.  A data processing system analyzes findings which are fed in turn to the satellite control network and the computer memory banks, increasing man's knowledge of his newest frontier. 

The complete system—from the space communication network of the space vehicles to the complex data-processing equipment of the ground station complex is a product of your team—if you're at Philco in Palo Alto—in the San Francisco Peninsula's new electronic center. A position with this trail-blazing group can be yours—now! Graduate engineers are needed for equipment design and for systems engineering, analysis and integration. Write now, in confidence, to
Mr. H. C. Horsley, Engineering Placement.



PHILCO WESTERN DEVELOPMENT LABORATORIES

3875 FABIAN WAY, DEPT. D-10 • PALO ALTO, CALIFORNIA

A PART OF THE GOVERNMENT AND INDUSTRIAL DIVISION OF PHILCO CORPORATION

CIRCLE 903 ON CAREER INQUIRY FORM

YOUR CAREER NEWS, NOTES, NOTIONS

Watch those adjectives is the title of a short article originally published in the Chicago "Scan-fax" and reprinted in the current issue of the PGEWS Newsletter. The article by the Chicago PGEWS Chapter Chairman Robert B. MacAskill says:

"In technical writing, as in life, where we try to add strength we often betray weakness. The man who tells of his accomplishments in glowing terms makes you suspect that he is not really as good as he claims.

"Likewise, the technical writer who builds up his nouns with adjectives makes you suspect that his nouns are not good enough to stand by themselves. Instead of fortifying nouns, an excessive display of adjectives usually produces an effect opposite to that intended.

"For example, the words prerequisite and essential are often used by the inexperienced writer to describe a condition. We then doubt whether a condition without an adjective is really a condition at all.

"We make a habit of saying we will take this under active consideration, we shall feel cheated when promised under bare consideration.

"If a part is always an integral part, there is nothing left for a mere part to be except a spare part.

"The word sufficient often precedes the word improvement. An improvement, which is an honest word by itself, pales in comparison.

"Adjectives are popular because they appeal to the glib idea of our nature. We use them more for emphasis than for the precision of meaning for which they are intended. They should not be used in a haphazard fashion. They don't always measure up to the noun they precede . . .

"You may report that a piece of equipment is extremely reliable. Convincing evidence of its reliability would be the fact that it has operated continuously for a year with no repairs."

• • •

Better use of uniformed engineers and scientists by the Army is expected. The Army has announced a new program "Scientific and Engineering Assistants' (S&E) Programs" which will make better in-service use of enlisted engineers and scientists. Although the Army has operated such a program since 1948 results have not been entirely satisfactory. The new program will "clearly require professional level performance in a scientific or engineering specialty" and frequency of interruption of professional-type duties will be reduced.

(Continued on page 132)

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.

22

(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

900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924
925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949

Advancement Your Goal? 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.

Put Yourself in this "Growth" Picture!

grow faster with a growing company . . .

utilize advanced facilities available

for research, development

and manufacturing projects of the highest technical nature



. . . where your work and talents are recognized

as extremely vital . . . enjoy year-round living

and recreation in the pleasant Southwestern climate

To date, almost 14,000 people at Texas Instruments are in this "Growth" picture. In addition, they are enjoying many other benefits from TI's enlightened personnel policy — company-sponsored profit sharing plan*, periodic advancement and salary reviews, educational assistance, insurance, and retirement programs.

TI offers a stimulating challenge in research, development and manufacture in geosciences, military and industrial instruments and systems, semiconductors and other electronic components. To keep its position as a leader in these fields, and to stay ahead of the ever-increasing demands of Space Age technology, more new permanent positions have been created for qualified Engineers.

Come grow with us . . . work and live in an environment of professional, social and recreational freedom. Write to your area of interest on the right.

*Which, in 1958, was 15% of base salary!

you'll grow faster with a growing company!

TEXAS  **INSTRUMENTS**
INCORPORATED
DALLAS 9, TEXAS



Over the past decade, TI personnel increased over 15-fold from 800 to almost 14,000. Will be 15,000 by end of 1959.



Semiconductor-Components plant . . . world's largest semiconductor manufacturing facility. Construction underway will more than double its size.



Typical of all TI plants and offices, the Apparatus division assembly area is well-lighted and air-conditioned.



TI Central Research Laboratory's new building, located adjacent to the Semiconductor-Components plant at the 300-acre complex.



TI sales have grown over 20-fold over the past ten years . . . from under \$5,000,000 to \$200,000,000 for 1959.



Typical of Dallas and Houston: modern buildings and facilities, new multi-lane freeways that bring downtown within minutes of suburbia.



