

March 10, 1961

electronics

*Marksman below is aiming an infrared communications beam at a receiver. Solid-state modulator controls the radiation, p 177
Parametric up-converter preamplifier for telemetry system, p 188*

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new instruments to speed, simplify your scientific work!



Ⓜ 5512A, 300 KC
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Ⓜ 906A Coax Sliding Load, 1 to 12.4 GC, SWR 1.05. Price on request.

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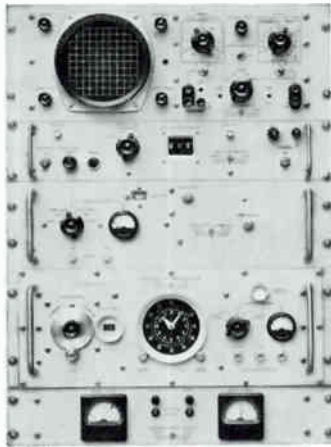
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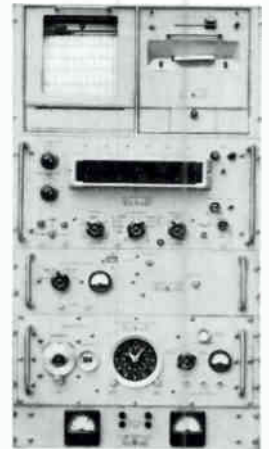
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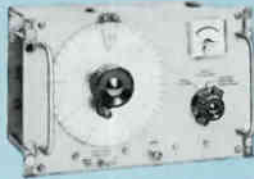


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- Auxiliary equipment for HF or VLF comparison: Ⓢ 523CR Electronic Counter, Ⓢ 103AR Frequency Standard, Ⓢ 560A Printer/Recorder, Ⓢ 120AR Oscilloscope.



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Ⓢ 526D Phase Measuring Unit. Plug-in for Ⓢ 524C/D Counters, gives 0.1 μ sec resolution 10 cps to 20 MC, reads 400 cycle phase shift directly in degrees. Ⓢ 526D, \$750.00.



New Oscilloscopes, Power Supplies, Oscillators, Voltmeters, Pulsers and Current Measuring Instruments Speed Your Audio-Video Work



Ⓢ 185B Oscilloscope. 1,000 MC all-purpose, "ultimate" oscilloscope, now with extended low frequency response. Price on request.



Ⓢ 215A Pulse Generator (not shown) produces fast rise-time pulses for computer, tunnel diode analysis. 1 nanosecond rise time, 1 MC rep rate. Price on request.



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Ⓢ 160B 15 MC Oscilloscope. Militarized, rugged, has same multi-purpose vertical and horizontal plug-in versatility of 170A. Beam finder, sure triggering for easy operation. \$1,850.00.

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New Ⓢ 166B Time Mark Generator joins other horizontal plug-ins: Ⓢ 166C Display Scanner for making recordings and Ⓢ 166D Sweep Delay Generator. Vertical plug-ins include Ⓢ 162A Dual Trace Amplifier, and new Ⓢ 162F Fast Rise Amplifier.



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Ⓢ 726AR Power Supply. Programmable 2 ampere, 45 v output. Includes positive-action circuit guarding transistors under test. Price on request.



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Ⓢ 405BR/CR Digital Voltmeters. Automatic precision instruments, jitter-free, in-line readout, floating input, range 0.001 to 999 v dc. Ⓢ 405BR, \$850.00. Ⓢ 405CR, with recorder, printer output. \$925.00.

electronics

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The Diagraphs employ the directional coupler principle. Measurements can be read directly on a Smith chart or a special transmission-line chart without any arithmetical or graphical evaluation work, thereby saving time, expense, and eliminating error. A large number of accessories is available such as baluns, variable shorts, etc.

THE DIAGRAPHS OFFER 4 MEASURING USES:

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- **Measuring Transmission Characteristics:** Transfer characteristics of multi-terminal networks and semi-conductors can be plotted directly on a transmission-line chart.
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- **Use as a Measuring Receiver:** The built-in superheterodyne receiver can be used as a linear measuring receiver.

Specifications

Frequency Range	Type	Ω
30 to 420 mc	ZDU	50*, 60 and 75
300 to 2400 mc	ZDD	50* and 60

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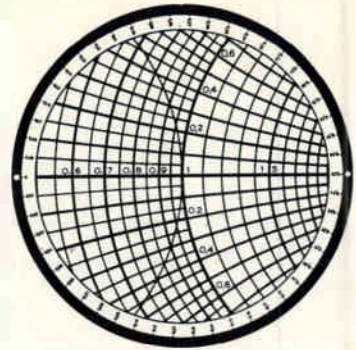
*NORMALLY STOCKED



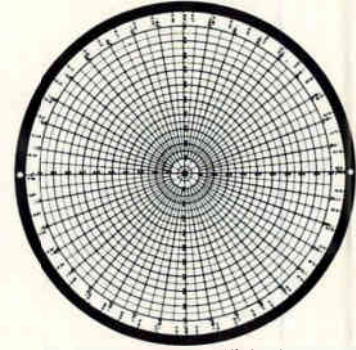
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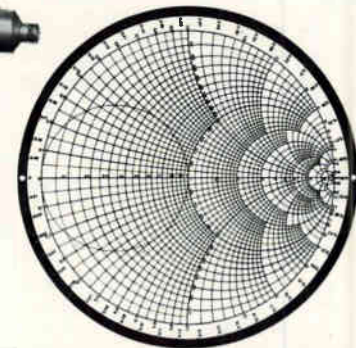
Visit our booth 3000 at the I.R.E. Show



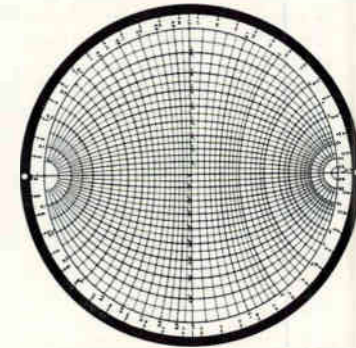
Expanded Smith Chart



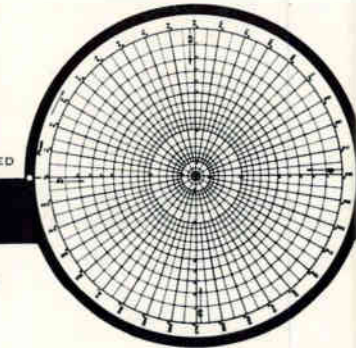
Reflection Coefficient



Smith Chart (Rectangular Coordinates)



Carter Chart (Polar Coordinates)



Attenuation and Phase Angle

2 & 3-mm precision waveguide components

delivery from stock

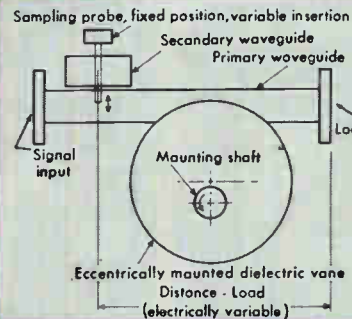
Only available from FXR... the world's most complete line of field tested, precision 2- and 3-mm components. It takes experienced, creative engineers, advanced production techniques, skilled craftsmen and high precision machine tools to produce components for the F band (90 to 140 KMC) and the G band (140 to 220 KMC)... and only FXR has these four production requirements under one roof.

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- All components internally gold plated to preserve their low insertion loss features.
- Precision differential screw micrometer drives (readable to ± 0.001 millimeters) used for FXR G band Frequency Meters and Precision Sliding Shorts.



**FXR G105A
SLOTTED SECTION**

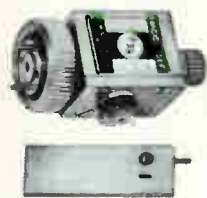


Frequency Range: 140-220 KMC/sec

Novel technique (see drawing) incorporates a fixed position probe and an adjustable phase shifter to sweep VSWR pattern past the probe.

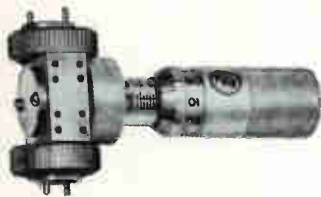
- Recommended accessories:
FXR G208A Detector Mount and Crystal

FXR also has available the most complete line of mm waveguide components for use in the 18 KMC to 90 KMC region.



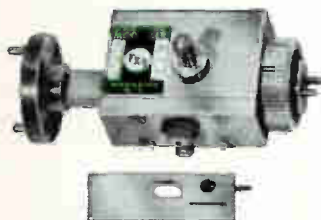
**FXR G208A DETECTOR MOUNT WITH
FXR Z224A CRYSTAL DETECTOR CARTRIDGE**

- Frequency Range: 140-220 KMC/sec
- In-guide detector elements for maximum sensitivity
- Series 208 Detector Mount can be used with replaceable crystal, bolometer, or thermistor cartridges
- Recommended accessories:
FXR Z224A Crystal Detector Cartridge
FXR Z230S Bolometer Cartridge
FXR Z235S Thermistor Cartridge



FXR G412A FREQUENCY METER

- Frequency Range: 140-220 KMC/sec
- Micrometer dial, calibration chart supplied provides an accuracy of $\pm 0.5\%$. Specific point accuracy $\pm 0.2\%$.
- Self-calibrating by using successive resonances



**FXR G781A HARMONIC GENERATOR WITH
FXR Z225S
HARMONIC GENERATOR CARTRIDGE**

- Provides second harmonic output signal in the frequency range 140-220 KMC/sec when supplied with a fundamental frequency input signal
- Required accessory:
FXR Z225A Harmonic Cartridge

These components are also available in the FXR F band (90 to 140 KMC)

2 & 3-mm waveguide components

FXR SERIES PREFIX WAVEGUIDE SIZE IN INCHES (I.D.)	F		G	
	.080 x .040		.051 x .0255	
FREQUENCY RANGE IN KMC/SEC	90.-140.		140.-220.	
SLOTTED SECTIONS	F105A	\$1400	G105A	\$1400
ATTENUATORS—Precision Calibrated	F163A	\$ 975	G163A	\$ 975
CRYSTAL DETECTOR MOUNTS—Tuneable	F208A	\$ 400	G208A	\$ 400
CRYSTAL DETECTOR CARTRIDGE	Z224S	\$ 150	Z224S	\$ 150
HARMONIC GENERATOR	F781A	\$ 475	G781A	\$ 475
HARMONIC GENERATOR CARTRIDGE	Z225S	\$ 150	Z225S	\$ 150
BOLOMETER CARTRIDGE	Z230S	\$ 150	Z230S	\$ 150
THERMISTOR CARTRIDGE	Z235S	\$ 150	Z235S	\$ 150
TUNERS—E/H	F313A	\$ 775	G313A	\$ 775
PRECISION PHASE SHIFTERS	F314A	\$ 950	G314A	\$ 950
FREQUENCY METERS— Reaction, micrometer	F412A	\$ 750	G412A \$ 750 G413A \$ 800	
TERMINATIONS—Fixed	F501A	\$ 150	G501A	\$ 150
WAVEGUIDE TEES—Series Shunt Hybrid	F620A F621A F622A	\$ 275 \$ 275 \$ 325	G620A G621A G622A	\$ 275 \$ 275 \$ 325
WAVEGUIDE BENDS—90° E-plane 90° H-plane	F623A F624A	\$ 275 \$ 275	G623A G624A	\$ 275 \$ 275
WAVEGUIDE 90° TWISTS	F625A	\$ 100	G625A	\$ 100
PRECISION SLIDING SHORTS	F631A	\$ 275	G631A	\$ 275
STRAIGHT WAVEGUIDE SECTIONS (Min. length)	F634A	\$ 85	G634A	\$ 85
STANDARD GAIN HORNS	F638A	\$ 200	G638A	\$ 200

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CROSSTALK

IRE CONVENTION—Chances are you are going to the IRE Convention a week come Monday; more than 70,000 electronics engineers are. By now you have your plane tickets for New York and, we hope, hotel reservations. And you are thinking about packing for the trip. May we suggest that you take along this copy of ELECTRONICS. Of course it is heavy. But you won't be charged for overweight if you carry it in your briefcase.

With this issue of ELECTRONICS as your guide, your visit to the IRE Show and Convention can be more profitable than ever. The meeting is a pretty overwhelming experience: there are 265 papers to hear (not counting panel sessions) and more than 850 exhibits to visit.

Now here is what ELECTRONICS' editorial staff has done for you:

First we combed the entire technical program for papers that were outstandingly new and significant. Then we went to the authors and their companies to get brief but authoritative technical previews and merged them into our feature article: Engineering Highlights of the 1961 IRE Convention (p 182).

Then we approached exhibitors to find out what new developments they are planning to reveal at the show (p 36).

We contacted employers and employment agencies to forecast what your prospects will be if you decide to investigate that area (p 40).

And these articles, as the man said, are only the beginning. We have in this issue an interview with IRE President Lloyd Berkner (p 274), new happenings in research and development (p 200), components and materials (p 204), production techniques (p 208), and foreign electronics (p 9), new products coming on the market at the show (p 212), and a list of exhibitors with booth numbers (p 279).

For you who are coming to New York, this issue is an indispensable guide; for you fellows who are "minding the store," it is a convenient way of keeping up with the art.

And for Show-bound travelers, the latchkey is out both at our editorial offices on the eleventh floor of the McGraw-Hill building, 330 West 42nd Street, and at booth 4314-16 at the Coliseum. Stop in; we will be delighted to hear your ideas for stories. You too can become an author.

GERMAN THOROUGHNESS. Trying to find filing space recently, a clerk in the Berlin office of a large German electronic equipment manufacturer was going over old, dusty folders—found one labeled "Top Secret." She took it to her boss and asked if it could be thrown out. Editor MacDonald of ELECTRONICS happened to be visting at the time. It turned out to be photographs of a transmitter installed in submarines in 1912!

Coming In Our March 17 Issue

BEAM MASER. Hydrogen cyanide is used in the beam maser described in our next issue by F. S. Barnes and D. Maley of the electrical engineering department at the University of Colorado in Boulder. The authors present a thorough discussion of the design and operation of the maser, which is built for three-millimeter wavelengths.

IN ADDITION. A variety of interesting feature material to appear next week includes: handling decimal digits with one clock pulse by A. A. Jaecklin of the Swiss Federal Institute of Technology; phase measurement at high frequencies by Y. P. Yu of Ad-Yu Electronics; and a wide-band transistor preamplifier for low-noise applications by S. R. Parris of Burroughs.

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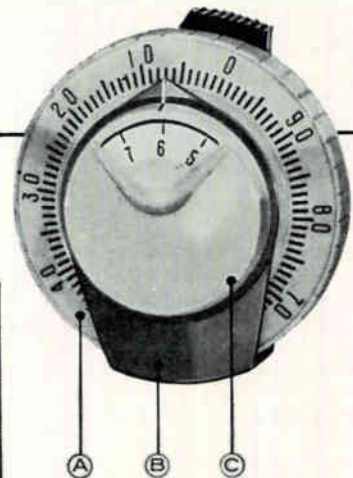
Model 1361

Actual Sizes

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WITH A SUBTLE TOUCH OF COLOR . . .

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1362	Light Gray	Dark Gray	Light Gray
1363	Black	Black	Red
1364	Dark Gray	Light Gray	Red
1365	Light Gray	Dark Gray	Red



Model 1362



BORG EQUIPMENT DIVISION

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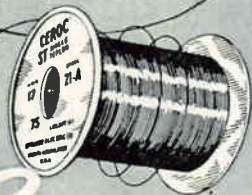
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UP TO 200°C



Ceroc

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HOTTEST SPOT TEMPERATURES
UP TO 250°C

For continuous operation at hottest spot temperatures up to 200°C (392°F) and up to 250°C (482°F) for short periods of time—depend upon TETROC—an all Teflon-insulated wire available in both single and heavy coatings.

CEROC is Sprague's recommendation for continuous operation at hottest spot temperatures up to 250°C (482°F) and up to 300°C (572°F) for short periods of time. Ceroc has a flexible ceramic base insulation with either single silicone or single or heavy Teflon overlays. The ceramic base stops "cut-through" sometimes found in windings of all-fluorocarbon wire. Both Tetroc and Ceroc magnet wires provide extremely high space factors.

Write for Engineering Bulletins 405 (Tetroc Wires) and 400A (Ceroc Wires).

SPRAGUE ELECTRIC COMPANY
35 Marshall Street, North Adams, Mass.

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THE MARK OF RELIABILITY

COMMENT

Medical Electronics

I have just read Medical Electronics Part I in the Jan. 20 issue (p 49). I would like to suggest that this report should also appear in a professional medical journal.

I believe that this report should receive wider distribution among the medical profession, and not be buried from them in an electronics publication that too few of them read. How do we go about this?

VERNE F. GOERGER, M. D.
RAYMONDVILLE, TEX.

We'd welcome the broader dissemination of the information in our five-part series on Medical Electronics.

The current series of editorial material on electronics in medicine prompts me to write you an expression of my observations over the past 20 years of the medical researcher as an electronic-instrument user.

No group of customers displays more emotion and less scientific evaluation in the selection of their measurement apparatus, which is too often chosen on the basis of what someone else may be using, rather than "how will this apparatus perform with respect to my problem?"

The research-minded MD is so constituted that in many instances he looks upon the electronics engineer as a mere servant, with little or no recognition that this man proudly knows his business and can offer constructive contributions to many measurements problems at hand.

He does not realize that the economics of commercial electronic instrument marketing simply cannot provide the hand-holding which is frequently demanded at his convenience on a time schedule unheard of in general industry.

If the medical researcher and clinical investigator, who collectively represent a significant electronic instrument market, would seriously attempt to define their instrument needs so that the test-instrument industry could design from a stable performance base, medical research would be better served.

Our grateful thanks are extended to the many wonderful, dedicated people involved in medical research who, by conducting themselves in a rational and reasonable manner, are the recipients of more than their share of help and attention from many service organizations, who are more than willing to incur short-term financial losses as an investment toward long-term humanitarian gains.

WALTER A. KNOOP
GAWLER-KNOOP CO.
ROSELAND, N. J.

We think reader Knoop is a bit severe, except in his closing paragraph. Certainly many medical researchers can't effectively outline their needs; sometimes they're not sure exactly what they're looking for, and frequently don't know how a technology such as electronics can help them. That's one of the reasons we're publishing this series; to try and bridge the gap in understanding between electronics and medicine.

Switched Pix

I noted with interest the story and picture concerning my client, S. Himmelstein & Co., on p 86-87 of the Jan. 27 issue. However, Mr. Himmelstein's picture was inadvertently carried over the Ross H. Snyder story on p 87, and perhaps it was Mr. Snyder's picture that appears with the S. Himmelstein story on p 86.

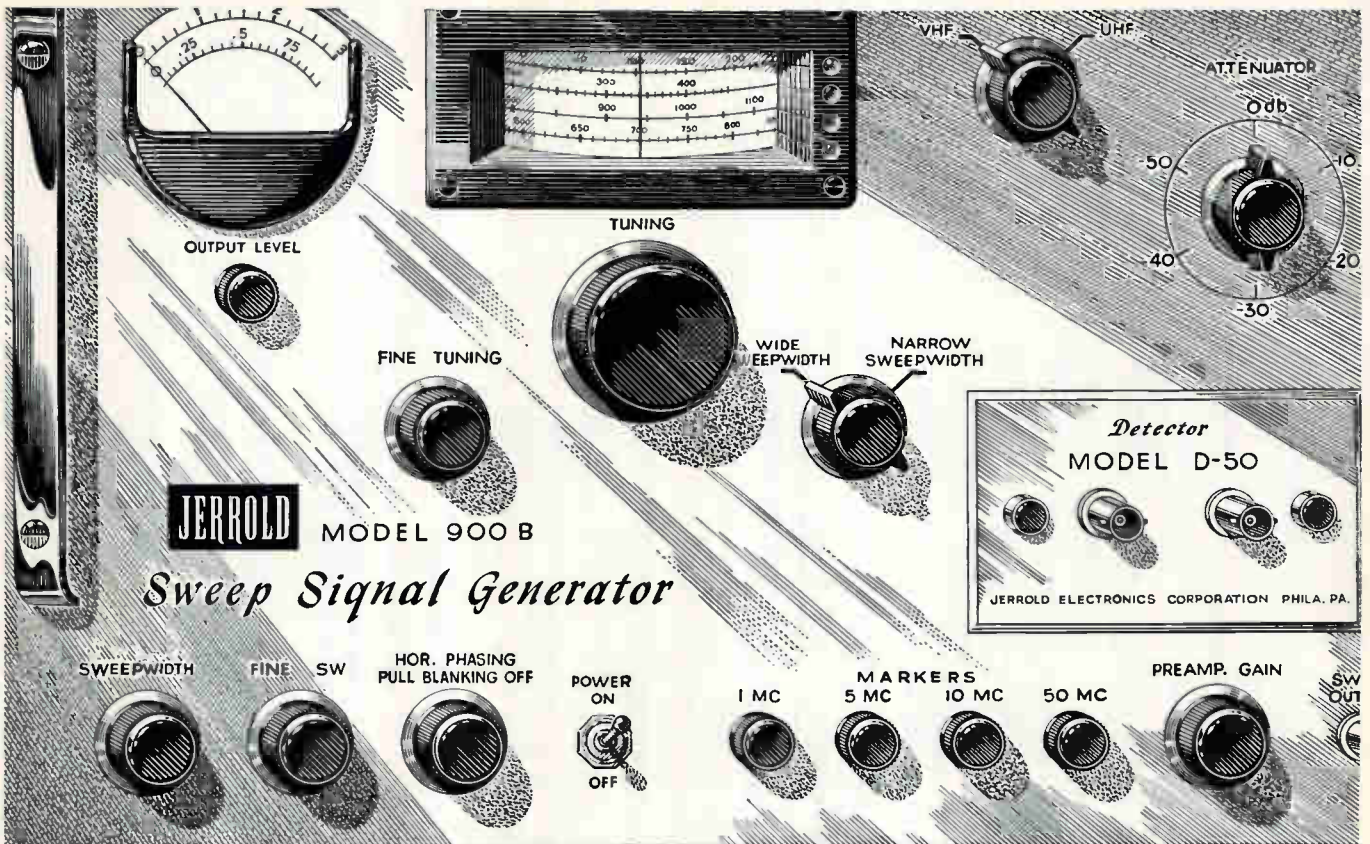
It could be that you might want to clear up this error to your readers. At any rate, both are fine-looking gentlemen, and certainly no harm has been done . . .

JACK MATHIS
MATHIS ADVERTISING
CHICAGO

It is indeed my picture which appeared on p 86 of the Jan. 27 issue over the Himmelstein item. Please do not be disturbed by the error; ELECTRONICS makes them very rarely, as I know from the care with which you processed an article of mine some years ago. No apology is needed.

ROSS H. SNYDER
EITEL-MCCULLOUGH INC.
SAN BRUNO, CALIF.

We knew who they were; the printer flopped the pictures.



UNUSUAL STABILITY IN SWEEP WIDTHS
FROM **10 kc** TO **400 mc**

New Jerrold WIDE PLUS NARROW SWEEP SIGNAL GENERATOR MODEL 900 B

Here's a generator that follows in the footsteps of Jerrold's famous wide band sweep—900 A. By adding narrow sweep capabilities and many of the features found only in signal generators, Jerrold has produced a new, unusually stable and extremely versatile Sweep Signal Generator. The 900 B is one instrument that can handle practically any sweep signal requirement from 500 kc to 1200 mc. Your VIDEO, IF, VHF and UHF communication requirements can all be serviced by the 900 B.

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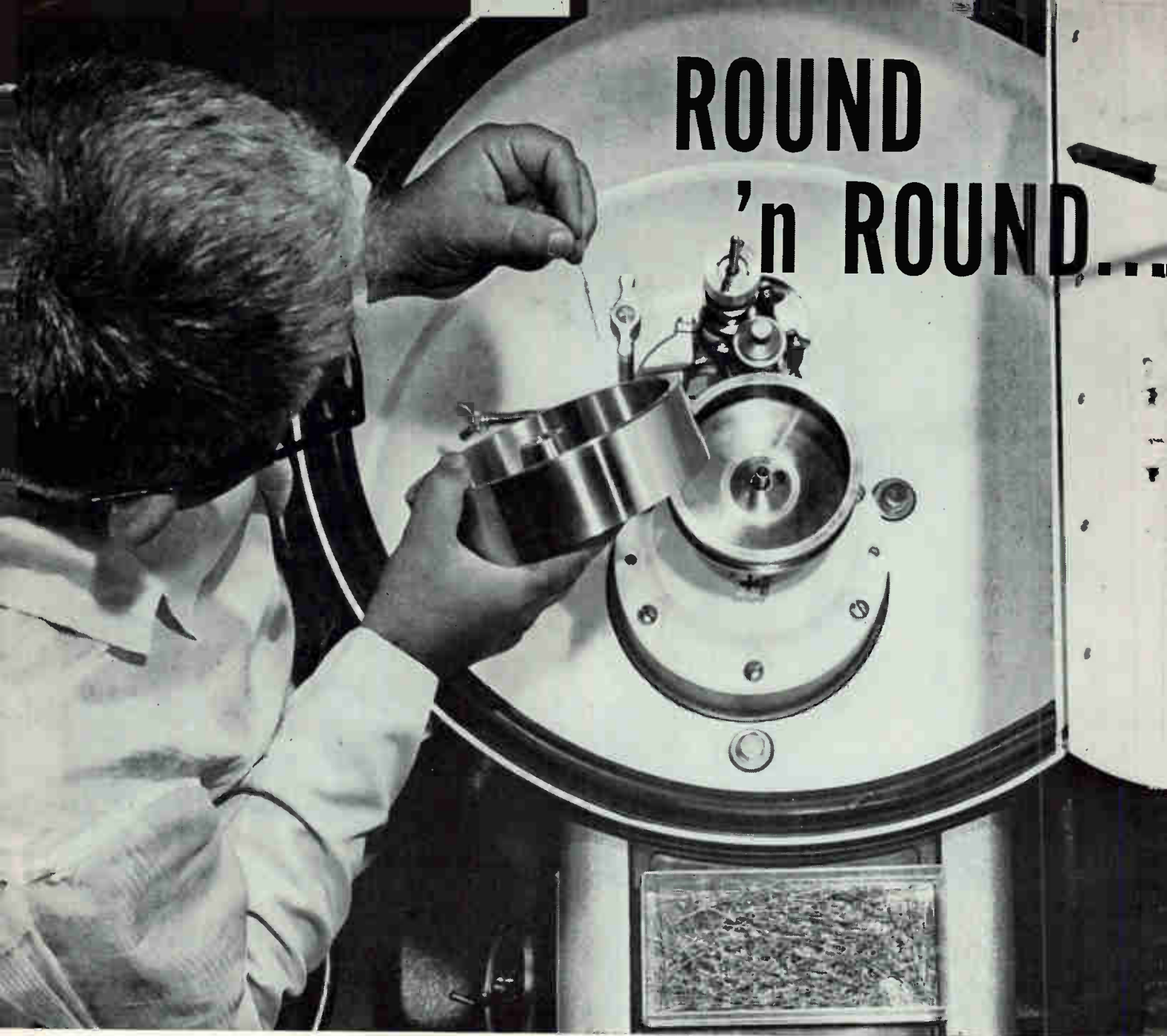
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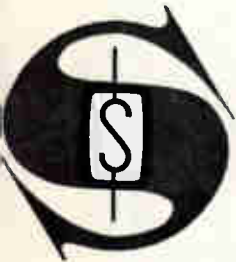


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CIRCLE 8 ON READER SERVICE CARD

IRE Show Papers Reflect Event's International Side

MANY ENGINEERS helping to shape electronics overseas will be participating in this year's 49th International Convention of the Institute of Radio Engineers.

Convention goers will have a chance to learn what is being done throughout the world.

One paper, for example, is being given by a Norwegian engineer, Herman Ruge of Oslo's Central Institute for Industrial Research. The paper, "An Adaptive System Using Periodic Estimation of the Pulse Transfer Function," is being presented by Ruge and an American engineer, S. C. Bigelow of Columbia University's department of Electrical Engineering.

A paper from Italy, "A Double Delay Line Clipped Linear Amplifier," is being presented by an Italian and an American engineer, S. Svelto of C.I.S.E., Milan, and R. L. Chase of Brookhaven.

A report on Soviet activity in thermoelectricity will be presented by an American observer, R. L. Petritz of Texas Instruments, Inc., while another broad category, "Status of New Energy Sources in Western Europe," will be discussed by Pierre R. Aigrain of the University of Paris.

A Japanese speaker, Masahisa Miyagi of Nippon Electric Co., will present a paper on unbalance distortion in a baseband combiner.

There will be a detailed description of the first commercial comprehensive microwave and troposcatter communication system in South America. The speaker will be F. B. Woodward of the Oficina Tecnico Amando Capriles in Caracas, Venezuela.

Cambodians Starting To Watch Television

PHNOM PENH—Private homes in this Southeast Asian country are installing television receivers, following inauguration of tv service late in 1960. Presently, most of the

program fare is motion pictures with dubbed-in Cambodian sound tracks. Transmission is from a small portable transmitter. Plans call for installation of a permanent transmitter and extension of present facilities later in the year.

Soviet Electronic Converter Brightens Medical X-Ray Image

MOSCOW—Electronic optical converter which increases the brightness of an x-ray screen a thousand-fold is being used at the Regional Research Clinical Institute.

The device reportedly allows radiologists to watch on film small areas of the stomach wall affected by cancer and to establish pathological movements of the membrane of the stomach's various regions.

Soviet medical researchers say the electronic converter is especially valuable in determining the location of invisible alien bodies in the respiratory tract.

Yugoslav Factory to Make Philips Television Sets

ZAGREB—Through a licensing agreement with Philips of Eindhoven, the Yugoslav factory, RIZ (Radio-industria, Zagreb) will start mass production of television receivers in May. The factory expects to produce 100,000 sets a year, plans to make 43 and 53-cm screen sizes.

Prices will probably be very high, according to spokesmen in this country, but both Philips and RIZ are optimistic because the tv sets will be in the category of expensive consumer items usually sold under installment plans.

The 43-cm size sets will sell for 135,000 dinars (about \$180), and the 53-cm size will cost 160,000 dinars (about \$220). The sets will be sold under the trademark Kumorovec, not Philips. The nomenclature is aimed at making consumers feel that this is a full-blooded Yugoslav product since its name is that of the birthplace of Marshal Tito in Croatia.

Other electronics activity in

Yugoslavia include plans for an international fair of contemporary electronics to be held in Ljubljana in October.

Last year's fair here saw 41 Yugoslav and 68 foreign exhibitors from 17 nations participating. The U. S. had 19 exhibitors. It's reported some 5.5 billion dinars in business was transacted at fair of 1959, about 8 billion dinars in 1960.

Argentina Cuts Surcharges On Some Electronic Gear

BUENOS AIRES—Observers here say a new decree by the Argentine government improves chances for U. S. manufacturers to bring more commercial electronic equipment into this country.

The decree provides for reductions in surcharges on electro-mechanical equipment operated from punch card systems, electronic computers and accessory hardware for statistical work, accounting and compilation.

The new law provides for a drop of 20 percent, as compared with the previous surcharge rate of 40 percent. It applies to both electronic and electrical equipment.

Ireland Planning New Tv Service

DUBLIN—Recently established Irish Television Authority reports plans to go on the air in November. The new tv service, called Radio Eireann, is now getting ready to install studio gear in four locations in Dublin central headquarters.

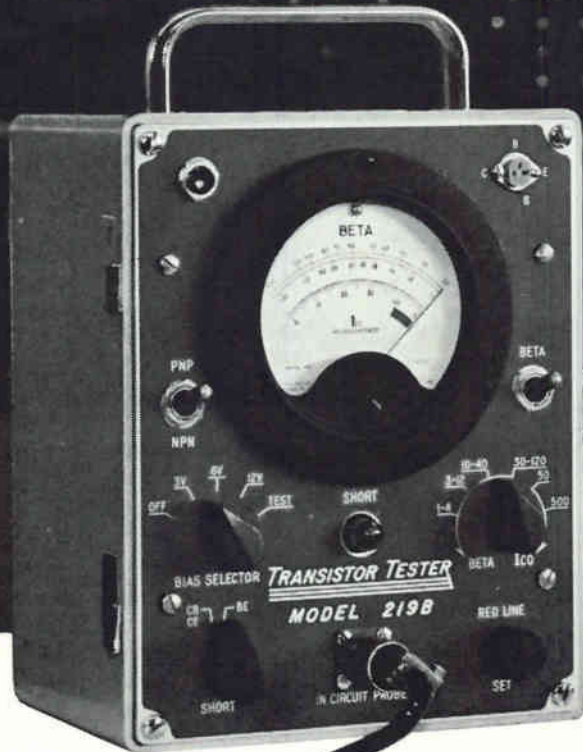
Two of the four studios will contain four 4½-in. image orthicon camera chains and associated audio and video gear consisting of two 16-channel sound mixers and two 10-channel video mixers. The third and fourth studios will contain equipment for live pickup.

Most studio equipment is being purchased from EMI Electronics, Ltd. Ampex Ltd. of Reading, England will provide video tape recording equipment for both studio and mobile use.

New broad range!

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No leads to unsolder
Four overlapping Beta Ranges • High meter resolution
Direct reading with test circuit power off

SPECIFICATIONS

New Sierra 219B 4-range Transistor Tester reads Beta directly in the circuit; also measures I_{CO} , Beta out of circuit.

Less downtime and less danger of damage to transistors under test with this new Sierra instrument—battery-operated, light weight, portable, easy to use.

Maintenance, quality control, incoming inspection and production testing are just a few of the applications where you save time and money by testing transistors, even complete assemblies, without unsoldering leads. Model 219B reads Beta in the circuit, 1 to 120. I_{CO} is measured on a straightforward basis; collector potentials of 3, 6 or 12 vdc may be selected. All controls are on the front panel . . . an instrument of convenience, speed, accuracy.

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Test ranges

Beta 1-4, 3-12, 10-40, 30-120*
 I_{CO} : 0-50, 0-500 μ a

Accuracy

In circuit: $\pm 20\%$ for external loads over 500 ohms.
Improved accuracy above 500 ohms, usable readings below 500 ohms.

Out of circuit:

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Power:

Internal battery, mercury or zinc-carbon type, 600 hrs. av. life; output indicated on front-panel meter.

Operating Temperature:

32 to 149° F

Size:

9" high, 7 $\frac{1}{2}$ " wide, 6 $\frac{1}{2}$ " deep, weight, 10 $\frac{1}{4}$ lb., including batteries.

Price:

\$275.00

*Beta readings to 300 may be approximated.

ELECTRONICS NEWSLETTER

Navy Designs to Emphasize Microelectronics

OFFICE OF NAVAL RESEARCH study group on microelectronics released its final report last week on circuits and systems with equivalent component densities "at least one order of magnitude greater than conventionally fabricated circuits."

The state-of-the-art report emphasizes that future design will involve a basic change in device fabrication and in approach to systems and circuits. Not only will dramatic reductions in size be possible, ONR feels, but also the new technology of molecular electronics will permit "greater simplicity and reliability, new functions, higher performance, and lower cost and power consumption . . . These objectives . . . are well within the possibilities of achievement as a result of proper and sufficient R&D effort."

Revenue Service Studies Taxability of Knowhow

INTERNAL REVENUE SERVICE announced last week that it is suspending rulings with respect to what part of a knowhow agreement is a nontaxable transaction.

Knowhow, to IRS, includes secret processes, technical assistance, technical information, diagrams, designs, and so forth. Technical assistance agreements frequently transfer these imponderables in exchange for stock in a foreign corporation. IRS is studying the issue to determine what parts should and should not be taxable.

Britain Now Constructing Integrated Air-Traffic System

BRITISH GOVERNMENT "Air Estimates" memorandum recently noted that a new high-performance radar system is under construction, designed to detect and control supersonic aircraft.

System will form part of an integrated civil and military air-traffic control network for Great

Britain. Associated computers and data-handling equipment will be fast enough to calculate intercept data for supersonic craft. Long-range equipment will supplement the BMEWS installation at Flyingdales, England, handling the aircraft part of the early-warning problem.

Project is under security wraps because of its military use. Even the names of contracting manufacturers are being withheld.

Study Subsurface Travel Of ULF Waves

AIR FORCE Cambridge Research Laboratories have hired Space Electronics Corp. to study subsurface propagation of ultra-low-frequency radio energy at long distances.

The company will experiment with 400-cps energy over paths thousands of miles long. Field-intensity measurements at various ranges and azimuths, the noise environment at 400 cycles, propagation mechanisms, radiation-to-medium coupling, and propagation anomalies are among studies to be undertaken. Space Electronics has conducted several USAF study programs in subsurface communications in the last two years.

Electronics Introduces Building Design Problems

ARCHITECTS and construction engineers are beginning to face the problems in building design and construction introduced by proliferation of electronic equipment, ELECTRONICS learns. Another part of the problem is energy from outside a structure being conducted through the metal frame to affect electronic operations inside.

Radio-frequency interference problems are compounded by new emission sources, from communications through computers to automatic elevators. Elevator controls have been known to interfere with medical instruments and computers. Building frame can be an

antenna, which makes matters worse.

R-f interference studies are currently being undertaken for architects on new buildings which will house electronic research or medical equipment, also for such computer-loaded office buildings as the Government Offices Center soon to go up opposite the White House.

Pay-Television Trial Underway in Hartford

FEDERAL COMMUNICATIONS COMMISSION acted *en banc* recently to give final approval to the first subscription-tv trial. Grant was made to Hartford Phonevision, licensee of Hartford, Conn., station WHCT (channel 18).

RKO General is sole owner of Hartford Phonevision. Zenith Radio developed the system; Television Entertainment Co. (Teco) is Zenith's patent licensee. RKO has assumed the cost of the test, which it estimates at \$10 million and which it does not expect to recover "during the three-year period."

Royal Navy Developing Weapons-Control Computers

GREAT BRITAIN'S Royal Navy is developing computers to track and classify targets automatically, store and display the information, and calculate and recommend battle procedures.

Revelation of the development came during debate in Parliament on the navy estimates last week. System will be flexible and simple enough to permit reprogramming for changes in weapons and weapons policy. It will prepare and accept information for automatic exchange among ships in its own and allied task forces.

"Dark Heater" Promises To Extend Tube Life

DEVELOPMENT of a "dark heater" that operates 350 K below the 1,500-1,700 K of a standard thermionic-cathode heater was reported last week by RCA's electron tube division.

The heater has a grey insulation

coating applied to the heater wire. The darker surface radiates heat more efficiently, improves the transfer of heat to the cathode, permits efficient cathode operation at 1,350 K.

Company spokesmen say the lowered bulb temperature will extend life and improve performance of entertainment-type tubes. RCA has already produced a quarter-million electron tubes using dark heaters.

Lowered internal stresses and reduced thermal change during cycling, according to RCA scientists, lessen the chances of recrystallization and burnout. Current characteristics are extremely stable. Effects of a-c leakage and hum are reduced.

Cooler operation means a greater margin of safety in present heater-cathode voltage ratings.

Air Force Accelerates Weather System Test

RADARS for detecting severe storms are being set up at Hanscom Field in Bedford, Mass., and at the Army Ordnance Depot in Maynard, Mass., for accelerated testing of USAF's 433L project. The 433L system will be a global semiautomatic weather system using AN/FMQ-5 Rawin gear, now under development (and similar to Weather Bureau's AMOS IV). The 5.6-cm AN/FPS-68 radar, developed by Navy, is the system that will be used to detect heavy rains and thunderstorms. An East-Coast prototype network for 433L, built for the Air Force by United Aircraft, should be ready for tests in May.

A vertically pointing radar at 0.86 cm is already under test for the detection of cloud layers.

Commissioner Pushes All-Channel Tv

SENATE is considering a proposal from Federal Communications Commissioner F. W. Ford to require that all new tv sets moving in interstate commerce be equipped to receive uhf as well as vhf channels.

Uhf has been caught in a vicious circle of inactivity: setmakers won't include tuning capability for channels 14 through 83 because too few broadcasts are transmitted

on uhf; broadcasters don't want to see the channels because few people want to spend the \$15 or \$20 to buy an adapter. Ford's proposed legislation would make manufacturers help expand tv coverage. Adding uhf would cost the setmakers about \$10 a set, Ford figures.

Prove Perceptron's Ability To Learn Problem-Solving

SEVERAL STUDIES of reinforcement procedures and other aspects of the perceptron electronic nerve network have been completed by Cornell Aeronautical Lab for the government.

The study results indicate that memory functions and training procedures currently exist which guarantee that a perceptron "will ultimately arrive at a solution to any given response-association problem" as long as a solution can be represented by an acceptable terminal state of the perceptron. A wide variety of problems—with wide variations in frequency and amplitude of stimuli—are soluble with existing training procedures. Different transfer functions built into a perceptron system evidently do not affect ability to arrive at solutions to learning problems. The perceptron eventually finds a way; the efficiency of the path is what varies with the variation in transfer functions.

Japan Industrialist Proposes Color Television for Taiwan

NATIONALIST CHINESE Government of Chiang Kai-shek recently received a proposal from Matsutaro Shoriki that color television be immediately introduced into Taiwan. Shoriki is publisher of Tokyo's *Yomiuri*, chairman of freewheeling Nippon Tv Network, and Grand Old Man of Japan's information media.

His proposal suggests that Taiwan's tv system, now going in, is years behind the world if it can only handle monochrome; if installed in color, it would be abreast of the world and ahead of the Chinese Peoples Republic (which now boasts a 29-station monochrome network). Shoriki points out that only Japan and the U. S. are now carrying on full-scale color

telecasting, suggests that—if undertaken before the present system is cemented into place—a color system could be installed in Taiwan by adding one or two hundred million yen (between \$280,000 and \$560,000) to the present appropriation.

NTV is offering not only technical assistance in setting up the island system on Taiwan, but also financial aid amounting to the necessary one or two hundred million yen.

Air Force Pays for Study Of Radiation Transients

PROBLEM of malfunctions in electronic gear from high transients of nuclear radiation will be studied by Boeing Airplane Co. under contract from USAF's Air Research & Development Command.

Study will use the pulsed nuclear reactor at Lawrence Radiation Lab, Livermore, Calif. It will seek to determine radiation levels at which present-day electronic gear can operate, will try to find design parameters to make equipment immune to high transient values of radiation. Flash X-ray system now under development at Boeing will also be used to simulate nuclear-weapon transients.

Missile-Warning Network Gets First Phone Circuits

FOUR STATIONS of the 34 USAF microwave and tropo-scatter stations being installed by Western Electric for the ballistic-missile early-warning system in Alaska went into operation last week. The initial link from Clear connects Murphy Dome and Pedro Dome to the Alaskan Communications System office in Fairbanks.

The whole system—connecting Clear through Anchorage, Fairbanks, Juneau and Ketchikan to North American Air Defense Command headquarters in Colorado Springs—will become operational this summer. It will complement and augment the existing White Alice system.

The Thule, Greenland, leg of BMEWS communications has been in operation since last Oct. 1.

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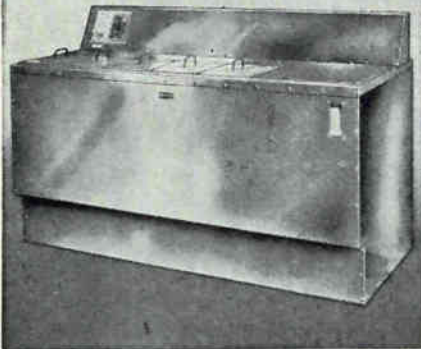


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FIRST IN PURE WATER

WASHINGTON OUTLOOK

KENNEDY ADMINISTRATION's reappraisal of the nation's defense policy is expected to result in a new emphasis on development and procurement of electronic command and control systems.

The Pentagon has recommended a sharp increase in spending for such equipment as part of the overall effort to reduce the vulnerability of strategic weapons systems and to improve operational decisionmaking. Service officers have long complained about inadequate budgets for command and control systems.

While the White House has accepted the Pentagon's general view on the need for bolstering electronic command and control facilities, no one is certain how much additional spending the administration will authorize for the fiscal year starting next July. Any substantial step-up will probably appear in fiscal 1963, when Kennedy's first complete budget will be in effect.

INDEPENDENT REVIEW of government patent policies concludes that the policies are functioning reasonably well and that there seems to be no urgent reason for change. The study was made for the General Services Administration by George Washington University's Patent, Trademark & Copyright Foundation.

The Foundation's conclusion, which is based on a study of R&D contracting by both Defense Department and Atomic Energy Commission, contradicts allegations of the electronics industry and other defense contractors. These contractors want the patent policy of National Aeronautics & Space Administration revised so that it will be more in line with the Pentagon's than with AEC's. The Defense Department allows contractors title to patents developed under contract; NASA's policy, like AEC's, restricts the award of patents resulting from federally financed R&D.

The GWU study claims this controversy on patents is "exaggerated" and that very few patentable inventions actually come out of research for the government. It argues that there is no strong case for a uniform patent policy, suggests that uniformity might hamper Pentagon-AEC flexibility in dealing with contractors.

It does concede, however, that AEC policies probably are too rigid and may have deprived the Commission of the fullest cooperation from private industry. It describes as "negligible" the danger of undue concentration in industry which some Congressmen have said would result from the Pentagon's policy.

NAVY is asking for authority to develop a Polaris missile with 5,000-mile range, and an even bigger Polaris for use as a seaborne satellite launcher.

The 5,000-mile version of the missile would be tagged A-5, would follow up the 1,200-mile model now operational, the 1,500-mile A-2, to be ready next year, and a 2,500-mile A-3 scheduled for service use in 1964. The A-5 could be developed by around 1970, Navy sources say.

The proposal to convert Polaris into a satellite launcher is called Project Sea Scout. The hefty solid-fueled rocket would be used to orbit the Transit navigation-aid satellite and for other Navy-initiated space projects.

FIRST CONSTRUCTION CONTRACT for a Minuteman ICBM base has been awarded after a five-month delay. The delay resulted from a \$25-million gap between the Pentagon's original \$50-million estimate for the work and the low bid that was received on the first round of bidding. Defense Department negotiated the price down to \$61.8 million by agreeing to furnish certain equipment which the construction contractor was initially required to buy and install himself.

Inventiveness: indispensable ingredient of Space Technology Leadership

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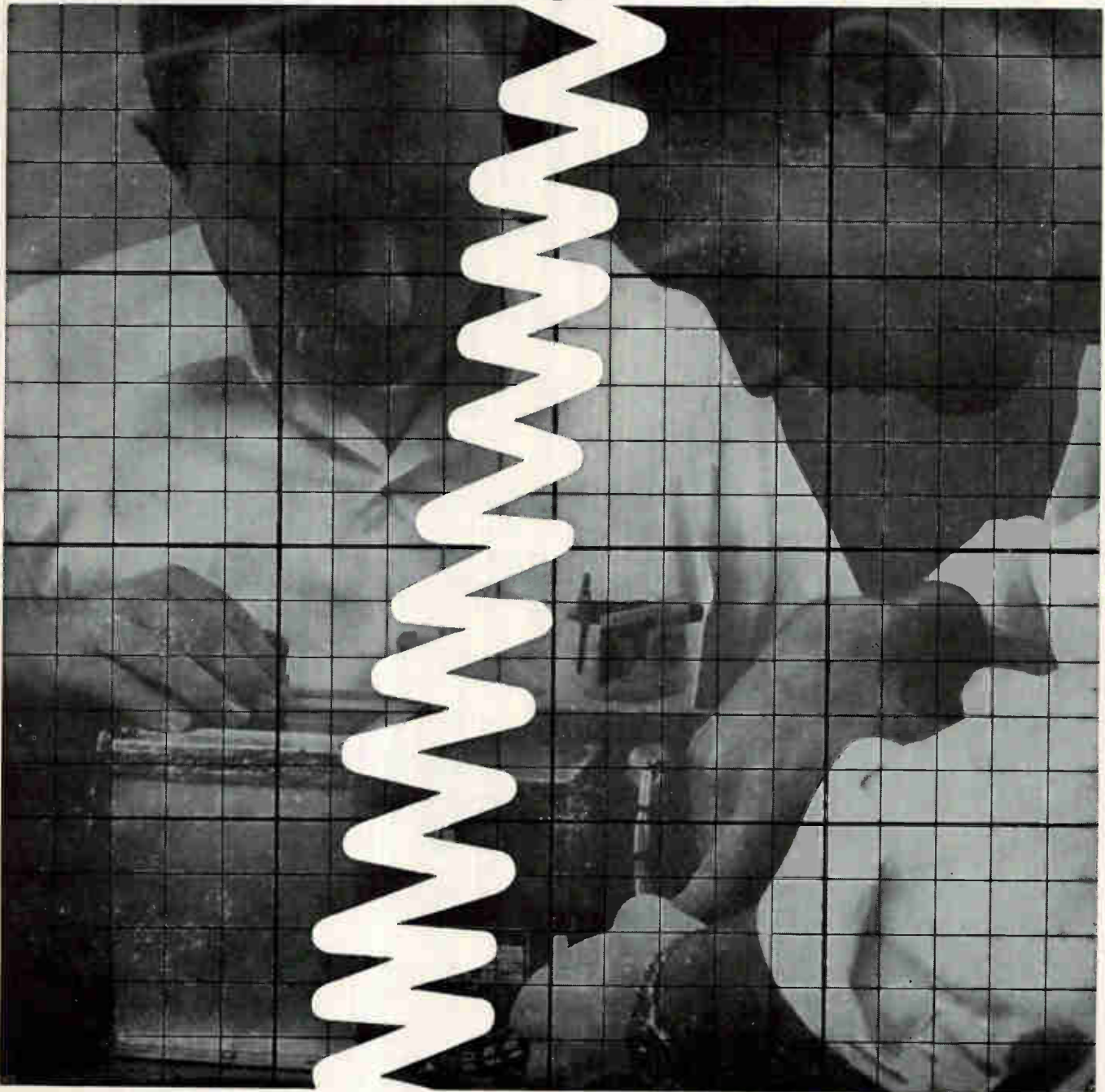
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have the advantages of a Keithley electrometer for as little as \$280!



MODEL 620 Battery-Operated Electrometer offers 31 ranges.



These two new low cost electrometers perform the work of several instruments in the measurement of extreme spans of voltage, current and resistance, and complement the more sensitive Keithley 610A and 600A electrometers. They are useful dc pre-amplifiers and have outputs for driving oscilloscopes and recorders.

The line-operated 621 features 37 ranges, and the battery-operated 620 offers 31 ranges. Accessory voltage-divider probes are available to extend the voltage ranges to as high as 30 kv. Input impedance of both instruments can be selected from 10^6 to 10^{14} ohms to permit optimum balance of low circuit-loading versus minimum pickup.

The 621 offers full scale current ranges of 10^{-11} to 10^{-4} ampere, while the 620 covers from 10^{-11} to 10^{-5} ampere. Both instruments measure signals below one micro-microampere with speed and ease.

Both the 620 and 621 include internal resistance measuring ranges covering the majority of high resistances normally encountered in the laboratory. The 621 ranges are 10^5 to 10^{12} ohms, and the 620 covers 10^5 to 10^{11} ohms full scale, on readable, linear mirror scales.

brief specifications

RANGES:	620	621/621R
Voltage:	0.1, 0.3, 1, 3, 10 volts f.s. to 2% of f.s. on all ranges.	0.1, 0.3, 1, 3, 10, 30, 100 volts f.s.; to 2% of f.s. on all ranges.
Current:	10^{-11} to 10^{-5} amp. f.s.; to 3% of f.s. to 10^{-9} amp. 4% beyond.	10^{-11} to 10^{-4} amp. f.s.; to 3% of f.s. to 10^{-9} amp., 4% beyond.
Resistance:	10^5 to 10^{11} ohms f.s.; to 4% of f.s. to 10^9 , 5% beyond.	10^5 to 10^{12} ohms f.s.; to 4% of f.s. to 10^9 , 5% beyond.
ZERO DRIFT:	After warmup, below 3 mv/hr.	After warmup, below 3 mv/hr.
AMPLIFIER:		
F. S. Outputs:	Up to 1 volt	Up to 1 ma or 10 V.
Gains:	0.1, 0.33, etc. to 10	0.1, 0.33, etc. to 100
Bandwidth:	DC to 1000 cps within 3 db.	DC to 1000 cps within 3 db.
PRICE:	\$280.	Cabinet or rack \$390.

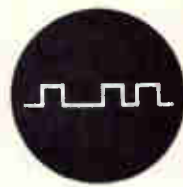


MODEL 621 Line-Operated Electrometer, shown with Shielded Test Lead, is also available as rack Model 621R shown above.