Many lakes, within minutes of Dallas, provide excellent recreation. Houston is "next door" to Galveston, nationally known seaside resort.

specific career opportunities now open at Texas Instruments

SEMICONDUCTOR-COMPONENTS DIVISION

DEVICE DEVELOPMENT—Develop new semiconductor devices; conduct experimental and theoretical studies on the effects of nuclear radiation on semiconductor materials and devices; evaluate experiments in the analysis of gases and electro-chemistry; conduct physical measurements on semiconductor surfaces; determine the effects of chemical reaction on semiconductor surfaces; studies in device stability, reliability and characterization; materials research and development including crystal growth and crystallography.

CIRCUIT DEVELOPMENT—Transistor circuit design and application; design automatic and semi-automatic test equipment.

MECHANIZATION—Design and develop high speed automatic machinery.

Please write to C. A. BESIO, Dept. 1104, P. O. Box 312, Dallas, Texas

CIRCLE 904 ON CAREER INQUIRY FORM

APPARATUS DIVISION

MANUFACTURING ENGINEER—To perform the planning and coordination of the manufacture of electro-mechanical/electronic systems and components on an assigned project basis; to determine action to be taken; follow-up and report successful operation of the course of action selected. BS in EE, ME or IE, with minimum 3 years experience in manufacturing processes, tooling, scheduling, and costs.

QUALITY CONTROL ENGINEER—To establish and maintain standards of quality and inspection methods for all raw materials, work in process and finished products. BS in EE, ME or IE with minimum 3 years experience in working to customer requirements, procedures, quality reports plus prevention and detection of defects in electro-mechanical apparatus.

SENIOR MICROWAVE ENGINEER—To perform applied research and development in the field of microwave and high-powered transmitter equipment including ASR transmitter and automatic performance monitoring. MS in Physics or EE with minimum 5 years experience in the field of microwave and high-powered transmitting equipment.

SENIOR ELECTRONIC ENGINEER—To conduct engineering analysis of techniques that will be incorporated into various product lines. Electronic design experience associated with the missile field involving circuit (transistor), computers, telemetry, and guidance systems design essential. MS in EE, ME or Physics with minimum 7 years experience in field of missile electronic design and systems planning and analysis.

CIRCUIT DESIGN ENGINEER—With strong instrumentation background with emphasis on circuit design. Experience in application of transistor circuits to instrumentation highly desirable although not essential. BS or MS in EE or Physics with minimum 5 years experience.

RESEARCH ANALYST—To perform industrial marketing research in the field of military and industrial electronics; requires analytical ability with imagination to foresee variables and recognize limitations and data; ability to present ideas clearly in verbal and written form. Must also be able to interpret and point out use and conclusion of statistical studies to division management. BS in ME, EE or MBA or MA in Economics.

SENIOR GUIDANCE ENGINEER—To design microwave antennas and circuit components; supervise engineering personnel in design and development of complete missile antenna and microwave systems; contribute original advancements in missile microwave and antenna concepts for proposals and system development. BS in EE or Physics with minimum of 5 years experience in stripline microwave design. Also thoroughly familiar with radiation and propagation theory.

MATHEMATICAL STATISTICIAN—To specialize in the study of noise applications; to perform systems analysis of sonar and radar product lines; to provide consulting service to other technical personnel. MS or PhD in Mathematics with minimum of 6 years experience in applied analysis of advanced mathematics.

MATHEMATICIAN—To specialize in transform calculus as applied to servo mechanisms and network analysis and continued fraction work; provide consulting services to other technical personnel. MS or PhD in Mathematics with minimum of 6 years experience in applied analysis of advanced mathematics.

Please write to JOHN PINKSTON, Professional Placement, Dept. 1104, 6000 Lemmon Avenue, Dallas 9, Texas

CIRCLE 905

GEOSCIENCES AND INSTRUMENTATION DIVISION

MECHANICAL DESIGN ENGINEERS—BS or MS in ME to design small electro-mechanical mechanisms.

ELECTRICAL DESIGN ENGINEERS—BS in EE or Physics to design and construct supervisory control systems of electro-mechanical and electronic design; transistor test equipment, requiring heavy experience on electronic circuit design, preferably with transistors; digital computers with experience in detailed logical design.

MANUFACTURING ENGINEER—BS in ME or IE with experience in production, planning, production control, methods and tooling in the electronics industry.

SALES ENGINEER—BS in EE, Physics or ME with sales experience in electro-mechanical instruments.