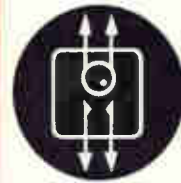


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CLEVELAND 6, OHIO

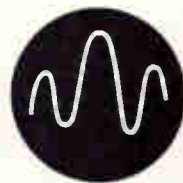
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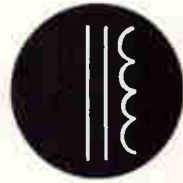
RELIABILITY



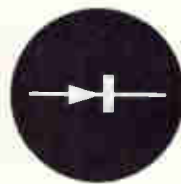
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RAYTHEON COMPANY

WALTHAM, MASSACHUSETTS

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of the many semiconductor sources

some are **GERMANIUM** houses

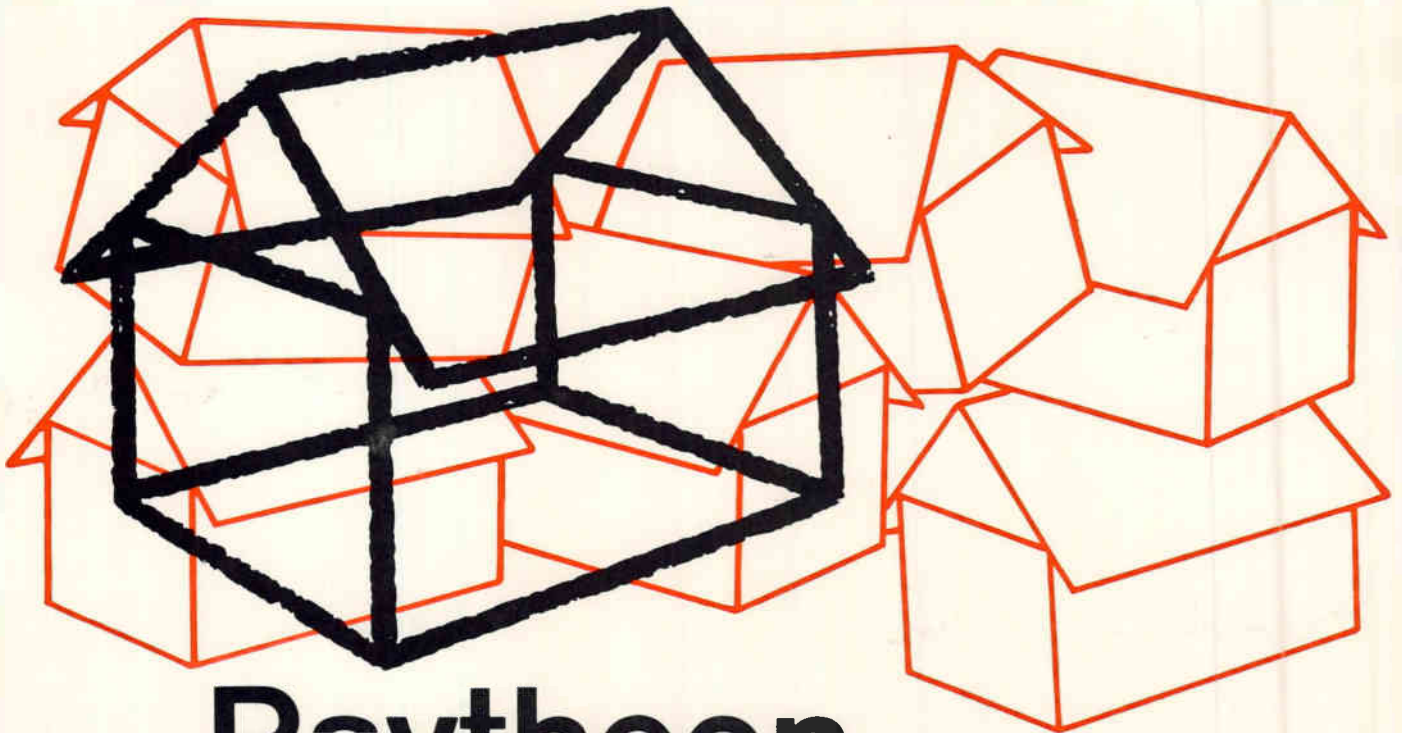
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some are **DIODE** houses

some are **RECTIFIER** houses

some are **TRANSISTOR** houses

some are **CIRCUIT PACKAGING** houses



Raytheon is all of these in one

plus *proven advances in* **RELIABILITY PROCEDURES**
mechanized production for **PRODUCT QUALITY**
extensive engineering for **APPLICATIONS ASSISTANCE**

There's a Raytheon semiconductor for your application. For information on all Raytheon semiconductor products, call your nearest Raytheon Sales Office. For a copy of our Short Form Catalog, *circle 200 on Reader Service Card.*

SILICON AND GERMANIUM DIODES AND TRANSISTORS • SILICON RECTIFIERS • CIRCUIT-PAKS

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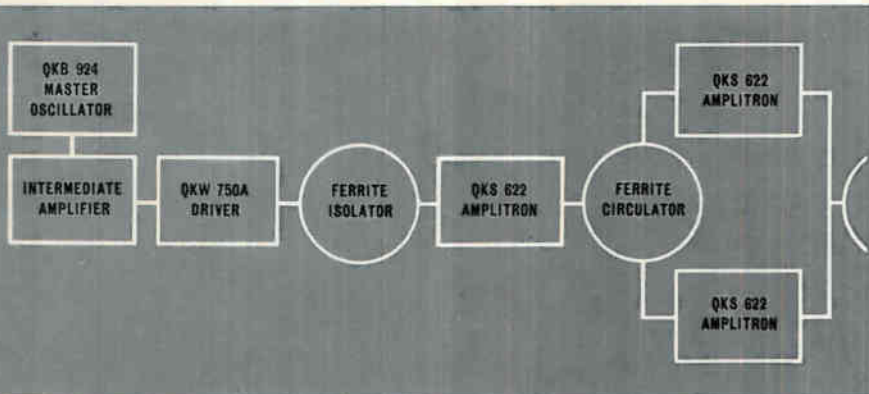
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New microwave tubes for broadband, high-power S-band MOPA chains



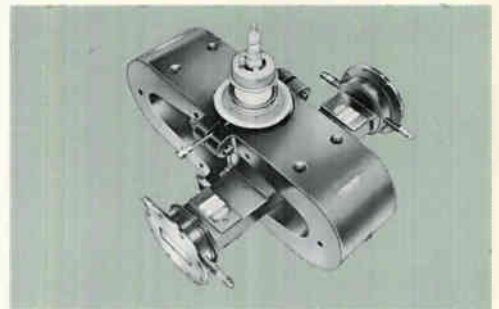
QKW 750A TWT has 20 db nominal gain and 100 kw nominal peak power to drive Amplitrons in MOPA chains. Duty cycle is .015 for pulsed operation over the 2,900 to 3,100 Mc range. A similar tube, the QKW 782, covers the 2,700 to 2,900 Mc range. *Circle 201 on Reader Service Card.*

QKB 924 BWO is the master oscillator. This tube in conjunction with an external delay line feedback, provides an extremely stable frequency signal over the 2,700 to 3,200 Mc range. Tubes with similar characteristics are available through X-band. *Circle 202 on Reader Service Card.*

The new tubes described on this page make possible highly efficient master oscillator-power amplifier chains with bandwidths of 7%, peak powers of 6 megawatts and average powers of 30 kilowatts.

A new concept in master oscillators permits the precise determination and stabilization of frequency. Thus, the MOPA chain is ideally suited to high-duty-cycle, frequency diversity applications employing fully coherent MTI, pulse compression and pulse-to-pulse frequency shift.

Tubes with similar performance characteristics are also available for MOPA operation in other frequency bands. For complete technical details on this new microwave technique and comprehensive brochure, write to Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts.



Two QKS 622 pulsed type Amplitrons* in parallel operation produce 6 megawatts of power output over the 2,900 to 3,100 Mc range at efficiencies of 75% to 80% and duty cycles as high as .005. The QKS 783 is a similar Amplitron that covers the 2,700 to 2,900 Mc range. *Circle 203 on Reader Service Card.*

*Raytheon trademark

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MICROWAVE AND POWER TUBE DIVISION

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High Power CW X-Band Circulators

Raytheon's Special Microwave Device Operations announces a new line of high-power ferrite X-band circulators which may also be used as isolators in conjunction with suitable auxiliary loads.

The typical unit illustrated is the model CXH2 covering 10.0 to 10.6 kMc with a continuous power rating of 10 kilowatts. Isolation is 20 db minimum, insertion loss is 0.25 db maximum and VSWR is 1.15.

Used as an isolator, the unit will handle continuous power levels up to 10 kilowatts with a front-to-back ratio of 60:1.

For complete details on this and other significant developments in microwave ferrite devices, please write to Special Microwave Device Operations, Raytheon Company, Waltham Industrial Park, Waltham 54, Massachusetts.

High power X-band circulator CXH2.
Circle 204 on Reader Service Card.

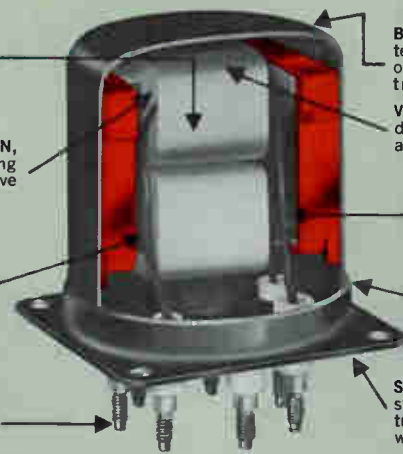


COLLOIDAL SILICA SOL impregnation and/or foam-potting with hollow ceramic spheres.

GLASS FIBER INSULATION, mica or aluminum winding forms, heat cleaned to remove organic residues.

PURE SILVER or chromium-plated copper wire insulated with a glass fiber or ceramic coating.

ALUMINA TERMINALS protected against oxidation by special plating process.



BLACK OXIDE FINISH on interior and exterior surfaces of case for better heat transfer.

VOLATILES REMOVED by degassing in high vacuum at high temperature.

CONTROLLED ATMOSPHERE inside hermetically sealed enclosure.

HELIARC WELD sealing inspected by helium mass-spectrometer leak detector.

STAINLESS-STEEL construction of case and structural members for minimum weight.

Circle 205 on Reader Service Card.

New Raytheon transformer will resist nose cone temperatures to 1,100°F

Raytheon is now building transformers capable of withstanding temperatures such as those encountered in a re-entering missile's red-hot nose cone.

The unit pictured above resists temperatures up to 1,100°F which is 700 degrees higher than units presently in use. The goal for units now under construction at Raytheon is a minimum operation time of 2,000 hours with an internal temperature 200 degrees above the ambient of 900 degrees.

To accomplish this, Raytheon has developed new construction techniques and high-temperature resistant wire and insulating materials.

For further information on high-temperature transformers please write, stating your specific requirements, to Magnetics Operations, Raytheon Company, Microwave & Power Tube Division, Waltham 54, Massachusetts.

For nearest
Raytheon Sales Office
see last page of insert.

Typical Specifications • MODEL CXH2

Frequency	10.0—10.6 kMc
Power	10kW (cw)
Isolation	20 db min.
Insertion loss	0.25 db max.
VSWR	1.15
Length	9 3/16 in.
Flanges	UG 39/U
Waveguide	RG 52/U
Weight	Less than 4 lbs.
Water cooled	

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MICROWAVE AND POWER TUBE DIVISION



UHF Planar Triodes for communications, radar, and missile application. Special types available include: quick warm up (12 sec. cathode heating) . . . 7.5 amp pulse current . . . grid pulsed power (2kW to 3000 megacycles). *Circle 206 on Reader Service Card.*

Electron tube specialist with major capabilities in these fields . . .

The Machlett Laboratories Inc., a pioneer in the art of high power electronics, offers significant advances in these specialized areas of electron tube design and manufacture . . .

Technical data and product line brochures on request.



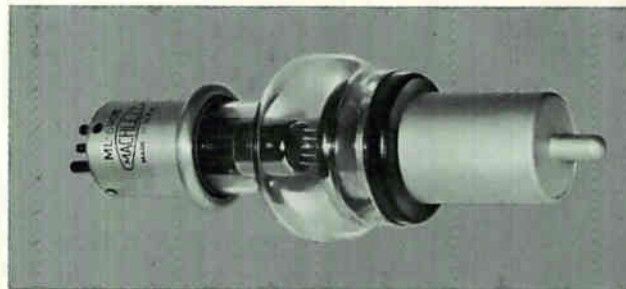
High Power Triodes for communications, industrial heating, pulse modulation. Water and vapor cooled tubes to 400kW CW output. Ceramic, coaxial-terminal construction; lightweight F-A-C tubes, low, medium and high mu. *Circle 207 on Reader Service Card.*

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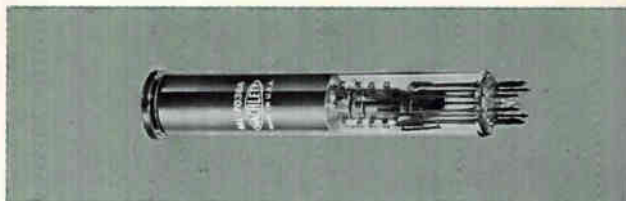
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Hard Pulse Modulator Tubes for high power radar systems, precise pulse shaping, high repetition rate, coded signaling. From the industry's strongest line: shielded grid triodes (unipotential oxide cathode, output powers to 3.5Mw); high power triodes (pulse powers to 20 Mw; hold-off ratings to 100kV in production to 350kV in development). *Circle 208 on Reader Service Card.*



High Vacuum Rectifier Tubes for hold-off diode application, high voltage power supplies. 110kV-10 amps, air insulated; 150kV-10 amps, oil insulated. *Circle 209 on Reader Service Card.*



TV Camera and Specialized CR Tubes — Vidicons: for ultraviolet sensitive response . . . low light level . . . near infrared. Scan conversion tube: S/N ratio of 100:1, rf separation not required. *Circle 210 on Reader Service Card.*

THE MACHLETT LABORATORIES, INC.

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A reputation for reliability Raytheon's complete line of components for industrial and military applications

Choose the most reliable electronic components available. Precision-produced by the Industrial Components Division, this broad line encompasses practically every electronic circuit requirement from electron tubes to the most advanced and sophisticated innovations in electronic components. Full technical data can be obtained by writing to: Industrial Components Division, Raytheon Company, 55 Chapel Street, Newton 58, Massachusetts.



Subminiature Tubes

Raytheon, leading manufacturer of subminiature tubes, maintains an unprecedented program of quality control. Outstanding features of Raytheon subminiature tubes include: reduced vibration output, superior characteristic uniformity, reduced microphonic output, controlled operation time, tightened characteristic limits, greater resistance to shock and fatigue. *Circle 213 on Reader Service Card.*



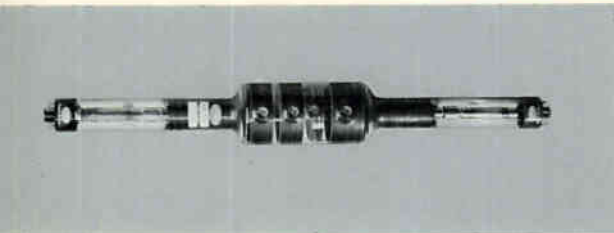
Receiving Tubes

Innovations in grid manufacturing techniques and advanced quality control methods result in higher performance and dependability in receiving tubes for radio, TV, high-fidelity, and mobile communications. *Circle 214 on Reader Service Card.*



Noise Modules

Wide band noise source modules are small, rugged, and require low power. They permit the successful design of extremely compact, portable test equipment and systems capable of reliable operation over wide extremes of shock, vibration, and temperature. *Circle 215 on Reader Service Card.*



Storage Tubes

The advanced design features of Raytheon recording storage tubes offer designers of radar systems many new application possibilities. A full line of single- and dual-gun types enable the design of unique circuits for scan conversion, retention, and signal integration. *Circle 211 on Reader Service Card.*



Cathode Ray Display Devices

Printer, infrared stimulable, and high-altitude CRT's like the CK1354 and CK1355 illustrated, are representative of Raytheon's advanced development techniques in cathode ray display devices. Many types—oscillographs, radar indicators, video recorders, and flying spot scanners are available for industrial and military applications. *Circle 216 on Reader Service Card.*



Raysistors

Raysistor control devices are electro-optical components designed to operate efficiently as relays, potentiometers, choppers, commutators, and high voltage controls. No mechanical parts mean long trouble-free operation in many circuit applications. *Circle 212 on Reader Service Card.*

For nearest
Raytheon Sales Office
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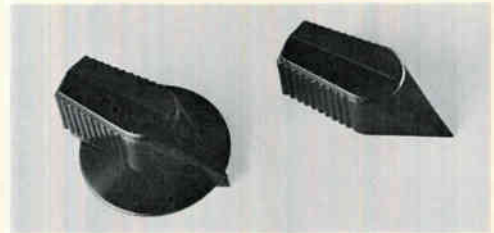
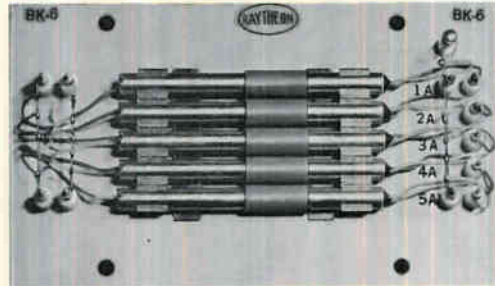
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Filters

For multiple narrow band filter channel applications, Raytheon magnetostriction rod filters are more rugged, weigh less, take less space and are more precise than other types available. Single filter and arrays are available in both stock and custom designs. *Circle 218 on Reader Service Card.*



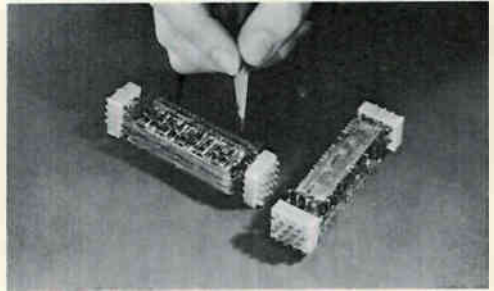
Control Knobs and Panel Hardware

For equipment that deserves the precision-engineered look, Raytheon offers the most complete line of matching control knobs to MS91528B plus panel hardware such as knob and shaft locks, test jacks, and panel fasteners. *Circle 221 on Reader Service Card.*



Rayspan Spectrum Analyzers

Utilizing a unique magnetostriction filter application, Rayspan Spectrum Analyzers provide the outstanding features of high speed, high resolution, and high sensitivity. Operating over a wide frequency range they enable the analysis of pulses and transients and distinguish weak signals. *Circle 219 on Reader Service Card.*



Weld-Pak Circuit Modules

Raytheon Weld-Pak circuit modules contain more than 100 components and 300 welds in each cubic inch. A full line of standard computer logic modules, as well as complete custom-design service is available. Raytheon also provides a complete line of Weld-Pak neon, incandescent, and thyratron light indicator packages. *Circle 222 on Reader Service Card.*



Low Power Industrial and Transmitting Tubes

Popular rectifier, series regulator, and transmitting types featuring greater efficiency and reliability are available. Tubes are outstanding for their higher voltages, higher power, and higher temperature handling capabilities. *Circle 217 on Reader Service Card.*



Miniature Tubes

Raytheon miniature tubes are reliable and rugged. Their advanced electrical and mechanical construction features assure long life and trouble-free operation under the most adverse environmental conditions. Frame grid miniature types provide exceptionally high gain and low noise. *Circle 220 on Reader Service Card.*



Accelerometers

The EM900 piezoelectric accelerometer illustrated, is a general purpose type. It accurately measures shock up to 100,000 G's and vibration up to 10,000 cps with no measurable hysteresis and is operable in ambient temperatures ranging from 100° below zero F to 500° above zero F. *Circle 223 on Reader Service Card.*

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION



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New portable fully transistorized d-c power supply. QR36-4AP regulates 0 to 36 vdc output voltage to $\pm (0.02\% + 1\text{mv})$ against combined line or load variations. Fully metered. Front panel terminals for remote sensing. *Circle 224 on Reader Service Card.*



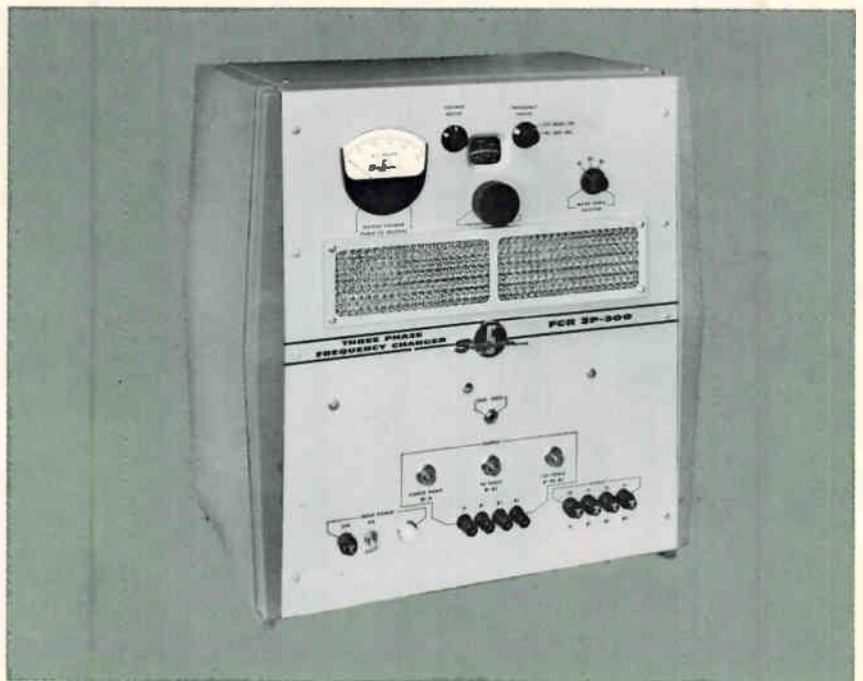
New portable high-voltage supply Model 230-6P has unusually versatile controls, unusually complete protective features for a unit of its size. Rated: 0-30,000 vdc, at 0-6 ma. Reversible polarity. "Coarse" and "Fine" front-panel voltage adjustments. *Circle 225 on Reader Service Card.*

New wide-range three-phase frequency changer, Model FCR3P300, supplies up to 300 volt-amperes, three-phase, at any frequency in the range 45 to 2000 cps. Low distortion. Also rated at 200 VA two-phase or 300 VA single-phase. *Circle 226 on Reader Service Card.*

Three new models added to Sorensen line of off-the-shelf controlled power units

... just a sample of the more-than-400 Sorensen models... including regulated d-c power supplies, a-c voltage regulators, voltage regulating transformers, high-voltage d-c power supplies, high-voltage a-c and d-c testers, and miniature component-type inverters, converters, and d-c supplies. Request your copy of the new 1961 Sorensen "Power Supply Handbook and Catalog" from Sorensen & Company, Richards Avenue, South Norwalk, Conn.

For nearest
Sales Office
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Sorensen
SUBSIDIARY OF RAYTHEON COMPANY

SORENSEN & COMPANY, INC.

SOUTH NORWALK, CONNECTICUT

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Analog-Digital converter handles 5 million information samples/second

Faster than any other available, Raytheon's new A-D converter provides up to 5 million independent 8-bit words per second.

The machine's twenty-five nano-second aperture time allows digitizing of pulses less than one-half microsecond in width.

About the size of an office typewriter, the A-D converter offers industry and government a basic solid-state tool which significantly extends the state of the art.

The machine lends itself readily to

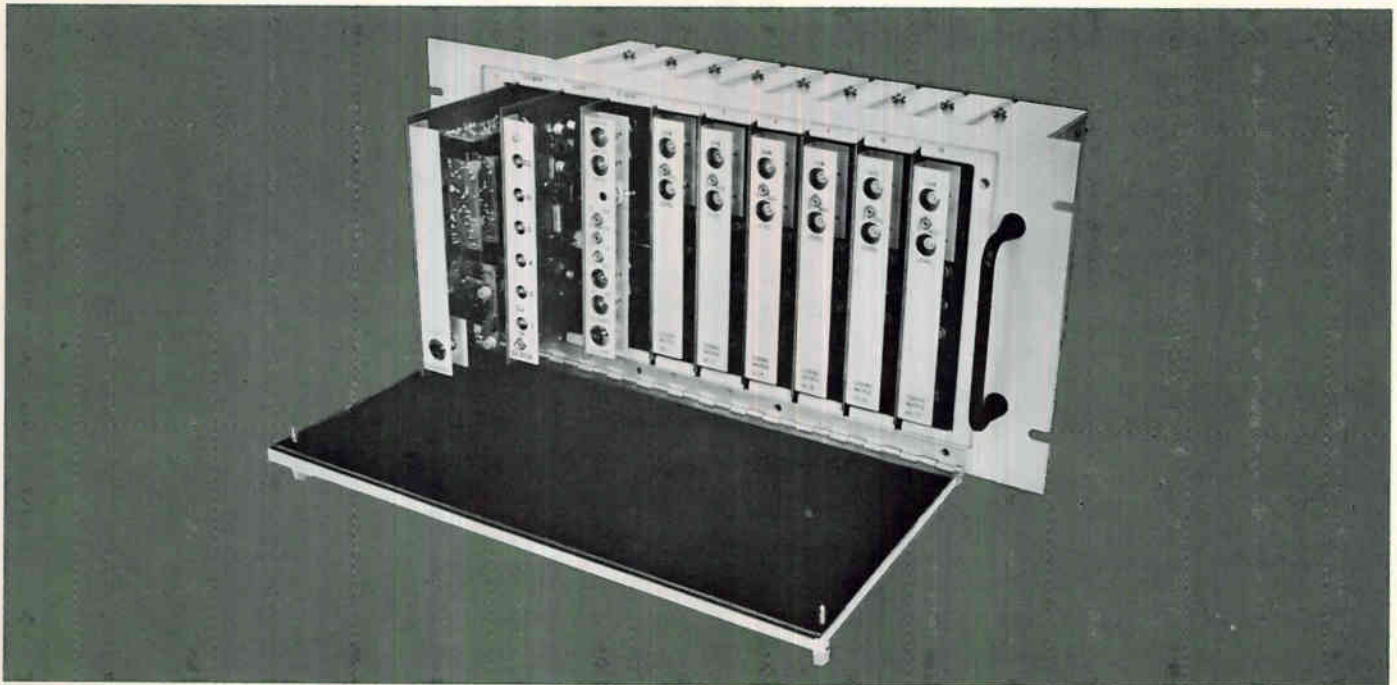
system integration because its flexible design allows acceptance of variable input as well as wide variations in output format and logic.

With multiplexed input, its applications encompass any product or process requiring continuous or intermittent digitizing of analog voltages in any form.

For complete specifications please write Communications and Data Processing Operations, Raytheon Company, 225 Crescent St., Waltham, Massachusetts.

For nearest
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Analog-Digital Converter, about the size of an office typewriter, is readily integrated in data handling systems. *Circle 227 on Reader Service Card.*



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Power, protection, regulation . . . all three in one transformer!

Series 2020 Voltage Regulating Transformers cost less than ordinary transformers plus associated regulating circuitry.

Is the transformer in your power supply merely supplying power or does it *regulate voltage* and *protect circuits*, too?

Raytheon's Series 2020 Voltage Regulating Transformers perform all *three* functions. They (1) provide the specified voltage and current from 10 VA to 10,000 VA, (2) stabilize voltage within $\pm 1\%$ and (3) protect tubes and delicate semiconductor rectifiers against power surges as well as internal and external short circuits.

These versatile "magnetic regulators" are extremely compact and inexpensive, too—take less space and cost less than ordinary transformers plus associated regulating circuitry.

Send for convenient Raytheon Selection Guide and Power Supply Design Data that helps you match your requirements from 2,020 standard units. Commercial Apparatus & Systems Division, Raytheon Company, Keeler Avenue, South Norwalk, Conn.

For nearest
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see last page of insert.



Series 2020 magnetic regulators are available in a wide range of models and styles. Convenient selection guide lets you choose from 2020 different units. *Circle 228 on Reader Service Card.*



New low-cost regulated dc power packages. These compact "RD" units are available in 132 different ready-to-operate models for standard 19-inch rack installation, 3 to 1,000 volts, 50 to 3,000 watts in 20 voltage steps and 7 power ratings. DC output is isolated and filtered with a ripple reduction to within 0.5 to 1.0% depending on model. *Circle 229 on Reader Service Card.*

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RAYTHEON DISTRIBUTORS in 57 cities offer immediate delivery of RAYTHEON RELIABLE COMPONENTS ... at no penalty in price

If no Raytheon Distributor is listed for your area, we will be pleased to send you the name of the Distributor nearest you.
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NATional 5-4000

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BRowning 2-9600
(Microwave and Power Tube Div.
Headquarters)

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Hillcrest 4-6700
(Semiconductor Division
Headquarters)

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BigeLow 4-7500
(Industrial Components Division
Headquarters)

1415 Providence Turnpike
Norwood, Mass.
NORwood 7-6700
(Commercial Apparatus & Systems
Division Headquarters)

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Waltham, Mass.
Twinbrook 9-8400
(Communications & Data Processing
Operations Headquarters)

130 Second Ave.
Waltham Industrial Park
Waltham, Mass.
Twinbrook 9-8080
(Special Microwave Devices
Operations Headquarters)

190 Willow St.
Waltham, Mass.
Twinbrook 9-8400
(Magnetics Operations
Headquarters)

411 Providence Turnpike
Westwood, Mass.
DAVIS 6-7700
(Distributor Products Division
Headquarters)

MICHIGAN

New Center Bldg.
7430 Second Ave.
Detroit, Mich.
TRinity 3-5330

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6121 Excelsior Blvd.
Minneapolis, Minn.
WEst 9-2988
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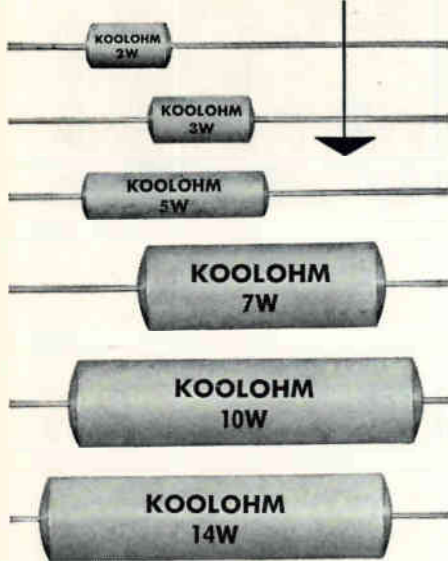
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FINANCIAL

Earnings Show Fluctuation

SALES for the six months ended Dec. 31, 1960 were \$49,053,963, according to reports from SIEGLER CORP., Anaheim, Calif. Earnings for the period were \$1,776,865. Per-share earnings for the period have no basis of comparison with the comparable period a year ago, says John G. Brooks, president. The reason is that a stock exchange made when the company acquired JACK & HEINTZ, Cleveland, O., missile component maker, has changed radically the number of shares outstanding for Seigler. In making the report, Brooks noted that the company's OLYMPIC RADIO AND TELEVISION division recently moved into new quarters at Glendale, L. I., and that the HALLAMORE ELECTRONICS division had increased its plant space facilities in Anaheim.