Please write to DAVE TURNER, Dept. 1104, 3609 Buffalo Speedway, Houston, Texas

CIRCLE 906 ON CAREER INQUIRY FORM

CENTRAL RESEARCH LABORATORY

HEAD-PHYSICS SECTION—4 to 5 years experience in semiconductor physics and proven ability to direct a variety of technical projects. Responsible for directing work on the measurement and understanding of electrical, thermal, magnetic, optical, and transport properties of semiconductors. Educational requirement is PhD in Physics.

HEAD-DEVICE SECTION—4 to 5 years experience in semiconductors plus experience in group leadership and proven ability to supervise a variety of technical projects. Will be responsible for directing work on design, fabrication and evaluation of new solid state devices. Educational requirement is MS or PhD in either Physics or EE.

SOLID STATE THEORIST—Responsible for the understanding and interpretation of the physical properties of semiconductors and other solid state materials. Educational requirements: PhD in Physics with concentration in quantum mechanics. Solid state experience desirable but not necessary.

DEVICE THEORIST—Responsible for the design of new solid state devices and interpretation of their characteristics in terms of physical and fabrication parameters. Educational requirement is PhD in Physics or EE, or MS with 2 to 3 years experience in solid state device theory.

SEMICONDUCTOR TECHNOLOGY—Responsible for the design and interpretation of experiments on the technology of semiconductors, including impurity diffusion and alloying. Educational requirement is PhD in Physical Chemistry or Metallurgy. Experience requirement: 3 to 4 years experience in semiconductor technology.

THEORETICAL PHYSICIST—2 to 3 years experience in electron or nuclear magnetic resonance with interest and background to perform theoretical analysis of EMR and NMR to develop possible new types of magnetometers or to make significant improvement in present types. Sufficient experimental background and interest to assist in translating theoretical results into experimental projects.

PHYSICISTS—Either MS or PhD with 1 year minimum experience in the fields of superconductivity and low temperature physics. Should be acquainted with conventional techniques of transferring and handling liquid helium and designing circuits and instrumentation for studies in this area.

Please write to A. E. PRESCOTT, Dept. 1104, P. O. Box 1079, Dallas, Texas

CIRCLE 907 ON CAREER INQUIRY FORM

CIRCLE 904 THROUGH 907 ON CAREER INQUIRY FORM

How, today, does a man advance most rapidly?

Your present ability and potential in a space-age specialty are important to Chance Vought. And you know from experience that advancement comes quickest when ability can be used immediately, *demonstrated* to the fullest.

Five divisions at Chance Vought now make it easier for the professional man to pinpoint the area that will make the fullest demands on his talents . . . and that will advance him accordingly. Vought's five divisions also provide a balanced backlog that means diversification, plus the fresh challenge of working with new knowledge.



AERONAUTICS DIVISION

Developing new generations of manned aircraft, atmospheric missiles, antisubmarine apparatus. Current work includes Navy-sponsored studies in submarine detection and classification; production of three versions of F8U *Crusader* aircraft.



ASTRONAUTICS DIVISION

Concentrating on advanced vehicles for space exploration and on ballistic and anti-ballistic missile systems. Supplying four-stage *Scout* research rockets and launchers to NASA. Participation in the competition for the development of the *Dyna-Soar* boost-glide vehicle.



ELECTRONICS DIVISION

Developing, manufacturing, marketing military systems including antennas and related electronics, ground support electronics, and antisubmarine apparatus.



RANGE SYSTEMS DIVISION

Establishing and operating test ranges and test equipment for missiles and space vehicles. Twelve years' experience in remote base operation.



RESEARCH DIVISION

Looking forward to a new Research Center. Basic research into astronautics, undersea warfare, the life sciences (relating to the human factors of flight), electrogravities and other areas.

One Vought division may well stand out today as a place for your most rapid advancement. Why not write for further information?

Professional Placement Office
Dept. W-5



You live at a discount in Dallas. In Texas there are no state income tax and no local or state sales taxes. Low school and property levies add to your savings. Home construction costs — as well as house and apartment rentals — are below the national average. Fuel costs are negligible, and most groceries cost less.