BENDIX CORP., Detroit, reports net income of \$7,632,537, including a nonrecurring sum of \$3,215,287 for the three months ended Dec. 31, 1960. Net income per share was \$1.42 based on 5,373,401 shares outstanding at the close of the period, and included 60 cents a share of nonrecurring income. The nonrecurring amount represented profit from the sale of ELLIOTT-AUTOMATION LTD. and also included a portion of monies reserved for purchased patents. A year ago, figures were \$5,753,583, or \$1.13 per share.

INTERNATIONAL RESISTANCE CO., Philadelphia, established record sales and earnings in 1960 for the second consecutive year. Net sales for the period ended Jan. 1, 1961 were \$20,824,173, a rise of 5.1 percent from the \$19,810,403 reported in the previous fiscal year. Earnings after taxes totaled \$1,943,450, an increase of 9 percent over the previous year's figure of \$1,783,859. Per-share earnings were \$1.40 in 1960, \$1.29 the year before.

OAK MANUFACTURING CO., Crystal Lake, Ill. component manufacturer, reports sales in 1960 of \$17,642,295, four percent lower than the \$18,-

442,747 in 1959. In a preliminary report to shareholders, E. A. Carter, president, said the sales decline was due in part to the general lack of vigor in business activity nationally, and particularly to the company's move from Chicago to a new \$3-million plant in Crystal Lake. The move, said Carter, resulted in the company being unable to meet some delivery requirements during the latter half of the year. Net income for the year amounted to \$351,310, or 54 cents per share on 647,794 shares. In 1959, the figures were \$991,685, or \$1.51 per share on 655,894 shares outstanding.

TUNG-SOL ELECTRIC and subsidiaries report sales of \$66,471,971 for 1960. The Newark, N. J. firm says this figure was below the all-time record volume in 1959, but represents the company's second highest sales year. Net earnings in 1960 declined to \$1,476,259, or \$1.37 per share after provision for preferred dividends. This compares with net earnings in 1959 of \$2,712,552, equal after preferred dividends to \$2.70 a share. Company officers say the reduced volume paralleled generally hesitant sales conditions during much of 1960. In addition, company spokesmen say that with only minor exceptions, major product lines were affected by heavy competitive pressure on prices while costs increased. They say this was particularly true of electron tubes as tv receiver demand declined. Sales of semiconductors and automotive products improved over 1959, but not enough to offset reduced volume in other areas.

HEWLETT-PACKARD CO., Palo Alto, Calif., reports net earnings of \$1,237,000 for the first quarter of the fiscal year. The quarter ended Jan. 31, 1961. The earnings, which included subsidiary companies' incomes, represent a four-percent increase over the \$1,192,000 reported during the corresponding period a year ago. Per-share earnings for the quarter this year were 12.5

cents, as compared with 12.1 cents a year ago. Sales for the period in 1961 were \$16,293,000, a 20-percent rise over sales of \$13,539,000 in the first quarter of fiscal 1960.

AMPHENOL-BORG ELECTRONICS, Broadview, Ill., announces earnings of \$2,934,814 or \$2.51 per share for 1960. This compares with earnings of \$2,926,605 or \$2.50 per share for 1959. Net sales in 1960 were \$60,358,468, up 6.9 percent over sales of \$56,451,533 in 1959.

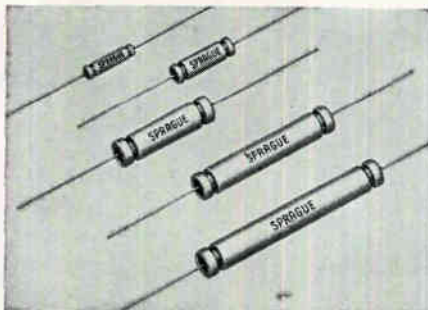
IRON FIREMAN MFG. CO., Portland, Ore., reports 1960 sales were the second highest in any peacetime year in company history. Consolidated net sales came to \$28,057,480, as compared with the peacetime record of \$28,664,942 the year before. In 1958 sales totaled \$27,938,130. Lewis J. Cox, company president, said the dip in sales—added to higher marketing costs and increased investment in new product development—brought last year's consolidated net income to \$645,014, or \$1.62 per common share. In 1959, the figures were \$749,305, or \$1.89 a share. Cox said slight declines in the aircraft and heating divisions of the company were almost offset by new sales records for the firm's electronics division.

25 MOST ACTIVE STOCKS

	WEEK ENDING FEBRUARY 24, 1961			
	SHARES (IN 100's)	HIGH	LOW	CLOSE
Sperry Rand	4,457	26½	24¾	26½
Elec Mus Ind	2,702	67½	57½	67½
Gen Elec	2,345	65½	62½	63¾
Ampex	1,821	22¾	20½	21½
Standard Kollsman	1,735	31¼	26¾	30¾
Gen Tel & Elec	1,419	28¼	27½	27¾
Westinghouse Elec	1,349	45	42¾	43½
Univ Control	1,229	13¾	12¾	13¾
Lear Inc	1,113	20¾	17¾	19¾
Martin	1,025	35	33½	34¾
Avco	970	16¼	15¾	15¾
Burroughs Corp	863	35½	32¾	35½
RCA	800	57	52¼	57
Republic Aviation	668	37¾	33¾	36¾
Elec Assistance	659	35¾	31½	32¾
Lockheed	615	35¾	33½	34¾
Transitron	543	37¾	35½	35¾
Int'l Tel & Tel	542	52¾	51¼	52¾
Gen Inst Corp	535	45¾	42¾	43
Victoreen-Ins	535	16¾	15½	16¾
US Ind	467	12	11½	11¾
Loral Elec	442	44½	39¾	43¾
Clarostat Mfg	440	16¼	14¾	15¾
CBS	430	40½	39¾	40
Ling Temco	409	30¾	27¾	29¾

The above figures represent sales of electronics stocks on the New York and American Stock Exchanges. Listings are prepared exclusively for ELECTRONICS by Ira Haupt & Co., investment bankers.

Foil-type Tantalum Capacitors Now Available in Ratings to 250 V



Sprague Electric Company has announced another major capacitor improvement. Higher voltage ratings, sorely-needed by circuit designers of military and industrial electronic equipment, are now available in Sprague's family of Tantalex® Foil-type Tantalum Capacitors.

Plain-foil 125 C types, previously limited to 150 volts, may now be obtained in 200 volt ratings. Plain-foil capacitors designed for 85 C operation, with a previous maximum of 150 volts, are now available in 250 volt ratings. Type numbers and pertinent characteristics are shown in the following table.

Capacitor Type	Polarity	Anode	D-C Voltage Range
85 C Max. Operating Temperature			
110D (MIL CL34, CL35)	polar	plain foil	3 to 250
111D	non-polar	plain foil	6 to 250
112D (MIL CL24, CL25)	polar	etched foil	15 to 150
113D	non-polar	etched foil	15 to 150
125 C Max. Operating Temperature			
120D	polar	plain foil	10 to 200
121D	non-polar	plain foil	10 to 200
122D	polar	etched foil	10 to 100
123D	non-polar	etched foil	10 to 100

Manufactured to meet or exceed the performance requirements of Specification MIL-C-3965B, this series of Tantalex Capacitors sets new standards of reliability for all types of military and industrial applications.

Tantalex Capacitors are available promptly in production quantities. For off-the-shelf delivery at factory prices on pilot quantities to 499 pieces, Sprague industrial distributors stock the more popular items in Types 110D, 111D, 112D, 113D, 120D, and 121D, as well as MIL Types CL24, CL25, CL34, and CL35.

For complete engineering data on the types in which you are interested, write Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Mass.

See us at The IRE Show—Booth 2416-2424

CIRCLE 36 ON READER SERVICE CARD



Sprague type 73Z1 core-transistor DECADE COUNTERS

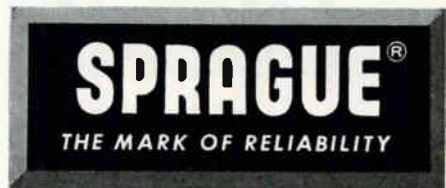
Here is a simple yet versatile, low-cost yet reliable component for counter applications. Counting to speeds of 10 kc, the 73Z1 decade counter provides an output signal for every 10 input pulses, then resets in preparation for the next cycle. For higher counting, two or more counters may be cascaded. Typical characteristics are shown below.

CHARACTERISTIC	INPUT	OUTPUT
Amplitude	1.5 to 8 volts	6.5 volts min.
Pulse Width	1 μsec min.	50 μsec nom.
Impedance	100 ohms	20 ohms

Utilizing two rectangular hysteresis loop magnetic cores and two junction transistors to perform the counting operation, the 73Z1 counter is encapsulated in epoxy resin for protection against adverse environmental conditions. It has five terminals —B+ (12v ± 10%), input, output, ground, and manual reset.

The 73Z1 counter is available as a standard item. However, "customer engineered" designs can be supplied when other counting cycles, speeds, and package configurations are required for special applications.

For complete technical data or application assistance on the 73Z1 counter or other Sprague components, write to Special Products Division, Sprague Electric Co., 35 Marshall St., North Adams, Mass.



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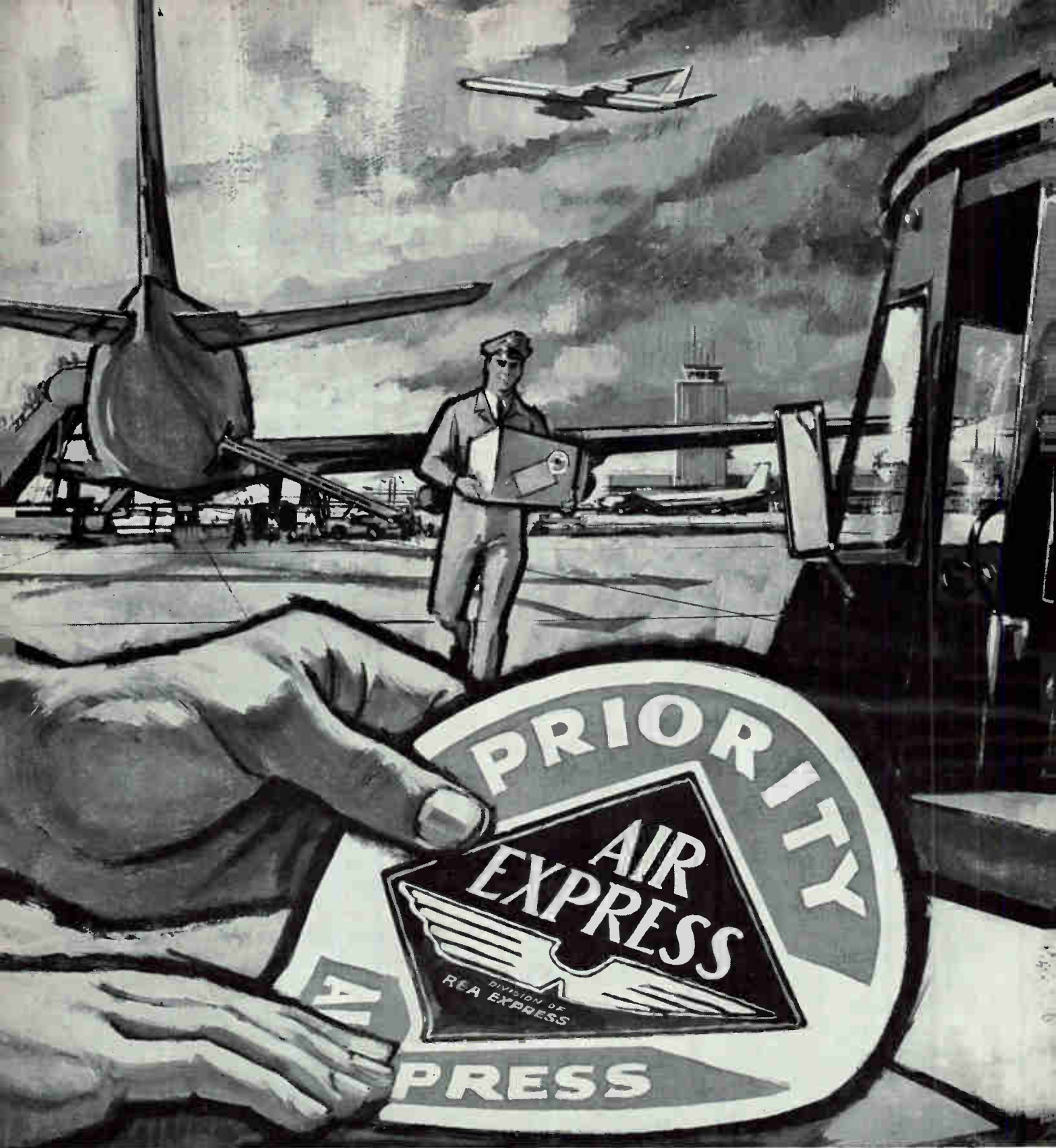
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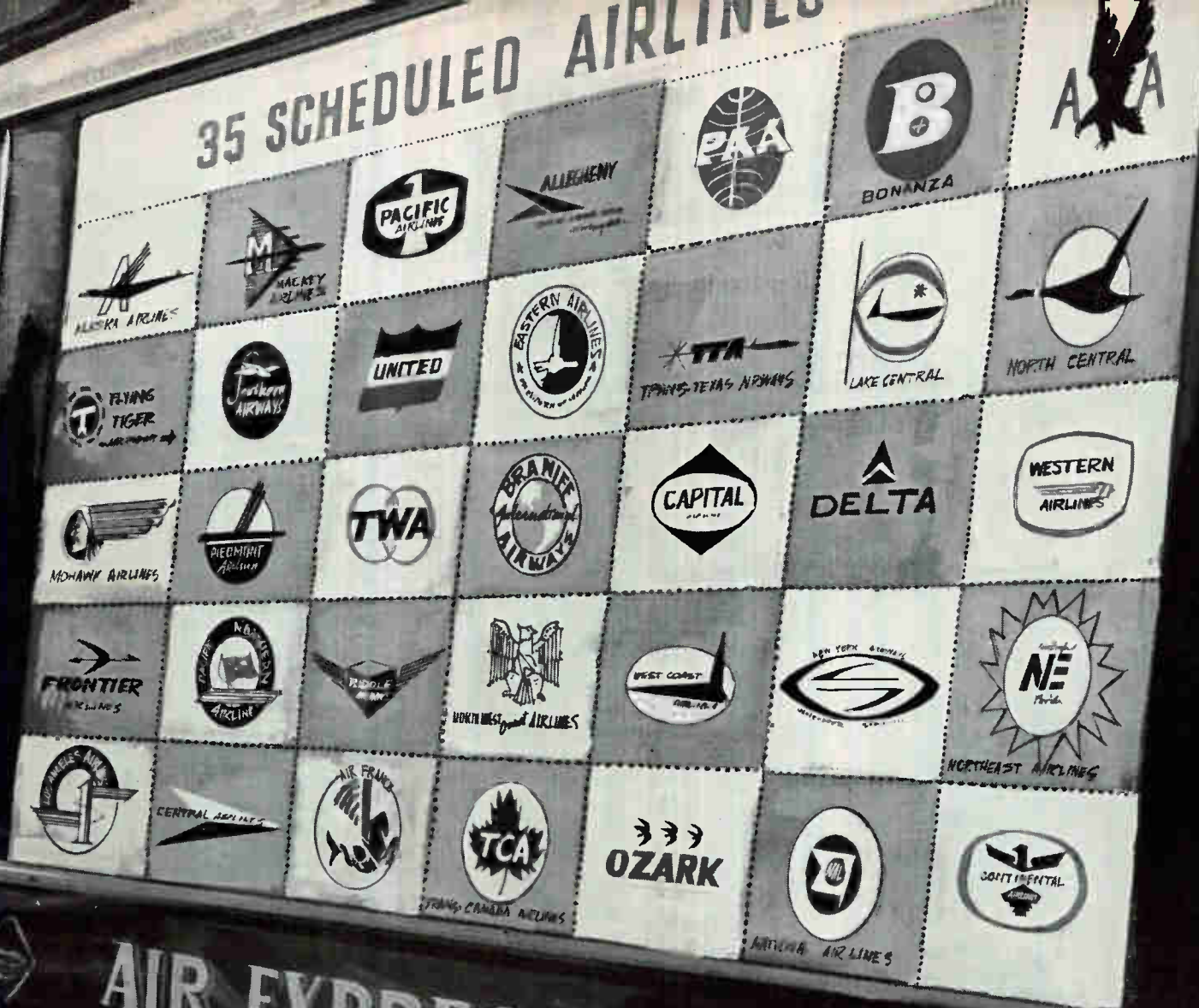


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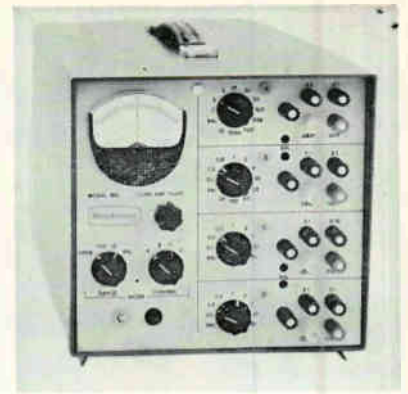
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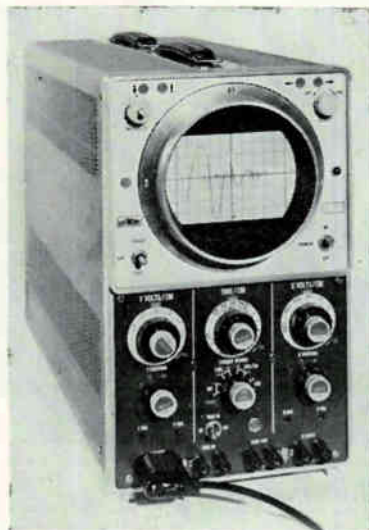
IRE SHOW: AN ENGINEER'S PREVIEW



Four chopper-stabilized operational amplifiers combined in one package by Beckman Instruments. Drift is under 20 microvolts in 24-hr



Video recorder to be introduced by Sony Corp. The two-head unit is compact, transistorized, has pushbutton control of console



Oscilloscope with a memory, writes dark trace on light background, uses special phosphor, now a production item by A. B. Du Mont Labs

ENGINEERING and product advances in every electronic field will be featured at the IRE Show in New York's Coliseum March 20-23. More than \$15 million worth of displayed equipment in over 850 booths is to be presented to over 70,000 visitors.

The booths will display advanced instrumentation equipment, new semiconductor devices, fresh packaging innovations for components and complete system equipments. Imports will spotlight the growing need by U. S. manufacturers to meet the design and price challenge of products from other countries.

Shockley Transistor will show a solid-state switching circuit able to switch a million watts in 30 nanoseconds. Using fifty 4-layer diodes, the circuit compares with the hydrogen thyratron in switching speed and power-handling ability, has been suggested for use in radar modulators for driving magnetrons, klystrons and traveling-wave tubes.

Hewlett-Packard will introduce a wide selection of instruments, and feature modular cabinet configuration that allows bench equipment to be easily converted to rack mounting. Several of the instruments will be in $\frac{1}{3}$ or $\frac{1}{2}$ rack-width modules, allowing several of them to be plugged directly into a shelf-mounted rack.

A portable transistorized oscillator, covering the range of 5 cps to 500 Kc will be shown. Battery operated, it is flat in output frequency to ± 3 percent.

To allow the use of d-c volt-

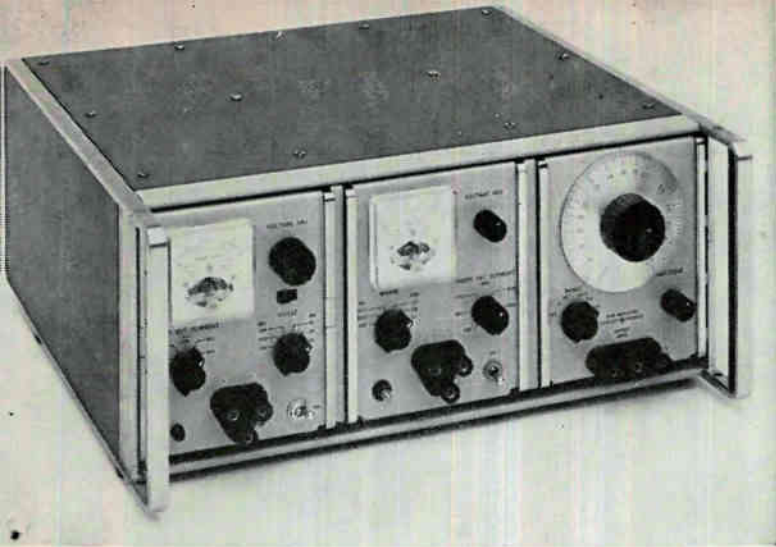
meters in measuring a-c voltage a converter operating from 50 cps to 50 Kc with an accuracy of ± 0.3 percent ± 2 mv, has been designed. It is an average responding, rms calibrated, instrument.

A family of transistor counters, with maximum counting rates to 1.2 Mc, and available with either column or in-line readout will be shown. A display storage feature gives continuous visual readout of the most recent count, even when the counter is gated for a new count. Should the new count differ from the stored one, the display will shift to the new reading.

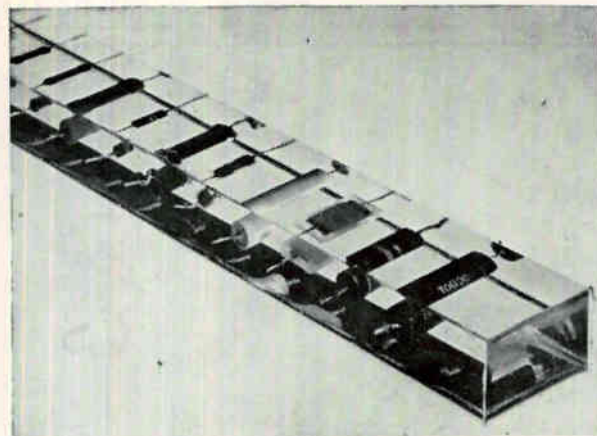
In the microwave field, PRD Electronics will be showing a power-measuring instrument with high accuracy and direct-reading meter. Operating with the firm's line of dry-block calorimeters, the PRD 680 uses a thermopile sensing element, compares it with a standard reference. Readout, accurate to 3 percent can be accomplished in seconds. The company will also feature a line of broadband coaxial ferrite isolators, covering the range 1 to 8 Gc; a noise generator, and a series of klystron-operated signal sources.

LEL Inc., will show a prototype of their RA-1 parametric amplifier bandwidth 225 to 260 Mc, designed for telemetry. Noise of the unit has been measured at under 2 db; with 25-db power gain; has a self contained power supply. See p 188 for technical details.

Westinghouse has a number of items including an image amplifier



Module instruments by Hewlett-Packard can be used on bench, or mounted three across in a rack



Transparent silicone encapsulating resin by Dow Corning allows components to be located for repair

for light intensification that has permitted photographs to be made of cosmic-ray particle tracks. A functional exhibit of the device will be presented. The company will also show a solid-state source for ultrasonic cleaning, providing an output of one kilowatt.

The firm's semiconductor department will display a high-gain power transistor; gain to 400 with a 10-amp output, able to operate at 200 volts, dissipate 150 watts.

W. L. Maxson Corp. will have a diagrammatic display board of a multibeam microwave antenna. Designed for relay work and similar applications, it uses 120 beams that can be electronically commutated to allow communication in 360 degrees. Wind resistance is lower than for a dish, mast and servos are eliminated. The antenna is made up of four separate antennas, each covering 90 degrees.

Cook Electric will introduce a photoelectric reader operating from coded-hole sets on prepunched tape. Nominal length 500-foot tape provides 100,000 bits. Transport is controlled by logic signals, and employs features used in the missile program.

Bendix will be showing a ceramic bonding material, called Ceramaterm, able to withstand a wide range of heat conditions, for transistor construction and similar service. The company has also developed a transistorized house-light dimming system that will be demonstrated.

American Electronic Labs. has

an application of their line of crystal switches, wherein they are used as audio modulators. Both coaxial and waveguide models are to be shown, covering the range 100 Mc to 20 Gc. Power levels from 1 to 10 watts can be handled, depending on frequency.

The company will also show a prototype of a transistor lead identifier, able to indicate collector, base and emitter by a logic operated display of lights. It indicates shorted or open units, can handle *nnp* and *pnnp* types.

Daystrom will introduce a compact Heathkit 3-inch d-c oscilloscope kit with identical vertical and horizontal d-c coupled amplifiers of low phase shift, model I0-10.

A. B. Du Mont Labs will show production models of their memory-tube oscilloscope, prototypes of which were shown at Wescon. The instrument can be used both as a conventional scope and to store a trace of low-speed phenomena on the crt for minutes or days. A low cost crt with P 10 phosphor is used, producing a dark trace on a light background. Storage time is determined by ambient temperature and trace density.

Sony of Japan has designed a small video recorder. It is a two-head instrument, runs at 7½ ips, and with a 2,400-foot tape will reproduce tv pictures and sound for 66 minutes. The recorder is only 3 feet high by 3 feet wide by 2 feet deep. It uses 96 transistors and 100 diodes, requires only 500 watts primary power, weighs 440 lb.

Video bandwidth is 2.5 Mc \pm 2 db. Resolution is 280 lines. Audio channel is 50 cps to 10 Kc. A video camera that can mate with the recorder will also be shown during the convention.

Dow Corning will introduce a transparent encapsulating material, with good dielectric properties. Replacement and repair of components is facilitated; additional resin can be poured over repaired area.

General Instrument will show a line of high reliability silicon mesa transistors, having a 0.001-percent per 1,000 hours failure rate on life test. They are high-speed types, featuring high beta linearity.

General Radio will display a frequency counter, covering d-c to 10 Mc. The instrument provides both continuous and fixed displays of the last four digits of the frequency being measured. Eight-digit sequential display is also available.

A 1,000-Mc frequency standard will also be on view, short-term stability, 1 part in 10¹⁰, long-term 5 parts in 10¹⁰.

A vibration calibrator, for checking transducers; and a frequency meter covering the range 3 cps to 1.5 Mc with an accuracy of \pm 0.2 percent, and independence of signal waveform will be shown.

Texas Instruments Incorporated will introduce two Solid Circuit semiconductor networks, now available for delivery. They are the SN 503 silicon NOR logic element, and

the SN 504, which is an AND gate. The company is also showing micro-miniature glass, silicon diodes in a package diameter of 0.04 inch, length 0.06 inch. They are intended for computer applications and have recovery time in the nanosecond range.

Hard-glass $\frac{1}{4}$ -watt resistors made of precision carbon film for high-temperature operation will be displayed.

Laboratory For Electronics will show a microwave stability tester able to measure frequency variations of 1.5 parts in 10 billion. It can display f-m deviation directly in cycles in eight full-scale meter ranges from 10-cps to 30 Kc. Applications in tests of local oscillators used in high-resolution radar and microwave communications are anticipated.

Edgerton, Germeshausen and Grier will show a triggered spark gap to perform the function of hydrogen thyratrons in radar modulator and similar applications. The gap is hermetically sealed in a ceramic envelope, is insensitive to atmospheric conditions. High-voltage holdoff capacity is 25 Kv, peak currents of over 10,000 amperes can be handled. Trigger energy is low.

Kin Tel will introduce a closed-circuit transistor television camera, and control unit. Coupled with a home receiver or tv monitor it becomes a complete system. Camera video bandwidth is 8 Mc.

The company also will show a d-c standard and null voltmeter, which provide a low impedance source of variable d-c voltage. A chopper compares output against an internal mercury-cadmium cell. Short-term stability is 25 parts per million, better than 50 parts per million in a 30-day period. Output is adjustable in 1 millivolt increments from 1 volt to 502.11 volts. Up to 20 ma can be supplied. The self-contained null voltmeter makes difference measurements between the standard's output and an unknown voltage.

ITT will show their star tracker for stabilization and navigation of satellites and space vehicles, using all electronic scanning. Multiplier phototube is heart of the unit. The firm will also introduce a vibration calibrator for use with crystal accelerometers.

Antennas for Tomorrow's Spaceships



Inflatable antennas of Mylar film and aluminum foil are under study at Lockheed Missiles and Space Div. Sphere is highly directive; conical spire gives wide coverage. Antennas fold into small package, inflate in space

Reveal Instrumentation For Mercury-Atlas Test

THE MERCURY-ATLAS test firing recently was highly instrumented to gather more information about the booster phase of the flight.

The added instrumentation included numerous strain gages, thermocouples, break wires, accelerometers and an extensometer to report physical conditions through the adapter and upper-tank areas.

An additional telemetry transmission canister was added in one of the side pods of the Atlas to transmit 20 channels of information to ground.

Bolted to the floor at various points inside the spacecraft were more than 200 lb of sensing instruments, cameras, recorders and a telemetry system. The latter provided eight channels of continuous or commutated information drawn from approximately 200 different sources.

This system was designed to transmit continuously for most of the 18-minute, 1,400-mi flight down the Atlantic Missile Range except for a critical minute or two during reentry when its signals were not able to pierce the plasma sheath. This system stopped transmitting when the main antenna canister

was jettisoned at about 10,000 ft before touchdown.

New Radioisotope Test Developed by UCLA

RADIOISOTOPE test using two scintillation counters and lasting 45 seconds accurately traces the flow of blood to the brain.

The new technique, developed by UCLA's Los Angeles Medical School in conjunction with the Los

Checking Ruby Laser



Operation of experimental ruby laser in generating coherent light is watched by L. M. Vallese of ITT

Angeles V. A. Center, may be helpful in diagnosing stroke-producing disorders.

Radioactive hippuric acid is injected into an arm vein. The scintillation counters, one on either side of the head, monitor the arrival of the radioactive material in the brain. Thus, the relative blood flow to the hemispheres of the brain can be studied to diagnose the blocking or narrowing of blood vessels to and in the brain.

Rocket Firing to Climax Cross-Modulation Study

GASEOUS ELECTRONICS LABORATORY of U. of Illinois will culminate its recent cross-modulation research in the firing of an Aerobee rocket from Eglin Field, Fla. next spring.

Cross modulation is a technique for controlling or minimizing ionospheric disturbance of radio waves at short-wave and commercial broadcasting frequencies.

The rocket will be fired through the lower ionosphere regions 45 to 65 miles above the earth. A high-powered transmitter on the rocket will send out a signal as it passes through this region. Ionospheric electrons near the rocket will thus be raised in temperature changing the properties of that portion of the ionosphere. These changes are detected by a sensing signal that follows.

Tv Coverage Increases In Latin America

ECUADOR got regular scheduled television service recently when Guayaquil station PTVE began telecasting for about 20 hours a week on channel 4.

Ecuadorians now own about 2,000 tv sets; rapid expansion is unlikely since an import duty of about 150 percent runs the set price out of the range of most citizens.

Mexico's Ministry of Communication has meanwhile announced its intention to support strongly the efforts of private investors to expand tv coverage. Object of government's promotion of commercial tv is to double within 18 months the present number of nighttime viewers, estimated at 2.5 million.

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Even before crowds swarm to this year's IRE show, the . . .

RECRUITING CLIMATE CHANGES

By THOMAS EMMA,
 Associate Editor

PERSONNEL RECRUITING DRIVES, traditionally kicked off to coincide with the annual conference of the Institute of Radio Engineers, will be seeing a number of changes this year, according to industry observers. Here are some predictions:

- The manpower market will be tighter than in past years as both companies and men become more selective.

- High-level engineers will be much in demand in such fields as systems engineering, semiconductor design, microwave communications, and computer design.

- More companies will be offering stock options, profit-sharing plans as inducements.

- Hoppers and shoppers will be largely ignored as employers tighten their demands.

The changing nature of the electronics industry is seen as the prime mover for most of these opinions.

"We're after brains now, not bodies." One recruiter told ELECTRONICS. "The days are gone when the industry recruited as though each company was preparing for a fire.

"Today's emphasis on specialized research and development, on technological breakthroughs and on big systems means major openings will be for men who can start right in

on income-producing activity. The man who needs a long period of breaking in won't interest us."

Tightened personnel requirements have imposed new requirements on recruiters, too. More firms are hiring outside specialists and consultants to find the men they want. This type of recruiter is often an engineer as well as a personnel man.

One such, David Cowin of Cowin Associates, told ELECTRONICS his clients' first obligation to him is to give him every opportunity to learn everything possible about the company. Total familiarity means, for these purposes, a full understanding of work in progress, work being planned, management policy, financial data and anything else that helps depict the company.

"I can't convince a man he ought to change jobs unless I can clearly show him what lies ahead," says Cowin.

One agency feels "we can't use a campus recruiter to go after these specialized men." We have to be able to talk to them man-to-man and engineer-to-engineer."

Some industry specialists are expressing disapproval for the place the personnel department holds today in many companies.

Van Evans of Deutsch & Shea, a New York advertising agency with a significant record in engineering recruitment work, says management should give personnel

the attention it gives marketing, sales and production.

"Management should get more involved with personnel," he says. "A company can't do its best if it's not able to bring in the best men, and a green recruiter can't do it."

Money is still the main lure employers use, but it doesn't occupy the exclusive position it once did. Today's specialized engineer, according to recruiters, sees a change in jobs as a complex step.

John Welds, technical employment specialist at Donahue & Coe, a New York advertising agency, considers what the man does, where he does it, who he does it with and how much he gets. "These are all factors now," he adds, "and many companies don't even want to talk to the man who wants to change only to get a raise in pay."

Upper echelons in engineering are less willing to relocate.

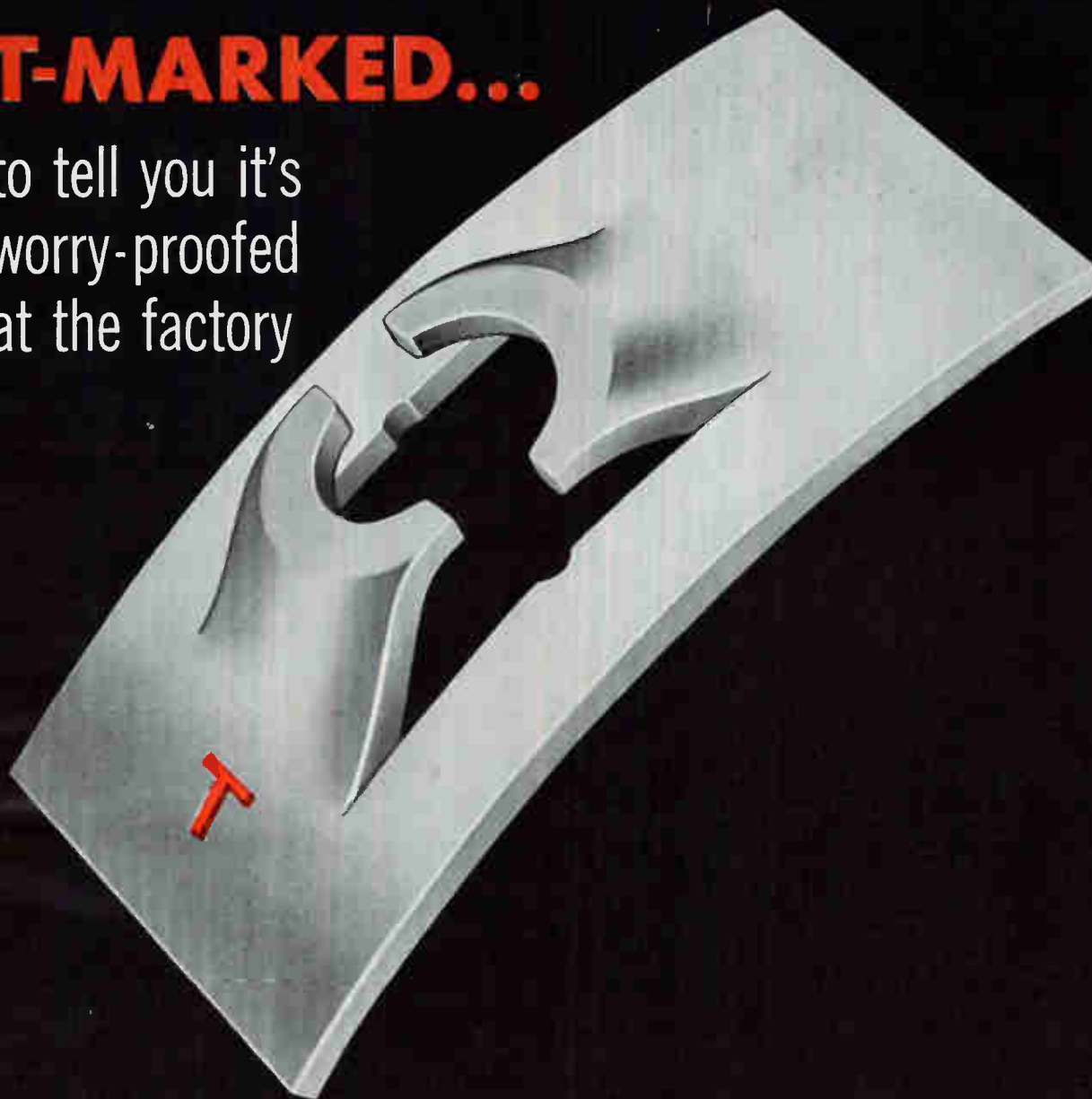
One personnel man points out these engineers are usually doing pretty well where they are and they are not as likely to move across the country as they might have been earlier in their careers. "The company that wants him to move had better be able to offer something pretty good," he adds.

Judging from pre-IRE Convention talks with recruiters, the men most heavily sought are the ones who can take over design and development of entire systems and

(Continued on p 48)

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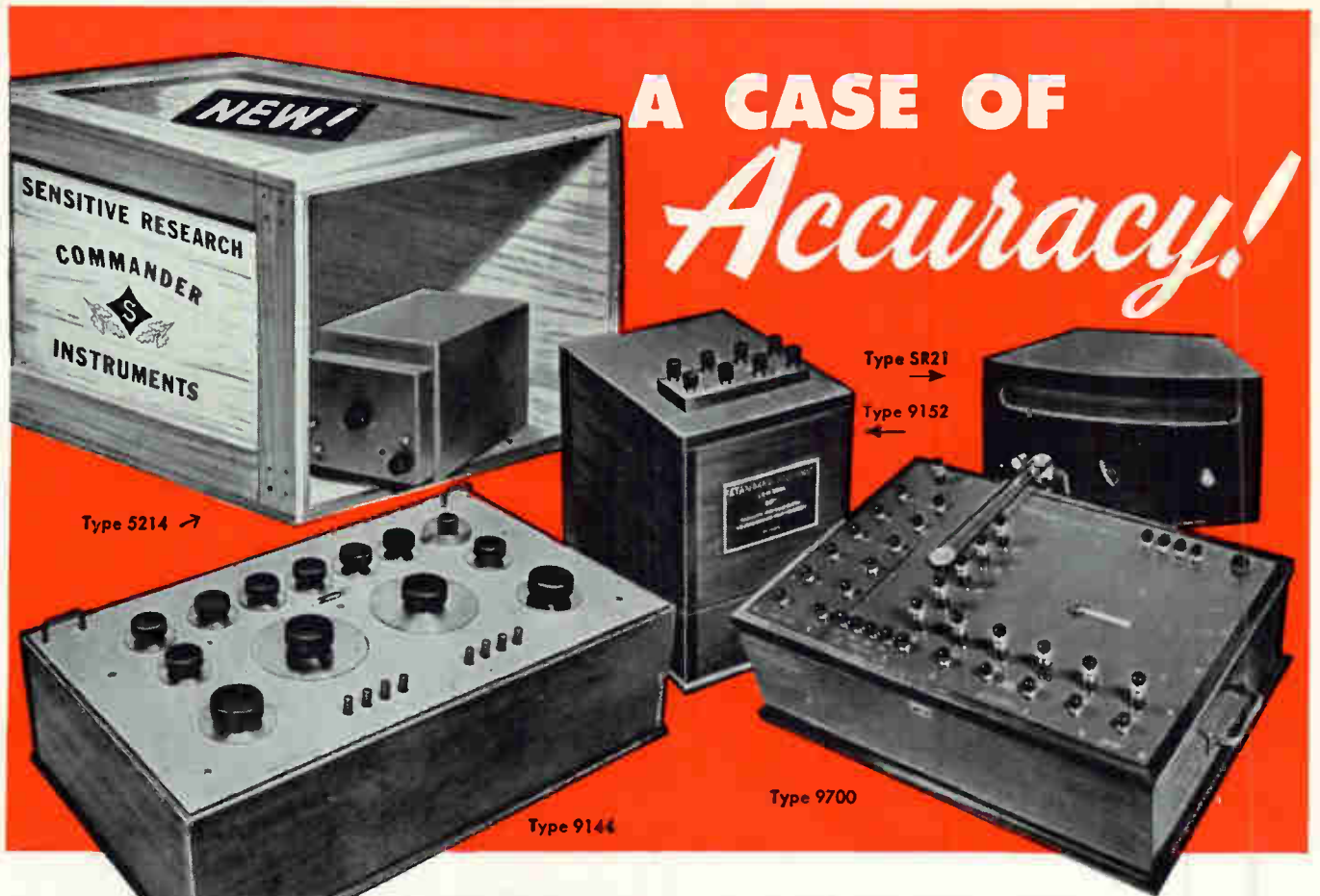
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Recruiting . . .

(Continued from p 40)

who can produce contract-winning proposals. "We'll be looking for what the military might describe as high-ranking line officers," says one agency.

Probably not sought as heavily: nontechnical administrators, men with under five years' experience, men with backgrounds in hardware design. Sales personnel will be sought, but not during the convention.

Also slated for attention is the academic world. Several agencies disclosed plans designed to attract mathematicians and physicists to the industrial community. An increasing number of companies have set up research laboratories more campus-like than production facilities. Also, industry pay is higher.

An engineer out of school one year can command an industrial salary of about \$6,775, according to a survey by the Engineering Manpower Commission of the Engineers Joint Council. In education he would get about \$5,375, in government service about \$6,275.

Five years after graduation, average industrial salaries are about \$8,200. Education will pay \$7,350, government \$7,175. Ten years out of school: \$9,975 in industry, \$9,100 in education and \$8,750 in government. The figures for 15 years are \$11,250 (industry), \$10,950 (education) and \$9,075 (government).

Another area getting attention from today's employer is the cost of hiring an engineer. People in the employment business are reluctant to name dollar figures because of the many variables.

The Department of Defense, however, conducted a survey last fall. The recruiting costs of 102 industrial firms supplying equipment to the government were studied.

The study shows 76 companies heavily in defense work placed recruiting costs at \$1,022 for each new engineer or scientist hired. The remaining 26 companies, predominantly in commercial work, showed a cost of \$751 per hire.

Recruiters looking to this month's IRE convention say there will probably be fewer hospitality

suites open to the casual job seeker. The emphasis, they say, will be on consummating appointments made in advance of the show. Recruiters this year say they are relying heavily on internal referrals: men of stature in specialized fields who have been suggested to them by client companies.

Arnold Deutsch, president of Deutsch & Shea, told ELECTRONICS his organization joins with a number of engineering societies in the wish to see all recruiting activity cut out at major conventions.

"Recruiting shouldn't ride piggy back to these meetings. The men should be attending technical sessions and examining exhibits, not tramping around to job appointments," he said.

Talks with other personnel men indicate a growing trend by companies to keep their key men away from conventions for this reason. "We may not have them as well-informed," says one company executive, "but we'll have them here!"

Opinions vary about how much campus activity recruiting will go on this spring. Many employers agree the tighter interest of today's more sophisticated industry will be reflected at the college level. It's predicted big companies will continue campus visits at about the present levels, but that many small companies will not be as active this year. Field recruiting is also slated for a sharp decline, according to a number of observers.

'Electrically Suspended'



Prototype of 'electrically suspended' gyro is being developed by Minneapolis-Honeywell for Polaris sub navigation system

Hyperpure Silicon Crystals From Arc-Image Furnace

TECHNIQUE for preparing contamination-free crystals of silicon has been developed by Wayne State University for Air Force Office of Scientific Research & Development.

Use of a high-intensity carbon arc combined with reflecting optics, plus floating-zone techniques, produced high-purity silicon crystals essentially free of oxygen.

Arc-image furnace uses two 60-in. paraboloid reflectors arranged above and below the powerful carbon arc. Lower reflector collimates the arc radiation; upper reflector forms an image of the arc at its focus.

Single-crystal seed is positioned in the image, and a long polycrystalline rod of small diameter is fed into the melt. As the melt increases in volume, it is gradually lowered so as to solidify in its lower region.

Another process, for preparing thin filaments of single-crystal germanium, was developed at Wayne out of a study of semiconductor surface phenomena. Filaments were prepared by photoelectric etching, measured 4 microns thick, had high surface-to-volume ratio, proved highly sensitive to surface ambients.

Canadian Sites Going Up For New Microwave System

THE MONTANA-ALASKA Microwave system announced by American Telephone and Telegraph late in 1959 is now nearing completion at a number of key Canadian sites.

Crossing the U. S. border north of Sweet Grass, Mont., the microwave path will transit Lethbridge in Canada's Alberta province.

Additional microwave equipment is being installed in Lethbridge to handle increased traffic, and construction crews are working on the link north and west of Edmonton.

The system, which will cost about \$20 million, could be used for tv transmission as well as message traffic. Initial phases of the operation call for 120 channels handling U. S. originated traffic. Later there will be 120 additional channels for Canadian use.

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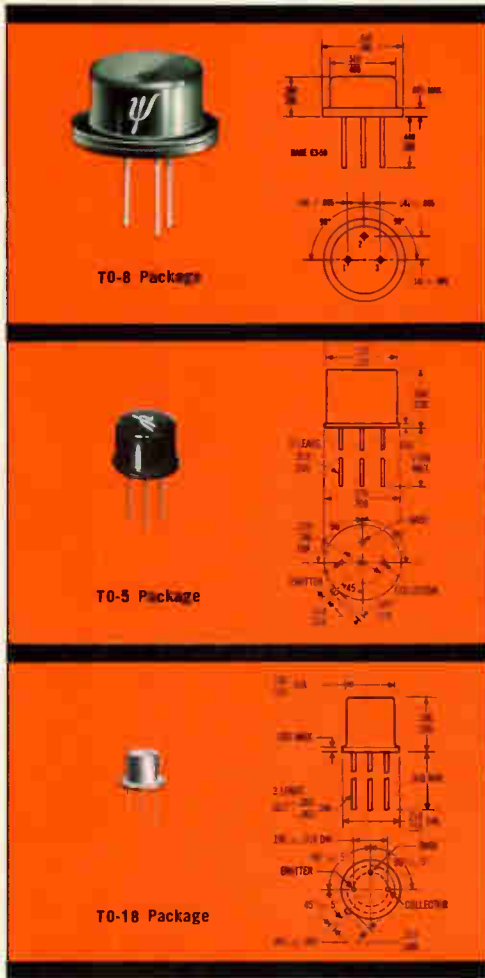


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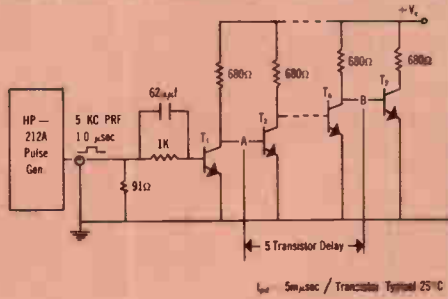
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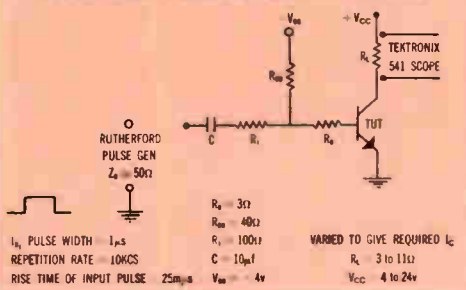


DIMENSIONAL DRAWINGS
All dimensions shown in inches

2N706 — PT706 DCTL Propagation Delay Measurement Circuit



PT600 — PT601 Switching Circuit and Switching Time



TO-18 PACKAGE HIGH SPEED TRANSISTORS							
TYPE	TOTAL POWER AT 25°C CASE Watts	V_{CE0} Min.	V_{CEr} Min.	V_{EB0} Min.	f_t mc TYP	h_{FE}^*	V_{CE} Sat* Max.
2N706	1.0	25	20	3	350	20 min	.60
2N706A	1.0	25	20	5	350	20-60	.60
2N706B	1.0	25	20	5	350	20-60	.40
2N753	1.0	25	20	5	350	40-120	.60
PT706	1.0	25	20	5	350	35-125	.20

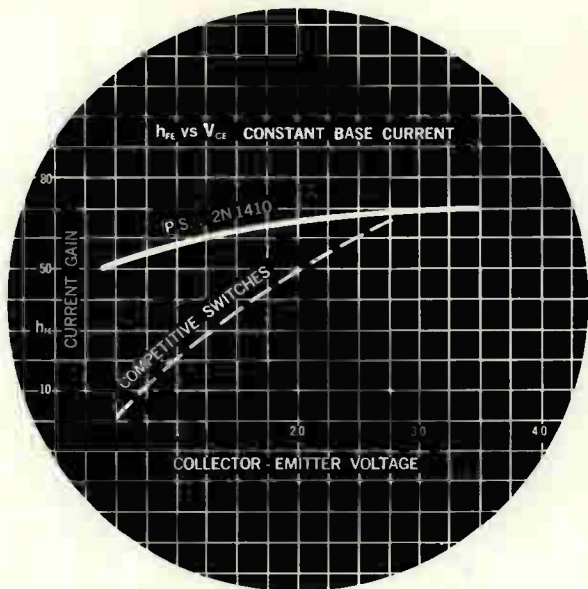
TO-8 PACKAGE PREMIUM TRANSISTORS							
TYPE	TOTAL POWER AT 25°C CASE Watts	V_{CE0} Min.	V_{CEr} Min.	V_{EB0} Min.	f_t mc TYP	h_{FE}^*	V_{CE} Sat* Max.
2N1837	2.0	80	50	8	210	40-120	.80
2N1837A	2.8	80	50	8	210	40-120	.80
2N1409	2.0	30	25	4	230	15-45	.80
2N1409A	2.8	30	25	4	230	15-45	.80
2N1410	2.0	45	30	4	230	30-90	.80
2N1410A	2.8	45	30	4	230	30-90	.80
PT850	2.0	120	80	5	200	40-120	2.0
PT850A	2.8	120	80	5	200	40-120	2.0

STANDARD TRANSISTORS								
TYPE	TOTAL POWER AT 25°C CASE Watts	V_{CE0} Min.	V_{CEr} Min.	V_{EB0} Min.	f_t mc TYP	h_{FE}^*	V_{CE} Sat* Max.	PKG
2N696	2.0	60	40	5	200	20-60	1.5	TO-5
2N697	2.0	60	40	5	200	40-120	1.5	TO-5
2N698	2.0	120	80	5	190	20 min	5.0	TO-5
2N699	2.0	120	80	5	190	40-120	5.0	TO-5
2N717	1.5	60	40	5	200	20 min	1.5	TO-18
2N718	1.5	60	40	5	200	40-120	1.5	TO-18
2N719	1.5	120	80	5	190	20 min	5.0	TO-18
2N720	1.5	120	80	5	190	40-120	5.0	TO-18
2N1420	2.0	60	30	5	170	100-300	1.5	TO-5

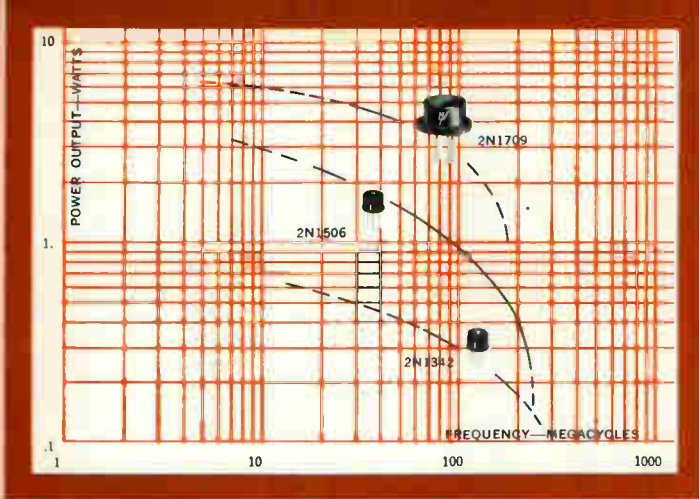
TO-18 PACKAGE GENERAL PURPOSE TRANSISTORS								
TYPE	TOTAL POWER AT 25°C CASE Watts	V_{CE0} Min.	V_{CEr} Min.	V_{EB0} Min.	f_t mc TYP	h_{FE}^*	V_{CE} Sat* Max.	PKG
2N1336	2.8	40	25	3	190	—	—	—
2N1838	2.0	45	30	4.5	190	40-150	1.4	—
2N1839	2.0	45	30	4.5	170	12-50	1.4	—
2N1840	2.0	25	20	5	150	10 min	1.4	—

SPECIAL PURPOSE TRANSISTORS								
TYPE	TOTAL POWER AT 25°C CASE Watts	V_{CE0} Min.	V_{CEr} Min.	V_{EB0} Min.	f_t mc TYP	h_{FE}^*	V_{CE} Sat* Max.	PKG
2N1340	2.8	150	100	5	220	5 min	0.7	TO-5
PT601	13.0	60	45	4	210	30-90	1.0	TO-8
PT600	13.0	60	45	4	210	15-45	1.0	TO-8
2N1900	125.0	140	100	5	50 min	10-20	2.0	POWER
2N1901	125.0	140	100	5	50 min	15-40	2.0	POWER

*SEE DATA SHEETS FOR CONDITIONS

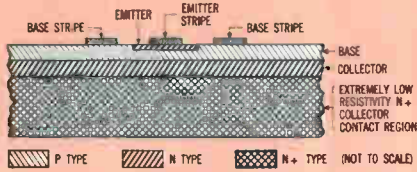


Extremely flat Beta vs. Collector Voltage is one of the many advantages made possible by the PSI Triple Diffusion Process.



FREQUENCY-POWER OUTPUT RANGE OF PSI COMMUNICATIONS TRANSISTORS

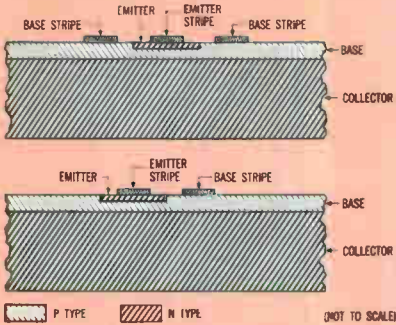
PSI TRIPLE DIFFUSED PROCESS



PSI triple diffusion makes possible these outstanding performance characteristics: Low V_{CE} saturation, faster switching, excellent high current beta, high small signal beta and broad VHF versatility.

The triple diffusion process, above, provides manufacturing control unmatched by any other process.