CIRCLE 908 ON CAREER INQUIRY FORM

CAREER NEWS

(Continued from p. 128)

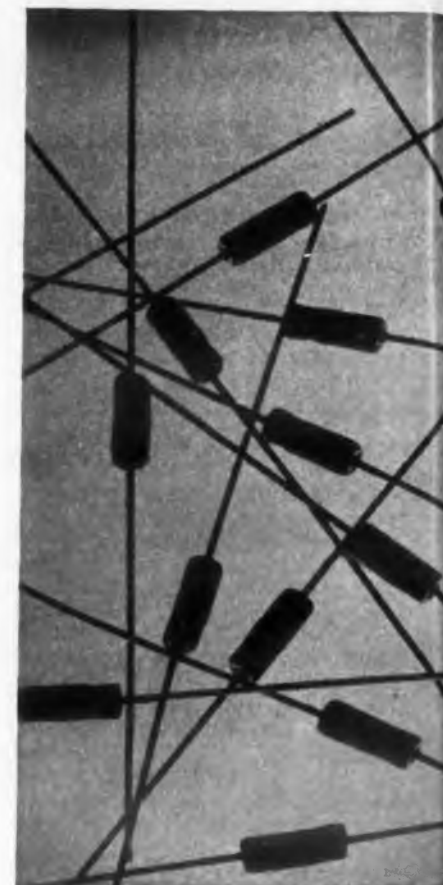
Over 30,000 have served in technical positions during the past ten years.

In general, engineers and scientists have been vocal about poor assignments and misused while in the armed services. Few kicks have come from men in the Air Force, where, in the Research and Development Command at least, an earnest effort is made to place highly skilled personnel in the right slots. The task of getting officer personnel into the proper job, Operation Square Peg, has been evolved into a science. According to the September 8 issue of *Engineering and Scientific Manpower Newsletter*, "Headquarters ARDC has embarked upon a project aimed at developing and implementing a new, highly mechanized system of job-man matching. . . . The system will employ a procedure for the matching of job profiles (job specifications) against the personal profiles of research and development officers. Such a matching procedure will be mechanized within the limits of the statistical reporting system; but in addition, available personnel records will be utilized to a considerable extent.

"A mechanical processing procedure has been devised which will produce a tabulated listing of officers and their qualifications who possess the necessary codifiable mandatory and desirable qualifications for successful accomplishment of the job in question. . . . This listing will be utilized as a basis for eventual personnel action. . . . The square peg program does not create a situation where officers become 'sprinkled perforations on a punchcard.' The mechanical phase of job-man matching merely speeds up a screening process which formerly was accomplished manually.

"ARDC does not claim perfection for the system, but it believes it is making as close an approach to perfection as the job potential in the Research and Development Command will permit. It is justifiably proud of the fact that other military units are considering adopting or adapting it to their specific needs. It is to be hoped that the method will spread to other units in the three services where engineers and scientists are utilized as such."

Women entering the engineering field are almost nil according to a recent survey made by the Women's Bureau of the Department of Labor. Highlights of the survey reported by the *Engineering and Scientific Manpower Newsletter* didn't even show up electronics as a possible classification. Of 88,000 women college graduates only 586 women had jobs as chemists, and 703 as mathematicians and statisticians, or 1.8 per cent of employed graduates, biological technicians represented 2.8 per cent. Graduates for the most part went into teaching.



device development project leader

If you are a man capable of heading a team of device physicists in the development of new advanced transistors, diodes and other semiconductor devices, the Semiconductor Division, Hughes Products (Hughes Aircraft Company) can offer you an exceptional position. You should have a Ph.D. in Physics and several years experience in research and development. A substantial background in the theory of device design is essential.

The ultra-modern facilities of the Semiconductor Division in Newport Beach, Southern California were just recently completed. This fully integrated division is responsible for semiconductor research, development, manufacturing, marketing and sales.

If you meet the requirements for the position of Device Development Project Leader, or if you are an engineer or physicist with semiconductor experience, please contact:

Mr. C. L. M. Blocher
Scientific Staff Representative
Hughes Semiconductor Division
500 Superior Avenue
Newport Beach 10, California

HUGHES PRODUCTS

HUGHES AIRCRAFT COMPANY

CIRCLE 909 ON CAREER INQUIRY FORM

**PAGES
MISSING
ARE NOT
AVAILABLE**

EXCEPTIONAL OPPORTUNITIES FOR

SENIOR ELECTRONICS ENGINEERS

LIVE AND WORK IN FLORIDA!

Our tremendous expansion program calls for immediate employment of 200 Senior Electronics Engineers in our new facilities at Palm Bay, Florida. Top salaries. Generous profit sharing plan. Excellent housing available close to your work.

WHERE YOU WILL WORK

Radiation, Inc. was incorporated in 1950 as an engineering organization devoted to the design and development of advanced electronic equipment. More than half the entire personnel are engineers, scientists, and other technically trained people — many with advanced degrees and extensive rec-

ords of original work. The company is primarily concerned with research and development, with limited production volume. It has pioneered in the development of radar, telemetry, data processing, instrumentation, and test equipment for use by industry and the various branches of the military services.



New office and Administration Building at Palm Bay.