OTHER MESA PROCESSES

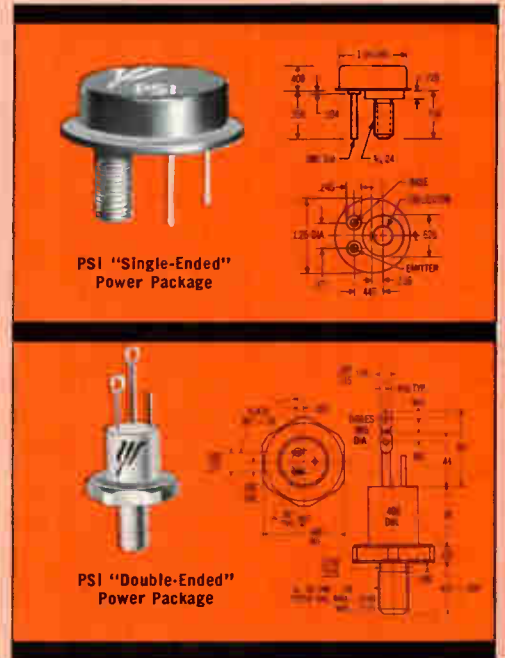


COMMUNICATION TRANSISTORS

NPN TRIPLE DIFFUSED SILICON MESA

Wide Range of Types

mW to Watts 10 to 100+ Source Voltages



DIMENSIONAL DRAWINGS All dimensions shown in inches

HF HIGH POWER TRANSISTORS

NPN TRIPLE DIFFUSED SILICON MESA

Wide Range of Types . . . for many new applications.

TYPE	V_{EBO} Min.	V_{CEB} Min.	V_{CBO} Min.	h_{FE}	10mc h_{FE}	ft mc	5 mc Class C AMPLIFIER Power Out	Power Gain	PACKAGE
2N1899 (formerly PT901)	140	100	5	10 min	3	50 min	125W	10db	Single End
2N1900	140	100	5	10-20	3	50 min	125W	10db	Single End
2N1901	140	100	5	15-40	3	50 min	125W	10db	Single End
2N1902	140	100	5	10 min	3	50 min	125W	10db	Double End
2N1903	140	100	5	10-20	3	50 min	125W	10db	Double End
2N1904	140	100	5	15-40	3	50 min	125W	10db	Double End
PT900	80	50	4	7 min	3	50 min	125W	10db	Single End

KILOWATT/MEGACYCLES/AMPERES/NANOSECONDS— Now possible with PSI Load Tested Silicon Mesa Power Transistors. In a typical switching application, the rate of current rise can be as high as 100 million Amperes per second. Selected Beta ranges now available.

Power Switching at higher speeds and RF Power Generation at higher levels than previously attainable are now possible.

Availability: Single ended packages are available in production quantities; Double Ended in Engineering quantities.

VERY HIGH FREQUENCY

TYPE	TOTAL POWER AT 25°C CASE	V_{CBO} Min.	V_{CEB} Min.	V_{CBO} Min.	POWER GAIN AT f=30mc TYPE	POWER GAIN AT f=70mc TYPE	POWER GAIN AT f=100 mc TYPE	PKG
2N1338	2.8	80	50	3	18 db $P_o=0.35W$	10.5db $P_o=0.35W$	7db $P_o=0.35W$	TO-5
2N1342	2.8	150	125	5		13db $P_o=0.4W$	10db $P_o=0.3W$	TO-5
2N1505	3.0	50	40	3	10db $P_o=1.8W$	8db $P_o=1.2W$	6db $P_o=1W$	TO-5
2N1506	3.0	60	40	4	12db $P_o=1.8W$	10db $P_o=1.2W$	8.5db $P_o=1W$	TO-5
2N1710	13.0	60	45	3	10db $P_o=5W$	6db $P_o=3.5W$	5db $P_o=3W$	TO-8
2N1709	13.0	75	60	4	12db $P_o=5W$	8db $P_o=3.5W$	6db $P_o=3.5W$	TO-8

THESE TRANSISTORS OFFER THE DESIGNER A WIDE SELECTION OF CHARACTERISTICS.

SUPPLY VOLTAGE—10 VOLTS TO 125 VOLTS.

OPERATING CURRENT—1 mA TO SEVERAL Amps

OPERATING FREQUENCY—UP TO SEVERAL HUNDRED Mc (HIGHER WITH VARICAP DOUBLING CIRCUITS)

POWER OUTPUT—MILLIWATTS TO NEARLY 10 WATTS.

The 2N1338, 2N1342, 2N1505, 2N1506 are available in production quantities.

The 2N1709 and 2N1710 are available in prototyping quantities.

PICO-TRANSISTORS and MICRO-TRANSISTORS

PSI Pico and Micro transistors are ultra miniature triple diffused silicon mesa devices. They are designed for low level amplification and for low power, high speed switching applications. These unique transistors are extremely valuable where weight and size are prime design and operational factors.

The remarkable high reliability standards of PSI Micro-Diodes are the result of simplified construction and advanced surface passivation techniques. These same techniques are employed in the manufacture of PSI and Micro Transistors.

The surface passivation process and coating materials provide protection from extreme environmental conditions of heat, moisture, thermal shock, mechanical stresses and electrical load.

After manufacture all devices are subjected to environmental testing to assure reliability and device parameters.

- Meet MIL-S-19500B and MIL-STD-202A
- -65°C to 200°C temperature range
- 200 hr. 200°C "Burn-in"
- 100 mW power dissipation
- Pico size 1/10000 of TO-5 package
- Micro size 1/100 of TO-5 package
- Companion components to PSI Micro-Diode

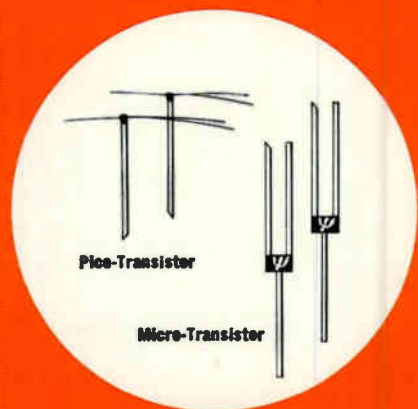
ABSOLUTE MAXIMUM RATINGS (25°C)

Micro Types	Pico Types	Equivalent EIA Type	Collector to Emitter Voltage V_{CEM}	Collector to Base Voltage V_{CBO}	Emitter to Base Voltage V_{EBD}	Junction Temperature T_j	Power Dissip.
PMT 111	PMT 011	2N1409	25V	30V	4V	150°C	100 mW
PMT 112	PMT 012	2N1410	25V	30V	4V	150°C	100 mW
PMT 113	PMT 013	2N696	40V	60V	5V	150°C	100 mW
PMT 114	PMT 014	2N697	40V	60V	5V	150°C	100 mW
PMT 118	PMT 018	—	30V	40V	5V	150°C	100 mW
PMT 119	PMT 019	—	30V	40V	5V	150°C	100 mW

ELECTRICAL CHARACTERISTICS

Micro Types	Pico Types	Collector Cut-off Current I_{CBO}	Base Saturation Voltage $V_{BE SAT}$	Collector Saturation Voltage $V_{CE SAT}$	Collector Capacitance C_{ob} (Typ.) $V_{CB} = 10V$.	h_{FE} (min.)	h_{FE} $f = 20mc$
PMT 111	PMT 011	10 μ A (20V)	1.2V (Max.) 1	1.1V (Max.) 1	20 μ f	15 (150mA, 10V)	3.1 (Typ.)
PMT 112	PMT 012	10 μ A (20V)	1.2V (Max.) 1	1.1V (Max.) 1	20 μ f	30 (150mA, 10V)	3.5 (Typ.)
PMT 113	PMT 013	1 μ A (30V)	1.2V (Max.) 1	1.1V (Max.) 1	20 μ f	20 (150mA, 10V)	2.0 (Typ.)
PMT 114	PMT 014	1 μ A (30V)	1.2V (Max.) 1	1.1V (Max.) 1	20 μ f	40 (150mA, 10V)	2.5 (Typ.)
PMT 118	PMT 018	1 μ A (10V)	.9V (Max.) 2	.4V (Max.) 2	20 μ f	10 (5mA, 5V)	2.0 (Typ.)
PMT 119	PMT 019	1 μ A (10V)	.9V (Max.) 2	.4V (Max.) 2	20 μ f	30 (5mA, 5V)	2.5 (Typ.)

NOTES: Test Conditions 1. $I_C = 50mA$, $I_B = 5mA$ 2. $I_{CE} = 5mA$, $I_B = .5mA$



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DEPENDABILITY
RADIO
RELIABILITY

← CIRCLE 48 ON READER SERVICE CARD

CIRCLE 49 ON READER SERVICE CARD 49

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Magnetic Bottles Confine Plasmas Near

"MAGNETIC BOTTLES" may attain something like 90 percent conversion efficiencies in extracting electrical energy from plasmas which expand after they have produced fusion reactions.

This is what Richard F. Post, Lawrence Radiation Laboratory, Livermore, Calif., told the second annual engineer education conference at Argonne National Labs.

Limit on efficiencies of such direct conversion would be efficiency of generating the magnetic field, Post said. Thermodynamic limitations just don't apply. "Once you learn how to manipulate plasmas and charged particles, you should be able to get the energy out," he said.

Most recent "toy top" multistage configuration of magnetic bottle (which confines injected plasmas for compression up successively stronger magnetic fields) has successfully sustained a football-sized plasma for a millisecond—long enough for several thousand particle reflections, Post said. Plasma's existence was revealed by neutron emissions.

Experiment was encouraging, he said, because it proves a stable case can exist. Third stage of "toy top" to provide still greater compres-

sions needed for fusion experiments is still being fabricated, and first operation is scheduled during coming weeks.

Any of magnetic "furnace liners" currently used to contain hot plasma in cage of magnetic field lines could yield a power balance if the systems can be stabilized, Post said.

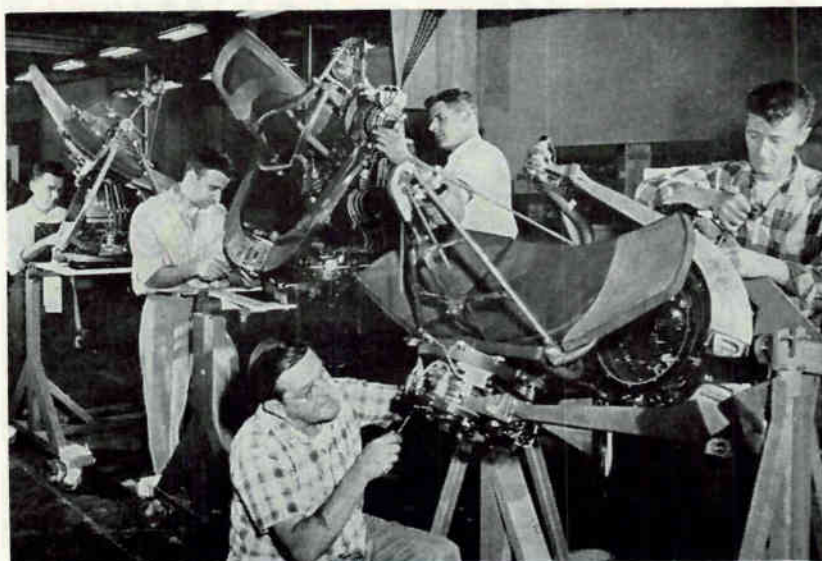
Among those he discussed were Spitzer's Stellerator, Firth and Livermore's Levitron, Christofilos' Astron and his own early model magnetic mirror, currently being rebuilt to include improved vacuum and magnetic field circuitry.

Improved cryogenic coil could knock at least a factor of ten, and probably more, off the total power required to generate very high magnetic fields—by refrigerating magnetic unit to extremely low temperatures and using ultra pure metals to generate the magnetic field, Post said. Semiconducting coils for generating high fields also offer most encouraging advances, he added.

Post predicted a revolution in techniques of generating and using very high magnetic fields within the next very few years.

Direct conversion efficiencies of 60 percent may be attainable from

Search Radar for USAF's B-58 Bomber



Search radar portion of Sperry's bomb-nav system for the B-58 is shown in this first production picture at Raytheon's Waltham, Mass. plant

Fusion Level

a combination plant, according to James Weddell, senior scientist, Martin company.

Starting with extremely hot plasma in a magnetohydrodynamic converter, system would use exhaust gas from magnetic field chamber to heat emitter of a thermionic diode, allow cool anode of this diode to serve as hot shoe of a thermoelectric generator and use heat exhausted from the generator to turn conventional rotating electric generating machinery.

Although less reliable than single-stage systems, such a combination may look promising 15 years from now, Weddell said in his talk about direct conversion systems. He added that direct systems are especially valuable as auxiliary power sources for space and in arctic and antarctic regions.

Still-to-be-built mhd devices promise efficiencies of 30 percent—highest of the direct conversion units, Weddell said. Thermionic devices are expected to level off at about 25 percent and thermoelectric units—expected most efficiently to cover the output range from one watt to a few kilowatts—will probably reach a plateau of 20 percent efficiency by the early 1970's.

Thermionic devices are expected to be most efficient from a fraction of a kilowatt to a megawatt, Weddell said, while mhd will probably operate at power levels from a fraction of a megawatt to many megawatts.

Radioisotopes are expected to be the best nuclear source from one watt to a kilowatt, while reactors will take over from kilowatts to several megawatts.

Although nuclear fuels are expected to make little or no impression on near-future requirements for coal and other fuels, by the year 2,000 they may supply from ten to 15 percent of total requirements, James A. Lane, Oak Ridge National Lab, Tenn., said in his talk about "Nuclear Power."

During the following 50 years, demand for nuclear power will probably be determined entirely by the competitive positions of nuclear and fossil fuels, he said.

the first complete line of TRANSISTOR VOLTMETERS . . .



6 ALL-TRANSISTOR MIL TRVMs

- miniature, panel-mounting, for build-in applications
- power supplies included—no battery replacement or checks needed
- isolated inputs • low power consumption
- compact (as small as 2.85" diameter by 6" deep including terminals)
- lightweight • longer life

Model	Meter	Description	Price
301-1 AC TRVM	3½"	zero-left, from 10MV range	\$250.00
302-1 AC TRVM	3½"	zero-center, phase sensitive, from ± 10MV	275.00
303-1 AC TRVM	2½"	50% less panel area than Model 301-1	275.00
304-1 AC TRVM	2½"	zero-center, phase sensitive, from ± 10MV	300.00
305-1 DC TRVM	3½"	zero-center, no zero-set, ± 100MV range	225.00
305-2 DC TRVM	3½"	zero-left version of 305-1, 250MV range	225.00

Note: Due to heavy demand, present delivery of most models is 6-8 weeks. For complete literature, write to Dept. E-3.

... when ordinary instruments are too big or inadequate.

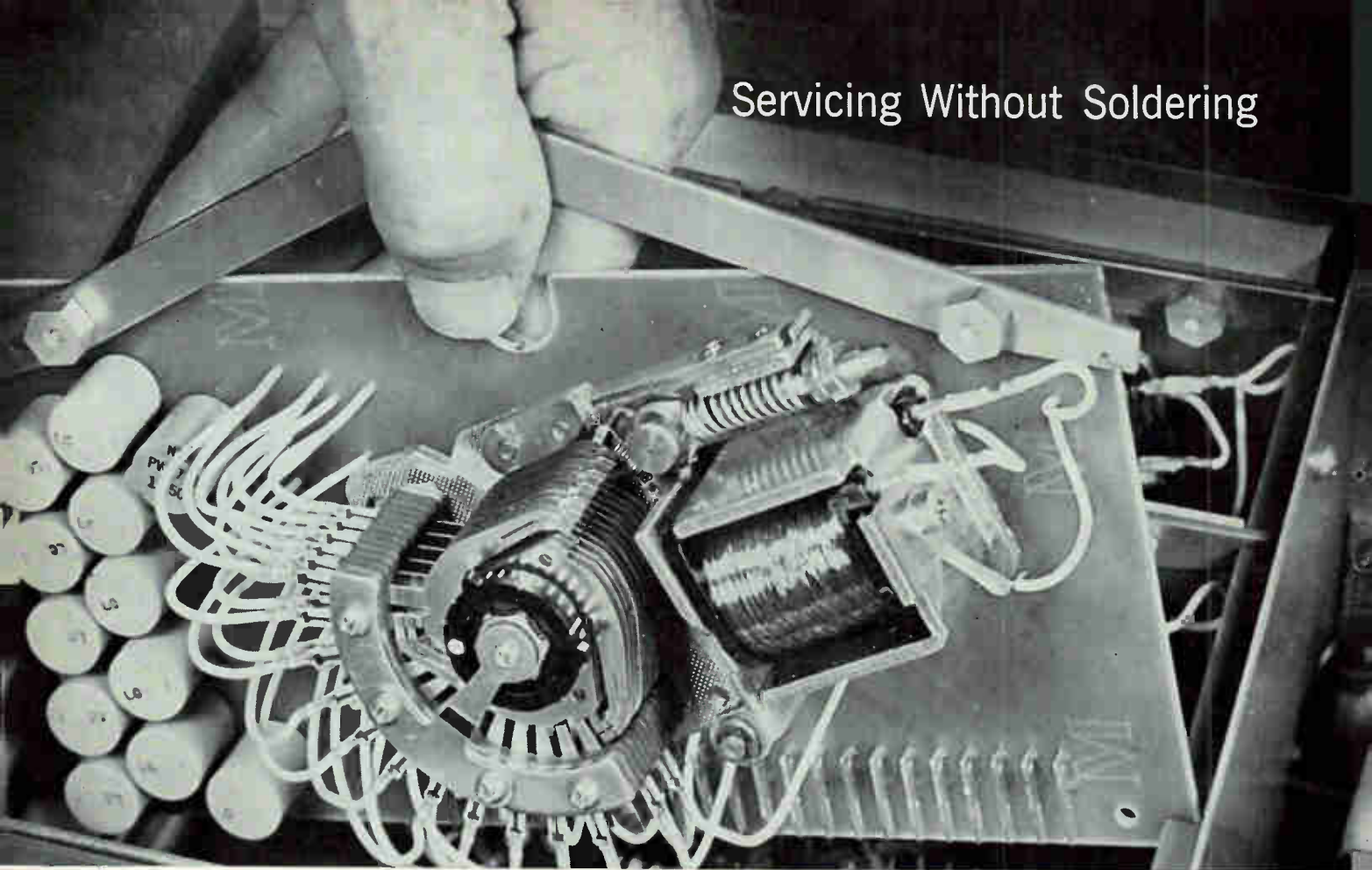


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See Trio Exhibits at the I.R.E. Show Booth 3033

Servicing Without Soldering



The new NLS 481A digital voltmeter features both plug-in stepping switches and a snap-out readout that virtually eliminate use of a solder gun or other tools in servicing. Note the "finger-control" leverage bars for easy switch removal.

Announcing the NLS Low-Cost 481A Digital Voltmeter

Here is the time-proved 481 with new features to permit replacement of all stepping switches and decade resistors in minutes instead of days. Plug-in stepping switch assemblies in the 481A also allow trouble-shooting by the substitution method. Like the thousands of 481s in use today, the new 481A features $\pm 0.01\%$ accuracy and completely automatic operation at low cost. It measures DC volts from ± 0.001 to ± 999.9 ; AC or low-level DC with plug-in accessories. Input impedance is 10 megohms . . . balancing time is 1 second, average . . . internal standard cell verifies calibration.

Although the 481A features exclusive plug-in stepping switches previously found only on higher cost NLS digital voltmeters, it sells for only \$1,525, complete. Delivery is from stock — 15 days are required if stocks are temporarily depleted. NLS will continue to manufacture the 481 in volume for customers who have standardized on this instrument or where initial price is more important than the long-term savings in servicing offered by the 481A.

A statement of policy: The 481A — like other new NLS instruments to be announced in the coming months — is not a "pie-in-the-sky" instrument or prototype. It has long since undergone complete testing and is now in volume production to assure you prompt delivery of a fully-tested, quality instrument.

See the new NLS 481A at IRE, Booth 3041-42.



Applications include production testing, instrument calibration, laboratory testing, receiving inspection.



The 481A features the basic circuitry of the NLS 481, today's most widely used digital voltmeter.



Originator of the Digital Voltmeter

non-linear systems, inc.

DEL MAR, CALIFORNIA

CIRCLE 52 ON READER SERVICE CARD



See It in Action . . .

For a demonstration of the new 481A, 481 or any digital measuring instrument, call any of the following NLS offices or sales representatives. If you prefer, please contact NLS for additional information.

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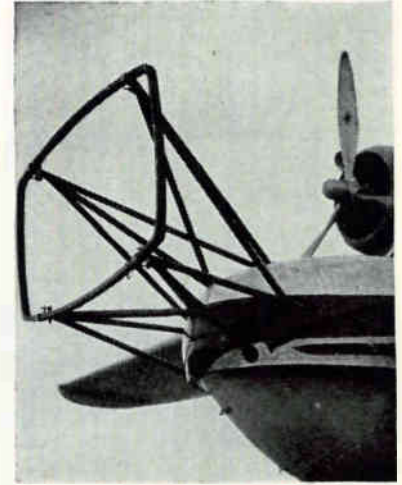
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Electromagnetic "Stinger" for Surveying



Tail cone (left) and nose frame mountings of EM detector elements equip Canadian Aero Service aircraft for electromagnetic surveys. Radiation counter, magneto meter and doppler radar are also carried

Israelis Plan New Radio Receiver Plant

TEL-AVIV—New plant for radio receiver manufacture and later for tv sets will soon be operating here, according to announcements following news that \$700,000 has been raised through a New York investment firm. Cooperating in the venture is Bornheim Investment Company and a French manufacturing firm, Schneider of Ivory.

In Israel the plan will entail the merger of two leading local firms, Klipper Radio in Tel-Aviv and American-Israel Electronics.

Board chairman of the new venture, which will have a total initial investment of about \$1½ million, will be Pierre Gilbert, former French ambassador to Israel.

The firm plans to seek markets in Africa and contract for radio transmitter sales abroad.

English Firm Makes Phosphor Display

LONDON—Data display device completed here by Ericsson Telephones, Ltd. uses electroluminescence to produce a coplanar display with no parallax. Called the Phosphotron, the compact panel uses little power.

Electroluminescent panels are made by sandwiching phosphor materials between two conducting sur-

faces, one transparent. An a-c voltage applied across conductors cause the phosphors to emit light.

The Phosphotron system relies on conventional techniques, but has its back panel divided into an array of strips, each with its own electrical connection. By connecting groups of these back conductor leads, patterns of lines are produced on the transparent display face to form numbers or symbols.

The device has 16 strips, consumes 500 ma at 240 volts, 400 cps. Light emission is rated at eight ft-Lamberts. The displays measure 4 in. by 3½ in. appearing on panels 4 in. by 5½ in., and are ¾-in. thick. They display decimal digits from 0 to 9 and the entire alphabet.

Train-Mounted Radar To Score SAC Bomb Runs

RADAR BOMB SCORING equipment mounted on railroad cars will be used in Strategic Air Command's "Oil Burner" training operations.

Oil Burner is the code name for SAC's low-level radar navigation and bombing training. Operations are carried out against simulated fixed targets. RBS equipment mounted on railroad cars parked on sidings will score the accuracy of the bomb runs. First mobile RBS installation goes into operation this month near Milan, Tenn.



Originator of the Digital Voltmeter

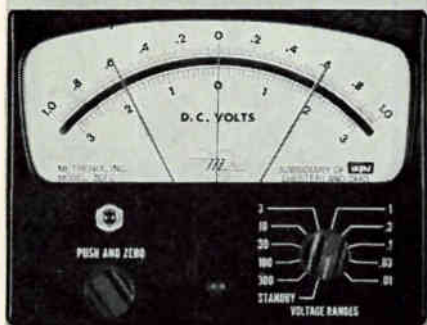
non-linear systems, inc.

DEL MAR, CALIFORNIA

CIRCLE 53 ON READER SERVICE CARD

March 10, 1961

10 Megohms



PLUS Control

An electronic voltmeter with a meter-relay

This happy combination makes an extremely versatile and acute instrument.

It has critical measuring ability that goes with high input impedance, in space-saving panel-mounting style.

It also has the reliable, simple control of a locking contact meter-relay, with adjustable set points.

Many difficult functions can be easily controlled: conductivity cells, life testing of components or systems, production testing and sorting, automatic Go-No Go of missile circuits.

Ready When Needed

Metronix DC instruments such as Model 301-C-CMR (illustrated) have input resistances up to 10 megohms. AC input impedances go as high as 5 megohms. Like all Metronix panel-mounting electronic voltmeters (PMEV's), they are always connected—immediately available for continuous monitoring of critical parameters.

Send for data sheets describing Metronix PMEV's in single or multiple ranges, DC or AC, with either meter-relays or conventional indicating meters.



METRONIX, INC.

a subsidiary of Assembly Products, Inc.

Chesterland, Ohio

Telephone: HAmilton 3-4440

How Many Technicians Per Engineer?

THREE TECHNICIANS for every engineer would make for the most efficient use of engineering manpower. This is the contention of the Technical Institute Curriculum Advisory Committee of the University of Illinois.

The present ratio is only one technician for each engineer. No specific mention was made of electronics engineering.

The University will sponsor an eight-week summer institute for college teachers starting June 19 that will include a course in electronics engineering problems and seminars on the technician's role on the engineering manpower team.

GRADUATE FELLOWSHIP in electrical engineering has been established at Syracuse University by the Electronics division of General Dynamics Corp. A similar grant is being renewed at Cornell. The fellowships carry a stipend of \$2,400, plus full tuition and all fees. The Dean of Graduate Studies at each school administers the fellowships.

ENGINEERING SCHOLARSHIPS will be administered without charge by the Hartz Engineering Scholarship Foundation of Los Angeles, Calif. This service is performed for companies that would like to sponsor engineering scholarships but do not have scholarship administrative facilities.

This offers a saving to smaller companies whose administration of a scholarship program might cost as much as the scholarships themselves, says Russel H. Clevenger, administrator of the Foundation. The Foundation also provides its own scholarships.

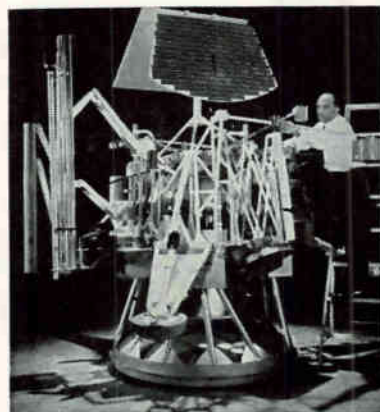
THREE-STAGE TANDEM VAN DE GRAAFF, 17.5-million-electron-volt, atomic particle accelerator has been purchased by U. of Texas Science Engineering Center. Also purchased from the High Voltage Engineering Corp. was a 4-million-electron-volt atom smasher. This is part of an effort to make the university a top flight research center.

A complex of experimental areas will be served by the accelerators. Interconnecting magnetic deflection, focusing and switching systems enable the beams of high-energy particles to be directed into desired areas.

RADIOACTIVE IODIDE GAS is being used by Dr. M. H. Ellestad of UCLA and Dr. M. E. Morton of Los Angeles Harbor General Hospital to detect leaks in the heart's pumping system. Patient inhales the gas, blood samples are taken from the right-arm artery and the right side of the heart. Differences in measured radioactivity of the samples help determine if a leak exists, its location and approximate size.

MATERIALS SCIENCE is a new graduate program at the U. of Cincinnati. Masters and doctorate degrees are given. According to William Licht the program is given in response to the nationwide demand for the creation of materials for new uses as especially exemplified by satellite and missile studies. Ceramics, plastics, and other related materials as well as metals and their applications will be studied. Background in any of the engineering fields, chemistry or physics qualifies students for the program.

Spaceload to Transmit Tv

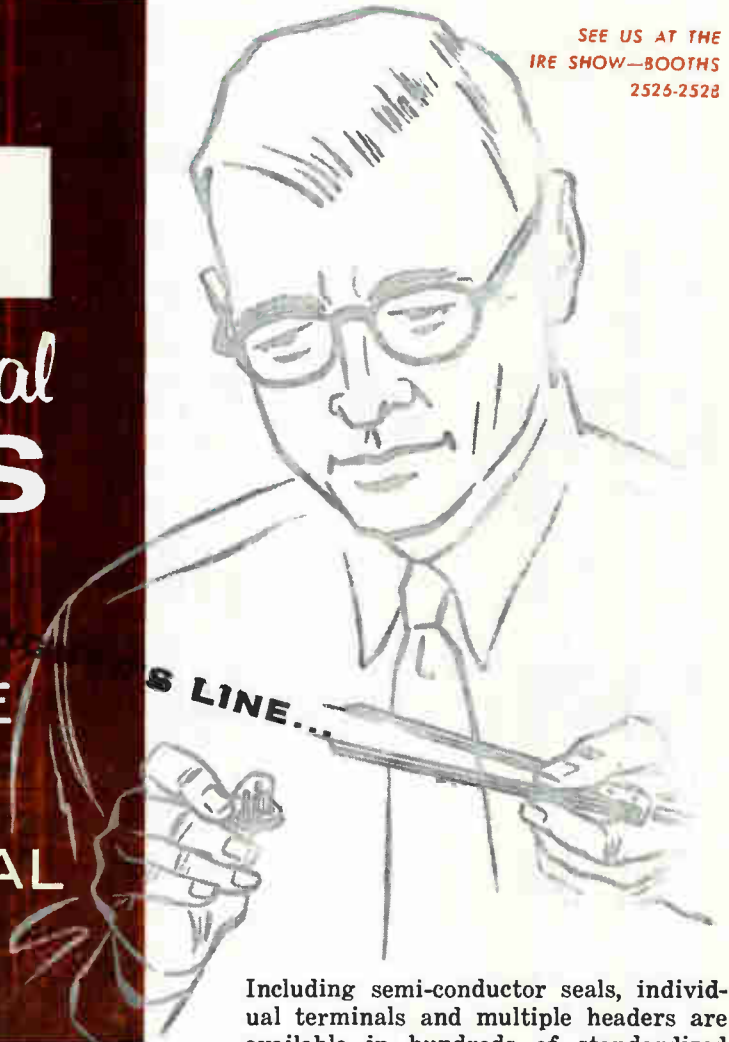


Payload model for Surveyor spacecraft designed for soft moonlandings is shown in full scale by Hughes Aircraft

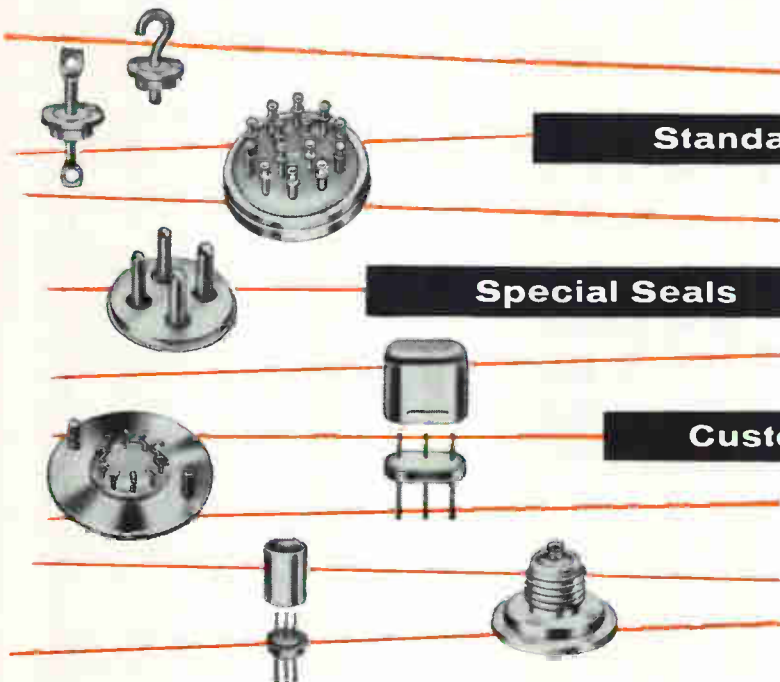
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2526-2528

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Including semi-conductor seals, individual terminals and multiple headers are available in hundreds of standardized types that reflect the economies of mass production methods. Offer a time and money-saving solution to all but the most unusual sealing problems.



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E-I engineers will design "specials" or produce seals to your exact specifications. Custom threaded types, color coding or unusual terminal arrangements can be supplied quickly in reasonable quantities.

Complete facilities available for sealing assemblies of your own manufacture. Please supply sample or drawings for estimates on your sealing requirements, or ask to have a field engineer make recommendations on specific seal applications. Literature on request.

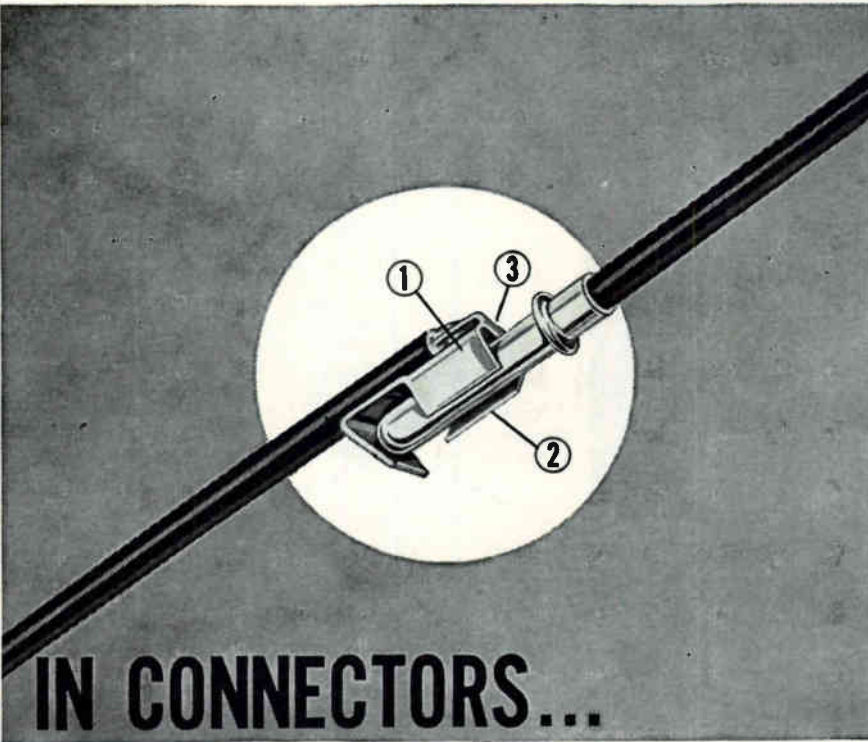
ELECTRICAL INDUSTRIES

MURRAY HILL, NEW JERSEY, U. S. A.

A Division of Philips Electronics and Pharmaceutical Industries Corp.



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



it's the
CONTACT
that counts!

3 positive contact surfaces on each Alden top-connected contact give you:

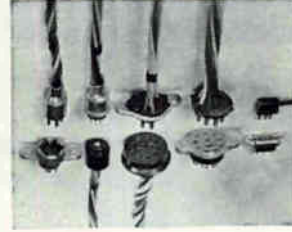
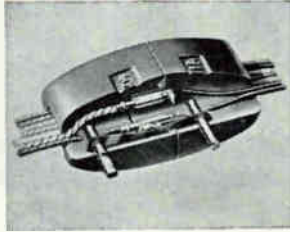
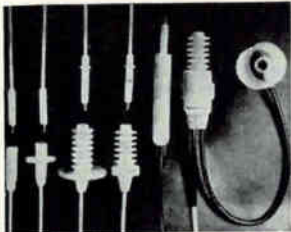
- More reliable electrical contact
- More secure mechanical grip
- Minimum electrical resistance

Each lead has individual strain relief because wire is doubled back through contact tab. Punch press contact design permits rapid heat transfer — eliminates unreliable cold solder joints as in screw machine contacts. Danger of insulation pull back is eliminated by bringing wire insulation right into molded clip pocket.

These unique Alden molding techniques in connector design drastically reduce the number of parts required and make possible multi-contact connectors of amazing basic simplicity and reliability.

Resilient Alden contacts can be included in any type of molded insulation for any combination of contacts. Hundreds of standard off-the-shelf designs are quickly available — with or without leads — or as part of unit-molded cables.

Our Customer Department will work closely with you on any connecting or cabling problems. A letter with description or sketch will enable us to provide recommendations or samples at once.



New, flameproof, high voltage connectors now available in high-density, flame-retardant polyethylene. Light, compact connectors for applications up to 30 KVDC and up to 250° F without distortion.

First major advance in connector reliability since potting offers fool-proof, tamper-proof connections for trouble-free operation. Alden "IMI" connectors and cables (wires, contacts, or other inserts) are integrally molded in a single hot shot of insulation so that material forming the connectors and covering the wires forms a single continuous, bonded insulation.

Standard assembled connectors in non-interchangeable layouts with from 2 to 11 contacts; miniature connectors, plain or shielded, for carrying power or signal; miniature plugs and sockets; signal connectors; and CRT connectors are all available for fast delivery.

ALDEN

PRODUCTS COMPANY
See you at Booths 1613 and 1615

MEETINGS AHEAD

- Mar. 11: Quality Control, American Society for; Hart House, Univ. of Toronto, Ontario.
- Mar. 14: Defense Planning Seminar, EIA; Statler-Hilton Hotel, Wash., D. C.
- Mar. 15-19: High-Fidelity Show, Magnetic Recording Industry Assoc.; Cow Palace, San Francisco.
- Mar. 20-23: Institute of Radio Engineers, International Convention, All PG's; Coliseum & Waldorf-Astoria Hotel, New York City.
- Mar. 21-22: Institute of Printed Circuits, Annual; Barbizon-Plaza, New York City.
- Mar. 27-31: Temperature, Its Measurement and Control, ISA, AIP, NBS; Veterans Memorial Auditorium, Columbus, O.
- Mar. 28: Rochester Soc. for Quality Control, ASQC; Univ. of Rochester, Rochester, N. Y.
- Mar. 28-29: Nuclear Aspects of Atmospheric and Space Systems, ANS; Statler-Hilton Hotel, Dallas.
- Apr. 4-6; Electromagnetics and Fluid Dynamics of Gaseous Plasma, IRE, IAS, U. S. Defense Research Agencies; Engineering Societies Bldg., N. Y. C.
- Apr. 4-7: Audio Engineering Society; Ambassador Hotel, Los Angeles.
- Apr. 5-7: Global and Space Environments, Institute of Environmental Sciences; Sheraton Park Hotel, Wash., D. C.
- Apr. 5-7: Materials and Electron Device Processing, ASTM Committee F-1; Benjamin Franklin Hotel, Phila.
- Apr. 10-14: International Air Symposium, FAA; Atlantic City, N. J.
- Apr. 11-12: Instrument Automation-Electronics Exposition, Ohio Valley; Cincinnati Gardens, Cincinnati, O.
- Apr. 11-13: Ultrapurification of Semiconductor Materials, Air Force Cambridge Research Laboratories; New England Mutual Hall, Boston, Mass.

THE ABC'S OF ELECTRONIC PACKAGING



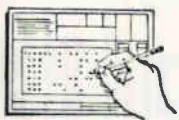
OF ELECTRONIC PACKAGING

... using Building Block Techniques

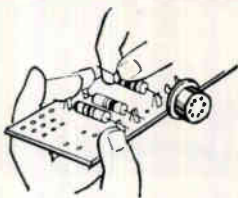
Designed by and for engineers, Alden Plug-In Unit Construction is the only complete, standard packaging system available to the electronics industry. Here's how simple it is to solve your mounting and packaging problems . . .

A

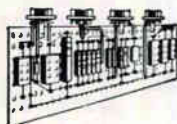
MOVE FROM SCHEMATIC TO COMPLETED CIRCUITRY IN HALF THE TIME!



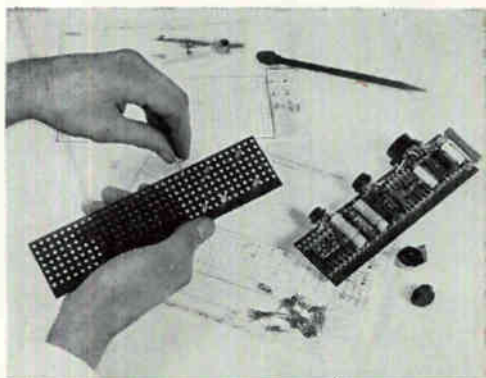
Lay out your circuitry on Alden full-scale planning sheets.



Snap component leads into ratchet jaws of Alden terminals.

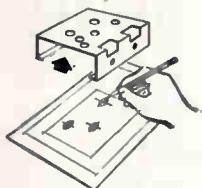


Make neat, component sub-assemblies organized into unit planes of circuitry.

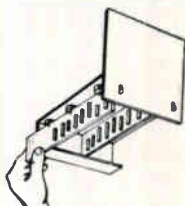


B

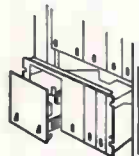
ORGANIZE YOUR CIRCUITRY BY FUNCTION FOR PLUG-IN FLEXIBILITY!



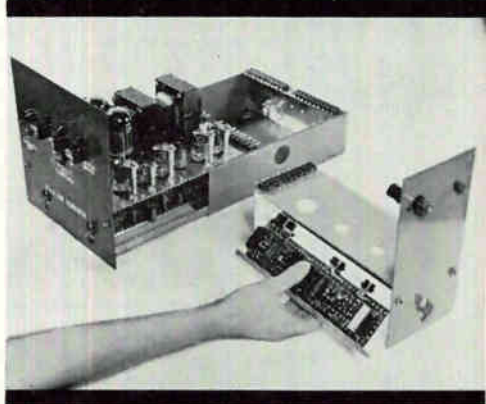
Indicate hole layout and sizes on full-scale planning sheets — complete chassis delivered to your specs.



Snap-in circuit cards in vertical planes for a neat, accessible assembly.

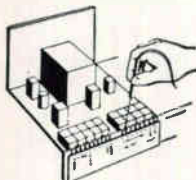


Sub-divide into modular, plug-in functions for true building block design.

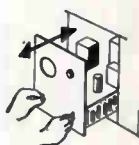


C

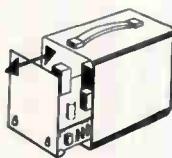
"DESIGN-IN" MAINTAINABILITY FOR THE REAL PAY-OFF!



Provide an accessible point of check for all in/out leads with unmistakable graphic identification.



Get quick replacement/accessibility of plug-in chassis by simple half-turn of handle.



Modular chassis interchangeable with instrument case for dual function or as transport case for replacement chassis.



See you at Booths 1613 and 1615

As the techniques of Alden Plug-In Unit Construction become more standardized throughout the world, those already designing to these standards will be setting the trends for equipment design in the rest of the industry.

You can get started now with any of the twelve Alden "Get-Started" KITS, ranging from \$11.25 to \$395.00. You can then evaluate — quickly—all or part of the Alden system in your particular application.

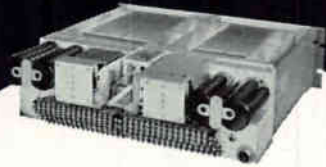


For FREE 250-page Alden Handbook, write on your company letterhead.

ALDEN

PRODUCTS COMPANY
3127 N. Main St., Brockton, Mass.

- improved performance and characteristics
- decreased size, weight and power consumption
- functional replacements for Military types TD97 and TD98



Rear view of a Multiplexer-Demultiplexer Shelf, Type 250 Model 1, showing 2 Transistorized Power Suppliers and Changeover Relay.



NORTHERN RADIO

New

ALL-TRANSISTOR

MULTIPLIER and DEMULTIPLIER
Type 248 Model 1 Type 249 Model 1

The new Multiplexer, Type 248 Model 1 (functional replacement for Multiplexer TD97-FTG-2), and Demultiplexer, Type 249 Model 1 (functional replacement for Demultiplexer TD98-FGR-3) are intended for use with twin-channel, single-sideband radio circuits operating in the high-frequency range. Their purpose is to derive two voice-frequency circuits from each of the radio channels. By means of frequency division multiplexing, the radio bandwidth from 200 to 6000 cps is divided into two transmission circuits, each with a bandwidth from 375 to 3025 cps. Four such vf circuits are derived from the twin-channel radio, and these are used to transmit carrier telegraph signals or to provide telephone or facsimile service.

The Multiplexer and Demultiplexer are designed to slide into the Northern Radio Type 250 Model 1 Shelf, which accommodates two each Multiplexers or Demultiplexers, or one each Multiplexer and Demultiplexer.



Two Multiplexers, Type 248 Model 1, are required for full utilization of the capacity of a radio transmitter. One is used to transmit telegraph, telephone, or facsimile signals from two vf circuits to the radio channel designated as sideband A. The second Multiplexer performs the same function for sideband B. In this way four vf circuits are applied to the twin-channel radio transmitter.



Two Demultiplexers, Type 249 Model 1, are required for full utilization of the capacity of a radio receiver. One is used to receive telegraph, telephone, or facsimile signals for two vf circuits from the radio channel designated as sideband A. The second Demultiplexer performs the same function for sideband B. In this way four vf circuits are derived from the twin-channel radio receiver.



The Multiplexer and Demultiplexer are transistorized equipments, including necessary bandpass filters, line amplifiers, carrier frequency sources, modulators and attenuators. The Multiplexer requires a nominal 14 volts DC at 125 milliamperes; the Demultiplexer, approximately 200 milliamperes at the same voltage. The power supply is normally provided from the Northern Radio Power Supply, Type 223 Model 1, which is plugged into the rear of the Type 250 Model 1 Shelf.

WRITE ON YOUR LETTERHEAD FOR FURTHER INFORMATION to Dept E-3

NORTHERN RADIO COMPANY, inc.
 147 West 22nd Street, New York 11, N. Y.

Pace-Setters in Quality Communications Equipment

In Canada: Northern Radio Mfg. Co., Ltd., 1950 Bank St., Billings Bridge, Ottawa, Ontario.

Visit Our Exhibit at IRE Booth 3510

Transitron

SILICON CONTROLLED RECTIFIERS

augmenting the industry's broadest line

With the addition of the 50-Amp Silicon Controlled Rectifier, Transitron now offers the industry the broadest line of Controlled Rectifiers available on the market today.

Research and development efforts during the past year have already produced an impressive array of types which include the following series:

TSW31S SERIES (TO-18 package).....operating current range to 200mA
 TCR251 SERIES (TO-5 package).....operating current range to 1 amp
 2N1595 SERIES (TO-5 package).....operating current range to 1 amp
 2N1600 SERIES (7/16" hex package)...operating current range to 3 amps
 TCR505 SERIES (7/16" hex package)...operating current range to 5 amps
 TCR510 SERIES (11/16" hex package) operating current range to 10 amps
 TCR520 SERIES (11/16" hex package) operating current range to 20 amps

NOW AVAILABLE — NEW 50-AMP CONTROLLED RECTIFIER

The latest addition to the Transitron line — the 50 Amp Silicon Controlled Rectifier — is a three-terminal, four-layer device designed to control very large load currents with small gate current signals. A mechanically rugged and electrically stable device, the new Controlled Rectifier is provided in the 1 1/16" hex base stud-mounted package and is hermetically sealed. Wherever high power handling ability is required, the 50-Amp Silicon Controlled Rectifier will find wide application ranging from frequency changing to welding control.

TCR550 SERIES (1 1/16" hex package)
operating current range to 50 amps

Type	Min. Peak Reverse Volt. and Min. Forward Breakover Volt. (volts)	Max. Average Forward Current at 90°C case (amps)	Package Configuration
TCR4050	400	50	1 1/16" hex
TCR3050	300	50	1 1/16" hex
TCR2050	200	50	1 1/16" hex
TCR1050	100	50	1 1/16" hex
TCR550	50	50	1 1/16" hex

Requires 50mA to turn on 50 Amp



For information on any or all of Transitron's line of Controlled Rectifiers, call or write today for Bulletin TE-1356.

WHY BIAS CONTROLLED RECTIFIERS?

THE BIASING OF SILICON CONTROLLED RECTIFIERS AND SWITCHES

Pioneering in *new* application techniques, Transitron application engineers have assembled information which demonstrates how "gate biasing" will improve the circuit reliability of the SCR. This informative booklet, entitled "The Biasing of Silicon Controlled Rectifiers and Switches," deals individually with *each* of Transitron's Controlled Rectifiers and Switches. It is an indispensable aid to the design engineer seeking *longer life* and *greater stability* in higher temperature applications . . . It's yours for the asking.

MEET US AT IRE — BOOTH NOS. 1220-1224

Transitron



electronic corporation
wakefield, melrose, boston, mass.

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"They all went Hath-a-way"



... and you're invited, too, during the IRE Show

The Hathaway Denver "spread" will be in Booth 2007, South Hall, second floor of the Coliseum.

You're invited to unsaddle and stop a spell at any time during the show. We'll have in the "corral" most of our products, including:

- Audio and RF Filters
- Comparison Bridges
- Microsources
- Miniaturized Power Supplies
- Resistance Meters
- Rotary Type Switches
- Signal Generators
- Static Converters
- Static Inverters
- Tuning Fork Frequency Standards
- Vacuum Tube Voltmeters
- Vibration Meters

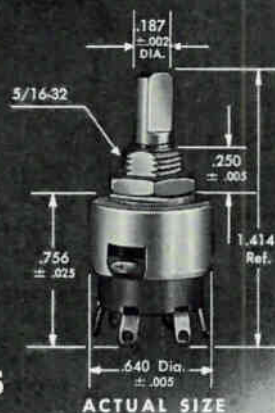
... plus some new additions to our recently acquired test instrument line (formerly SIE).

HATHAWAY DENVER

5802 East Jewell Avenue, Denver 22, Colorado

A division of HATHAWAY INSTRUMENTS, INC.

NEW Midget Rotary Tap Switch



Grayhill Series 45

— meets most environmental requirements per MIL-E-5272 and MIL-S-3786

COMPLETELY NEW — A real midget — genuine Grayhill quality. Conservatively rated to break one ampere at 115 VAC, resistive circuit, and to carry 5 amperes — life expectancy 100,000 cycles. Single deck, single pole, shorting or non-shorting, totally enclosed — provided with 2 to 6 positions (stop standard on 2 to 5 positions) and 6 positions normally supplied as continuous rotation. The Series 45 incorporates 60° indexing with a stop strength of 10 pound inches, and a rotational torque of approximately 12 ounce inches.

Complete specifications and prices available on request.



Grayhill offers a full line of Rotary Tap Switches, Push Button Switches, Test Clips, Binding Posts, and other miniature electrical and electronic components. Ask for current catalog



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CIRCLE 296 ON READER SERVICE CARD
electronics

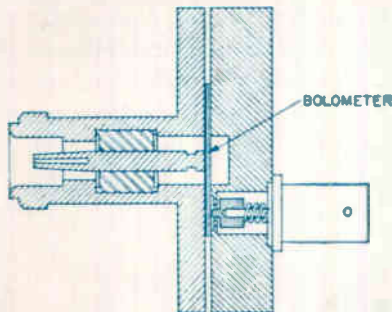
PRD *previews/reviews/design notes*

Bolometers, Barretters, and Thermistors

We have often been asked, "What is the difference between a bolometer, a barretter, and a thermistor?" At PRD the following is generally accepted: *Bolometer* is a general term which describes a temperature-sensitive element whose resistance changes as it dissipates microwave power. Bolometers include (a) thin short lengths of Wollaston wire, (b) evaporated metallic film, (c) small beads of semiconductors. The wire and film types are called "bolometers" or "barretters" and have a positive temperature coefficient. The semiconductor is called a "thermistor" and has a negative temperature coefficient.

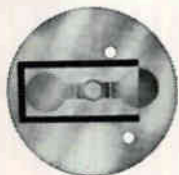
Power Measurement Equipment

The bolometer, plus appropriate mount, provides us with an accurate, dependable means of measuring microwave



BOLOMETER MOUNT

power. In itself, of course, the bolometer is a temperature-sensitive resistor, and gives no indicator reading. The most commonly used instrument for direct reading of microwave power is the self-balancing bridge. The PRD 650-B Universal Power Bridge can



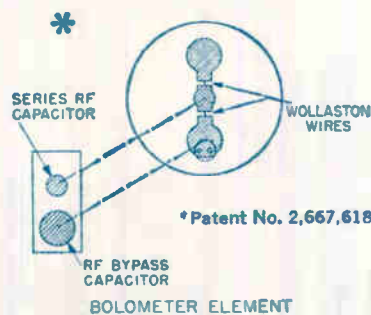
PRD 631-C

accommodate bolometers, barretters, or thermistors and reads power directly to 100 milliwatts.

Design Details

The drawing above is the PRD 627-A Broadband Coaxial Bolometer and Thermistor Mount which houses the PRD 631-C (wire type), PRD 631-D (film type), and PRD 631-G (thermistor). The two general types of bolometers manufactured by PRD are Wollaston wire and evaporated metallic film applied to thin mica discs. The PRD 631-G Thermistor uses two semiconductor bead elements and has excellent stability characteristics.

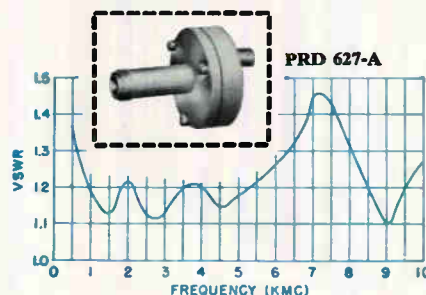
Each bolometer has a nominal operating resistance of 200 ohms when biased. For low power (1 mw max.), the PRD 631-C uses short lengths of



Wollaston wire which when deplated cannot be seen by the naked eye but must be delicately constructed under powerful microscopes. The metallic film units (PRD 631-D) are high power devices and can dissipate up to 100 mw.

Mounts

PRD bolometer mounts, such as the PRD 627-A, require no tuning, operate over a frequency range of 500 to 10,000 megacycles/sec, and are designed to insure high efficiency. The mount provides a low VSWR over the



entire band and allows for easy replacement of bolometer elements without retuning. A typical VSWR curve is shown.

PRD produces a variety of mounts



and bolometers. These include coaxial, waveguide, tunable, and broadband. Shown are, from top to bottom, a Waveguide Bolometer Mount (PRD 618) which operates from 26.5 to 40 KMC/S, a Waveguide Thermistor Mount (PRD 643-A) for 8.2 to 12.4 KMC/S, and a Coaxial Crystal and Bolometer Mount (PRD 613) for 1 to 12 KMC/S.

Precision in Production

PRD offers as standard catalog items some 34 different mounts and seven types of bolometers and thermistors. Our assembly line turns out several hundred bolometers alone in a week, all of which undergo rigorous stability and humidity tests after construction. PRD also produces, of course, all necessary associated equipment for power measurement. For more theoretical information, write for PRD Report Vol. 1, No. 4, "Microwave Power Measurements" or contact our Applications Engineering Department.

We have many interesting openings for engineers...contact Mr. John R. Zabka

PRD
ELECTRONICS, INC.

A Subsidiary of Harris-Intertype Corporation
Formerly Polytechnic Research & Development Co., Inc.

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NEW

VISIT LAMBDA at the IRE SHOW
BOOTHS 2917-18



20 AMP 0-34 VDC

Regulated POWER SUPPLY joins

EASY SERVICE ACCESS

Dual-deck, swing-out back construction provides simple and fast service access without the need to remove unit from rack. All major component terminals are accessible from rear.

CONVECTION COOLED—

no blowers or filters—
maintenance free

Advanced design and special, highly efficient, radiator type heat sinks eliminate internal blowers, maintenance problems, risk of failure, moving parts, noise and magnetic fields. Units are rated for continuous duty at 50°C ambient.