Radiation, Inc. has achieved an enviable position in the field of electronics by continually seeking and employing the most competent engineers and encouraging them to make a creative approach to the problems they encounter. It can offer you great personal satisfaction as you welcome the many challenges. Here your work will take you to unexplored horizons. Here are the facilities and talent to create new equipment when projects require them. Here is association with acknowledged authorities in their various fields . . . men whose every-day thinking is newer than the newest texts. And here you'll find not only satisfaction in your work, but fair reward as well. Liberal compensation. More - than - liberal

employee benefits. Unique profit sharing plan. An opportunity for you and your family to live *right now* where others only dream of living.

Radiation, Inc. has opportunities at all levels for research, design, administrative and sales engineers with experience in digital and analogue equipment, logic circuitry, transistor applications, servo mechanisms, antennas, radar, ECM., microwave, electronic packaging, missile systems, weapons and warfare system analysis, space technology, guidance systems, communications systems, and infra-red studies. Opportunities exist to perform "state of the art" hardware development and basic research in all of the above fields.

Send resume and complete information to: A. J. Wilson, Engineering Employment Manager, Radiation, Inc., Melbourne, Florida



CIRCLE 910 ON CAREER INQUIRY FORM

ELECTRONIC DESIGN • October 28, 1959



Miles of broad, sandy beach for family fun.

WHERE YOU WILL LIVE

In order to make sure that comfortable housing will be available for new personnel and their families at reasonable prices, Radiation, Inc. has entered into an agreement with the Mackle Company to give Radiation, Inc. employees top priority on the purchase and construction of new homes in Port Malabar.

This outstanding new community is being built by the Mackle Company, largest community planners and builders in the nation, through General Development Corporation, one of Florida's largest land owners. The new home section lies within the city limits of Palm

Bay—adjacent to the Radiation plant—and has paved streets, city fire and police protection, municipal water and sewer system.

Excellent schools, churches of all denominations, a fine public library, a large new shopping area, and a long established downtown business section are all conveniently near.

The area is one of the finest in Florida for enjoyable year-round living, with swimming from safe, uncrowded ocean beaches — boating and fishing in the Indian River and Atlantic Ocean—golf, tennis, and water skiing.



This 3 bedroom home only \$900 down, \$117 a month.

If you qualify for one of these positions at Radiation, Inc. you will have your choice of 12 beautiful Mackle-built homes, ranging in price from \$10,725 to \$20,300. FHA terms are available, with down payments from \$325 and monthly payments from \$70.

A brochure showing pictures of the homes, floor plans, prices, and terms will be sent you upon receipt of your job application. This is a rare combination—the opportunity to secure an excellent, well-paying job and live nearby in a Florida community in a well-designed, well-built home at reasonable cost.



Outstanding MACKLE-BUILT COMMUNITIES
Through

GENERAL DEVELOPMENT CORPORATION



AD 59056 (1)

CIRCLE 335 ON READER-SERVICE CARD

SIGNIFICANCE

Much of United Aircraft Corporation's success may be attributed to its ability to determine the genuinely significant areas of technology before committing valuable talent and resources.

Having made its decision . . . the concentration of effort . . . the engineering breakthrough . . . the right product . . . accomplished first at the right time is a matter of record — oft repeated. The significance of its accomplishments is a source of corporate pride . . . and confidence.

Projects in Missiles & Space Systems share this same heritage of significance as we move into a new era of achievement. If you are interested in joining a new organization destined shortly to demonstrate its significance contact John North.

MISSILES & SPACE SYSTEMS — Division of **UNITED AIRCRAFT CORPORATION**
East Hartford, Connecticut

CIRCLE 913 ON CAREER INQUIRY FORM

CAREER OPPORTUNITIES BROCHURES



Lead

Through this illustrated brochure—Lead, the new Lockheed Electronics and Avionics Division is introduced.

Lead is intended to serve the broad field of electronics: the military, the non-military, government, and industry. Generally, the company is interested in the design, development, and production of electronic devices, subsystems, and systems.

Lockheed Electronics and Avionics Div., Dept. ED, 6201 E. Randolph St., Los Angeles 22, Calif.

CIRCLE 870 ON READER-SERVICE CARD

**Packard Bell
Electronics Corp.**



Programs now in progress at Packard Bell Electronics Corp. are briefly discussed in the brochure entitled, "A Challenge To Engineers."

Areas covered are: Communications, Beaconry, Automatic Checkout, Digital Technology, Anti-Submarine Warfare, ECM and ECCM. Company facilities and benefits are listed.

Packard Bell Electronics Corp., Dept. ED, 12333 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE 871 ON READER-SERVICE CARD

**PAGES
MISSING
ARE NOT
AVAILABLE**