NO VOLTAGE SPIKES OR OVERSHOOT

Lambda's design prevents output voltage overshoot on "turn on, turn off," or power failure.

MIL QUALITY

Hermetically-sealed magnetic shielded transformer designed to MIL-T-27A quality and performance. Special, high-purity foil, hermetically-sealed long life electrolytic capacitors.

GUARANTEED FOR FIVE YEARS



LA 50-03A	without meters	0-34 VDC	0- 5A	\$395
LA 50-03AM	with meters	0-34 VDC	0- 5A	425
LA 100-03A	without meters	0-34 VDC	0-10A	510
LA 100-03AM	with meters	0-34 VDC	0-10A	540
LA 200-03A	without meters	0-34 VDC	0-20A	795
LA 200-03AM	with meters	0-34 VDC	0-20A	825

**COMPACT
NO BLOWERS**

5 AMP 3½" HIGH
10 AMP 7" HIGH
20 AMP 10½" HIGH



PATENTS PENDING

Lambda LA Series Power Supplies are compact, convection cooled and rated for continuous duty at 50°C ambient temperature.

LAMBDA Transistorized 5 and 10 AMP LA Series

COMPLETE SPECIFICATIONS OF LAMBDA LA SERIES (Including improved data on 5 and 10 AMP Models)

DC OUTPUT (Regulated for line and load)

Model	Voltage Range ¹	Current Range ²	Price
LA 50-03A	0-34 VDC	0-5A	\$395
LA 50-03AM	0-34 VDC	0-5A	425
LA100-03A	0-34 VDC	0-10A	510
LA100-03AM	0-34 VDC	0-10A	540
LA200-03A	0-34 VDC	0-20A	795
LA200-03AM	0-34 VDC	0-20A	825

¹The output voltage for each model is completely covered in four steps by selector switches plus vernier control and is obtained by summation of voltage steps and continuously variable DC vernier as follows:

MODEL	VOLTAGE STEPS
LA 50-03A, LA 50-03AM	— 2, 4, 8, 16 and 0-4 volt vernier
LA100-03A, LA100-03AM	— 2, 4, 8, 16 and 0-4 volt vernier
LA200-03A, LA200-03AM	— 2, 4, 8, 16 and 0-4 volt vernier

²Current rating applies over entire output voltage range

Regulation (line)	Better than 0.05 per cent or 8 millivolts (whichever is greater). For input variations from 100-130 VAC.
Regulation (load)	Better than 0.10 per cent or 15 millivolts (whichever is greater). For load variations from 0 to full load.
Transient Response (line)	Output voltage is constant within regulation specifications for step function line voltage change from 100-130 VAC or 130-100 VAC.
Transient Response (load)	Output voltage is constant within regulation specifications for step-function load change from 0 to full load or full load to 0 within 50 microseconds after application.
Internal Impedance	LA 50-03A less than .008 ohms LA100-03A less than .004 ohms LA200-03A less than .002 ohms
Ripple and Noise	Less than 1 millivolt rms with either terminal grounded.
Polarity	Either positive or negative terminal may be grounded.
Temperature Coefficient	Better than 0.025 %/°C

AC INPUT	100-130 VAC, 60 ± 0.3 cycle ³
	LA 50-03A . . . 360 watts ⁴
	LA100-03A . . . 680 watts ⁴
	LA200-03A . . . 1225 watts ⁴

³this frequency band amply covers standard commercial power lines in the United States and Canada.

⁴with output loaded to full rating and input at 130 VAC.

AMBIENT TEMPERATURE

AND DUTY CYCLE Continuous duty at full load up to 50°C (122°F) ambient.

OVERLOAD PROTECTION:

Electrical Magnetic circuit breaker front panel mounted. Special transistor circuitry provides independent protection against transistor complement overload. Fuses provide internal failure protection. Unit cannot be injured by short circuit or overload.

Thermal Thermostat, manual reset, rear of chassis. Thermal overload indicator light front panel.

INPUT AND OUTPUT

CONNECTIONS Heavy duty barrier terminal block, rear of chassis. 8 foot, 3 wire detachable line cord.

METERS Voltmeter and ammeter on metered models.

CONTROLS:

DC Output Controls Voltage selector switches and adjustable vernier-control rear of chassis.

Power Magnetic circuit breaker, front panel.

Remote DC Vernier Provision for remote operation of DC Vernier.

Remote Sensing Provision is made for remote sensing to minimize effect of power output leads on DC regulation, output impedance and transient response.

PHYSICAL DATA:

Mounting	Standard 19" Rack Mounting
Size	LA 50-03A 3½" H x 19" W x 14¾" D
	LA100-03A 7" H x 19" W x 14¾" D
	LA200-03A 10½" H x 19" W x 16½" D
Weight	LA 50-03A 55 lb Net 85 lb Ship. Wt.
	LA100-03A 100 lb Net 130 lb Ship. Wt.
	LA200-03A 140 lb Net 170 lb Ship. Wt.
Panel Finish	Black ripple enamel (standard). Special finishes available to customers specifications at moderate surcharge. Quotation upon request.

Send for complete Lambda Catalog.



LAMBDA ELECTRONICS CORP.

515 BROAD HOLLOW ROAD, HUNTINGTON, L. I., NEW YORK 516 MYRTLE 4-4200

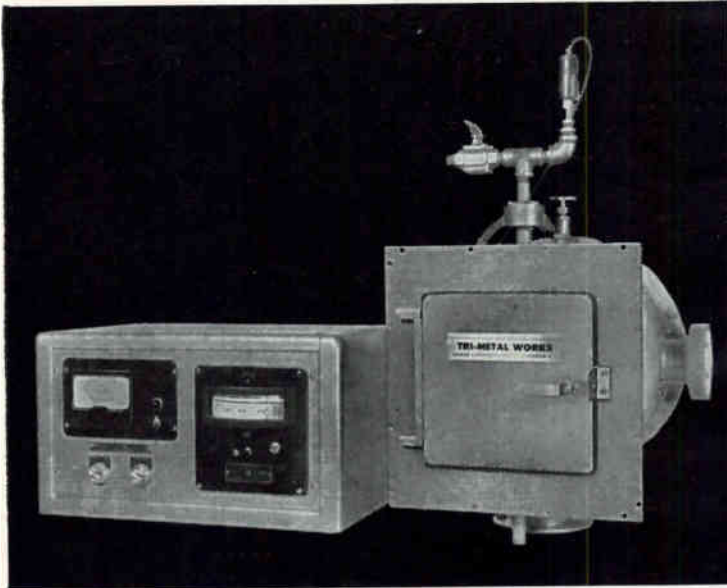
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CIRCLE 63 ON READER SERVICE CARD

MEET

0-8

NEW HIGHER TEMPERATURE, HIGH VACUUM OVEN.



Here is Tri Metal's low-cost 0-8 oven engineers throughout the nation are talking about. This unique model consists of a suspended inner muffle surrounded by heating elements mounted on ceramic stand-off insulators. The heating elements are surrounded by a series of polished shields which reflect the radiated heat onto the muffle and thus achieve exceptional temperature uniformity. The outer shell of the oven is water cooled. No water cooling of the door is required. The low-cost Neoprene door gasket remains cool even when the oven is operating continuously at elevated temperatures. Accepts Bench or Dry Box Mounting. Various Sizes Available.

HIGHER TEMPERATURES
Up to 800°C. (1472°F.)

BETTER UNIFORMITY
Plus or minus 3°C. (5.4°F.)

LESS MAINTENANCE
Low-Cost, Neoprene "O" ring gaskets guaranteed one year.

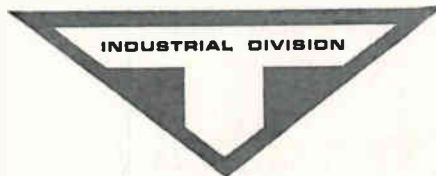
FASTER HEAT UP
500°C. (932°F.) in 23 minutes.

CLOSER CONTROL
1/C Thermocouple INSIDE the work zone.

HIGHER VACUUM
1x10⁻⁶ Torr* (mmHg)
@ 500°C. (932°F.)

COOLER EXTERIOR
All surfaces cool to the touch.

TRI METAL WORKS INC.



PRIVATE SHOWING FOR IRE VISITORS

Get acquainted with 0-8
in our private suite at the Waldorf-Astoria.
Look us up.
Your company will be glad you did!

Tri Metal Works is recognized as a leader in design and fabrication of high and ultra high vacuum equipment. Tri Metal Works has been engaged in the custom fabrication of high vacuum components and equipment for leading manufacturers and users since 1946. You are invited to see a demonstration of 0-8 in our plant laboratory. Call or write for appointment. For a Free Detailed Brochure Write To: TRI METAL WORKS INC., Industrial Division 1600 Bannard Street, East Riverton, New Jersey, or phone 829-2000

*Terminology recommended by Standards Committee of American Vacuum Society

ELECTRON TUBE NEWS

...from SYLVANIA



7

significant developments create

NEW DIMENSIONS FOR DESIGNERS!

- Sarong Cathode
- Strap Frame Grid
- 9-T9 Outline
- 10-Pin Tubes
- 12-Pin Tubes
- "Bonded Shield" CRT's
- Compact TWT's

See them all on display —
Sylvania I.R.E. Exhibit!
Booth #
2322-2332, 2415-2425

Among the notable accomplishments in recent tube technology are important Sylvania refinements in the state of the art. Impressive advances are being made in tube *reliability*, tube *versatility* at Sylvania. Performance parameters are undergoing marked improvement while electrical uniformity is rigidly maintained. Some results of this vigorous new approach to the tube art can be seen in the following Sylvania tube developments.

SYLVANIA...new dimensions for designers

SYLVANIA STRAP FRAME GRID

Delivers high Gm, low noise

Sylvania *Strap Frame Grid* improves tube reliability, provides high Gm per mA of Ib, enables uniform grid-cathode spacing and resultant narrow dispersion of characteristics. It affords much improved control of cutoff characteristics. *Strap Frame* design significantly improves stability, resistance to vibration and shock. Extensive Sylvania development brings *Strap Frame* advantages to: 6ER5, *semi-remote cutoff triode*; 6DJ8, *sharp cutoff double triode*; 6FQ5A and 6GK5, *semi-remote cutoff triodes*; 6EH7, *semi-remote cutoff pentode*; 6EJ7, *sharp cutoff pentode*. Another example, Sylvania-6ES8, *semi-remote cutoff double triode*, combines *Strap Frame Grids* and *Sarong Cathodes* for greater accuracy in grid-cathode spacing for improved cutoff characteristics, high stability, exceptional uniformity.



SYLVANIA-DEVELOPED SARONG CATHODE

Improves tube stability, uniformity

The extraordinary *Sarong Cathode* is a major tube refinement designed to stabilize cathode performance, add life to tube service. The *Sarong Cathode* uses a thin film of cathode material precisely controlled for uniform density and surface smoothness, and *wrapped* on an ultrasonically cleaned cathode sleeve. As a result, possibility of plate-to-cathode arcing or cathode "hot spots" is drastically reduced.

SYLVANIA TYPES UTILIZING SARONG CATHODE

5V4GA	6BC8	6DE4	6W4GT
6AL5	6BQ7/A	6ES8	7F7
6AU4	6BY5GA	6FQ5A	12AU7/A
6AU6	6BZ7	6K6GT	12AX7/A
6AX4	6CY5	6U8	35Z5
6BA6	6DA4	6V6GT	

SYLVANIA 9-T9 TUBE OUTLINE

Brings new efficiency to chassis layout



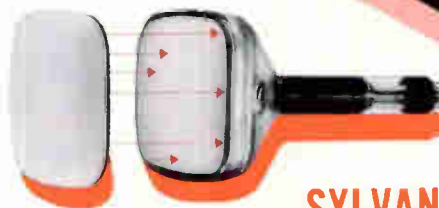
Utilizing the straight-sided bantam envelope and a miniature 9-pin circle, Sylvania-developed 9-T9 increases volumetric efficiency by eliminating the T9 octal base. 9-T9 enables the use of large tube assemblies in those stages where higher power dissipation capabilities are a design requirement. First new 9-T9 types are — 6/10EW7... double-triodes intended for service as a vertical deflection oscillator and amplifier • 6/17HC8... triode-pentodes designed for use as vertical deflection oscillator and amplifier in 110° deflection circuits of TV receivers 7695... beam power pentode features unusually high power sensitivity as an AF amplifier. In Class A1 operation, self-biased, it delivers 4.5W power output with a B+ voltage of only 140 volts • 7754... 6-volt version of 7695 • 6GM5... beam pentode features improved sensitivity and output characteristics for AF power amplifier use • 6GC5... beam power pentode features high power sensitivity as an audio power amplifier.



NEW SYLVANIA 10-PIN TUBES!

Double tetrodes in T-6½ bulb!

Sylvania adds a new dimension to circuit design with the addition of a 10th pin to the center of the 9-pin miniature circle. Sylvania 10-Pin design provides improved tube performance, makes possible new multiunit combinations . . . offers unusual design advantages with a minimum of chassis redesign. Case in point: *Sylvania-6C9* and *-17C9*, sharp cutoff double tetrodes, offer two high-performance units in the compact T-6½ envelope . . . providing potential savings in circuitry, reducing space requirements. With the addition of the 10th pin, heat dissipation capabilities are increased, cathodes have separate connections, shielding is introduced to effectively reduce undesirable oscillator signal radiation. *Sylvania-6C9* and *-17C9* are designed for VHF service as RF amplifiers and autodyne mixers.



SYLVANIA "BONDED SHIELD" CRT's

Measurably improve image display

Sylvania pioneered the dramatic improvements made in image viewing by "Bonded Shield" design. First to demonstrate the feasibility of quantity-producing "Bonded Shield" TV picture tubes, Sylvania applied its knowledge to the specialized requirements of industrial-military CRT's for virtually any application.

"Bonded Shield" eliminates the need for conventional safety glass, reduces the number of reflecting surfaces by 50%. Here's what it does for the viewer: apparent light transmission and contrast are increased; mirror-like reflections are eliminated. Image display is brought "out front" for wide-angle viewing, mounting and styling are simplified, tube face is made accessible for easy cleaning. Other unique advantages: "Bonded Shield" caps are available with special anti-reflection treatment that can diffuse up to 70% of reflected light; several "Bonded Shield" CRT's are available with calibrated reference scales permanently etched on the safety cap, thereby reducing viewing errors caused by parallax.



NEW 12-PIN MULTIFUNCTION TUBES

Sylvania 12-T9, 12-T12 types!

Presently under development at Sylvania are five new 12-pin tube types for TV receiver applications. A natural advance in the evolution of small-size, multifunction tubes, Sylvania 12-pin tubes utilize dome-shaped bulbs evacuated from the bottom providing reduced seated height. First types to be announced soon will be commercial versions of these prototypes: two 12-T9 types using the T-9 bulb—SR-3202, damper tube; SR-3203, double diode-double triode, horizontal phase comparator and oscillator; and three 12-T12 types in the T-12 bulb—SR-3201, double-diode, low voltage rectifier; SR-3204, double-pentode, sound discriminator, sound output; SR-3205, beam power pentode, horizontal deflection tube.

Contact your nearest Sylvania Sales Engineering Office for further information on these and other exciting tube developments under way at Sylvania. For data on specific types, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. C, 1100 Main Street, Buffalo 9, N. Y.

MICROWAVE DEVICE NEWS from SYLVANIA



50% Smaller!
80% Lighter!

LOW-PRICED PPM-FOCUSED TWT's
for test equipment applications

TYPES	FREQUENCY	POWER OUTPUT	GAIN-db (Min.)
	RANGE (kMc)		
TW-4267	1-2	10 mW	35**
TW-4268	1-2	1 W	30*
TW-4261	2-4	10 mW	35**
TW-4260	2-4	1 W	30*
TW-4281	4-8	10 mW	35**
TW-4278	4-8	1 W	30*
TW-4282	8-12	5 mW	35**
TW-4273	8-12	1 W	30*

**Small signal gain

*At saturation

Sample quantities of L- and S-band TWT's immediately available.

Sylvania introduces important advantages to microwave amplifier applications where economy, compact size, light weight are vital design considerations.

Less than 4 lbs. in weight and 2¼" in maximum diameter, Sylvania TWT's for test equipment present unusual opportunities for design of compact equipment when compared with bulky 15-35 lb. package of the solenoid types. However, electrical performance advantages over solenoid types are still maintained. Investigate the wide range of TWT's by Sylvania. Contact your nearest Sylvania Sales Engineering Office, or write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. MDO-C, 1100 Main Street, Buffalo 9, N. Y.

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS



For the engineer who refuses to stagnate



HALF the world is half asleep! Men who could be making *twice* their present salaries are coasting along, hoping for promotions but doing nothing to bring themselves forcefully to the attention of management.

They're *wasting* the most fruitful years of their business lives . . . throwing away thousands of dollars they may never be able to make up. And, oddly enough, they don't realize—even remotely—the tragic consequences of their failure to forge ahead while time is still on their side.

Engineers and other technically-trained men are particularly prone to "drift with the tide" because their starting salaries are reasonably high and promotions come at regular intervals early in their careers. It isn't until later—too much later in many cases—that they discover there is a definite ceiling on their incomes as technicians.

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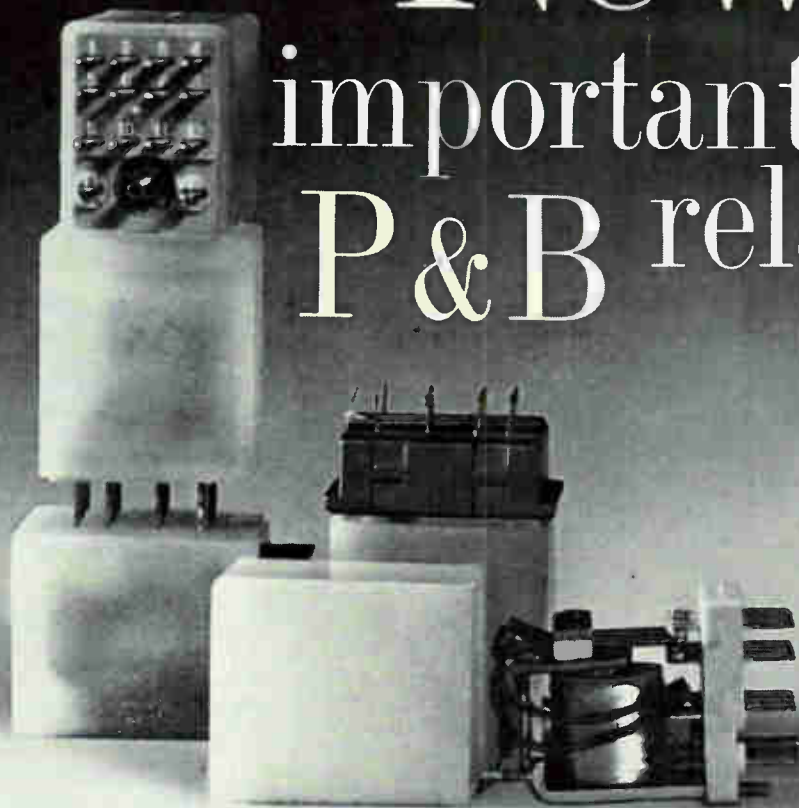
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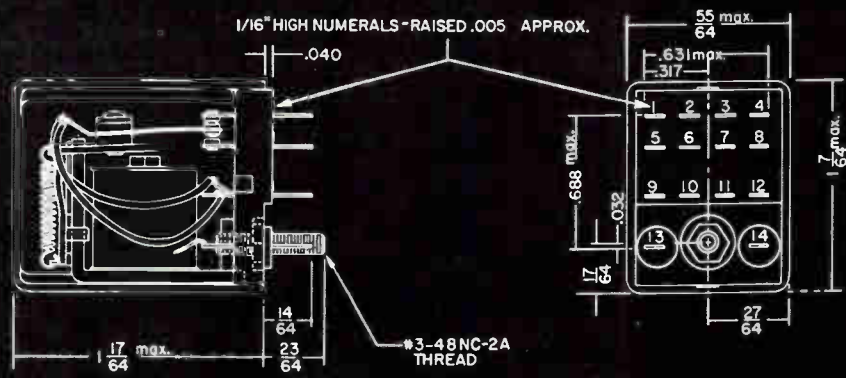
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Home Address

a **New** and
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P & B relay . . .



KHP SERIES SHOWN ACTUAL SIZE



having rare longevity

This small, 4-pole relay has the happy faculty of maintaining its original operating tolerances over an exceptionally long life. Example: tests (by customers!) show this relay has variations in electrical characteristics of less than 5% after more than 100 million operations.

But that's far from all. This is a *small* relay . . . about a one inch cube. This relay is easy to install using the conveniently spaced solder lugs or a socket. Thus you save time and production costs. This relay is versatile . . . its 4PDT contacts will switch loads from dry circuit up to 3 amperes. This relay—well, why not order samples and see for yourself! Order today from your P&B representative or call us at Fulton 5-5251, in Princeton, Indiana.

KHP SERIES SPECIFICATIONS

CONTACTS:
Arrangement: 4 Form C, 2 Form Z.
Material: 3/32" dia. Silver standard. Silver cadmium oxide and gold alloy available.
Rating: 3 amps @ 30 volts DC or 115 volts AC resistive for 100,000 operations.
COILS:
Resistance: 11,000 ohms max.
Temperature: Operating Ambient: -45°C. to +70°C.
Power: 0.5 watts min operate @ 25°C. 0.9 watts nom. @ 25°C. 2.0 watts max. @ 25°C.

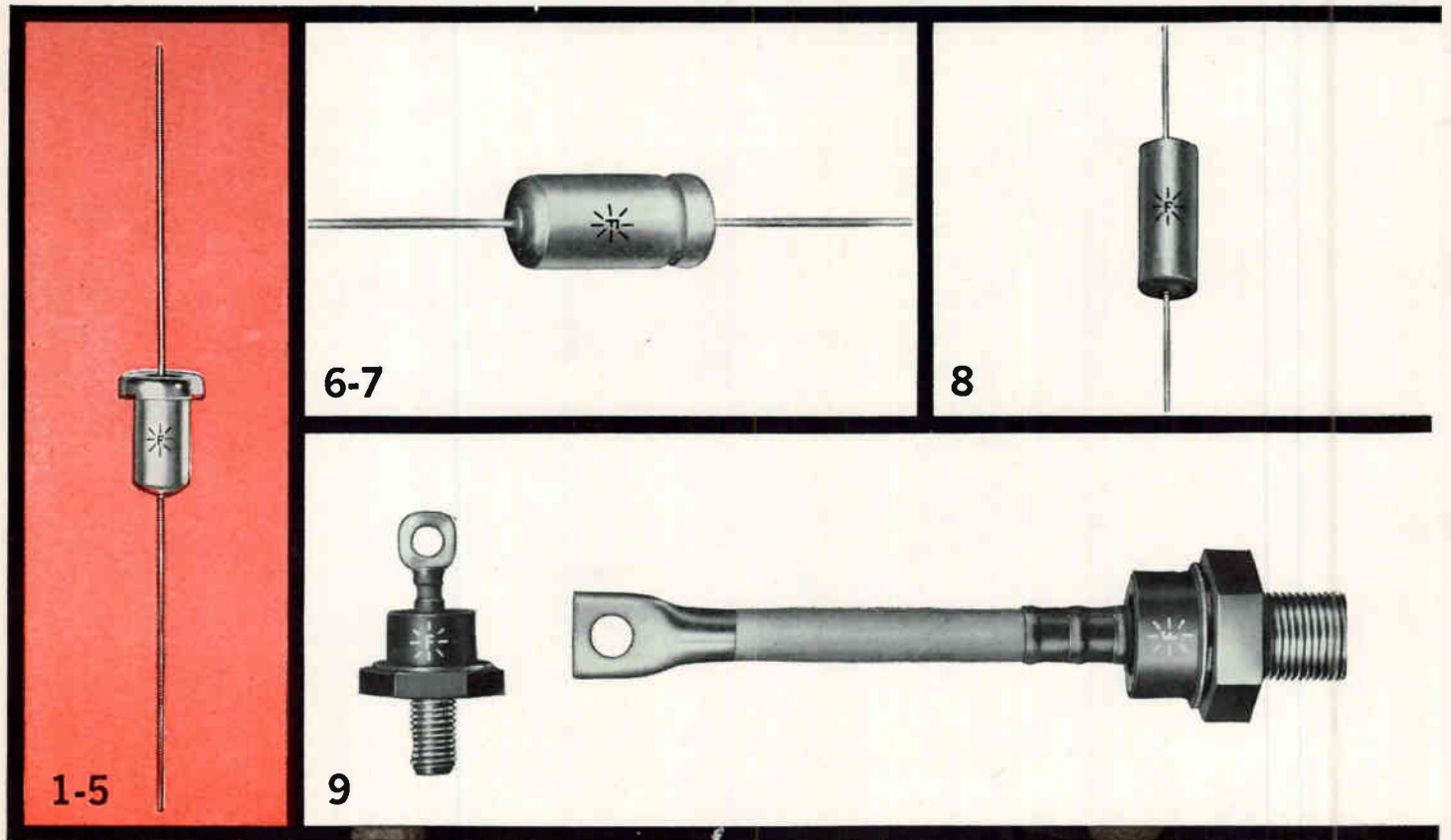
TIMING VALUES:
 Nominal Voltage @ 25°C. Max. Values
 Pull-in time 15 ms
 Drop-out time 5 ms
INSULATION RESISTANCE: 1500 megohms min.
DIELECTRIC STRENGTH:
 500 Volts RMS 60 cycles between contacts.
 1000 Volts RMS 60 cycles between other elements.
MECH. LIFE: In excess of 100 million cycles.
SOCKET: Solder lug or printed circuit terminals. Available as accessory.
DUST COVER: Standard.
TERMINALS: Solder lug and taper tab.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



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FANSTEEL HIGH RELIABILITY



FANSTEEL TANTALUM CAPACITORS

In 1949, Fansteel introduced the first commercially available miniature, porous tantalum electrolytic capacitor. This capacitor was the result of more than 25 years of research into the film forming properties of tantalum and techniques for refining and fabricating the metal. Today, Fansteel's complete line of tantalum capacitors includes, in addition to the original PP type (with improved shock and vibration resistant properties), high temperature tantalum capacitors, pre-tested capacitors with certified reliability and solid tantalum types. From this broad line, it is possible to select a capacitor to meet virtually every requirement.

1. GOLD-CAP* TANTALUM CAPACITORS

Pre-tested for reliability with test results certified in writing. Gold-Cap Tantalum Capacitors are available in a wide range of ratings— $2 \mu\text{f}$ to $330 \mu\text{f}$ —6V to 100V (-55° up to $+125^\circ\text{C}$) and are supplied with a standard tolerance rating of $\pm 10\%$.

2. PP TANTALUM CAPACITORS

Most widely used of all tantalum electrolytic capacitors. Meets MIL-C-3965B for vibration Grade 3 capacitors. Excellent low temperature characteristics—operating range -55° to $+85^\circ\text{C}$ at full rated voltage. Fansteel PP Tantalum Capacitors have outstanding frequency stability, negligible electrical leakage and are shock and vibration resistant. Capacity tolerance of $\pm 10\%$ is standard for Grade 1 PP capacitors.

3. HP TANTALUM CAPACITORS

For high temperature applications. Fansteel HP Tantalum Capacitors offer reliability and unexcelled stability over a -55° to $+125^\circ\text{C}$ ambient temperature range. In addition, HP types are able to withstand severe vibration and impact shock. Grade 1 HP capacitors have a standard capacity tolerance of $\pm 10\%$.

4. All types of CL-44 and CL-45, conforming to MIL-C-3965B, are also available.

5. BLU-CAP* TANTALUM CAPACITORS

These economical units are designed to bring the benefits of tantalum capacitors to any commercial or military application where wider capacity tolerances (-15% , $+75\%$) are permissible.

6. SP TANTALUM CAPACITORS

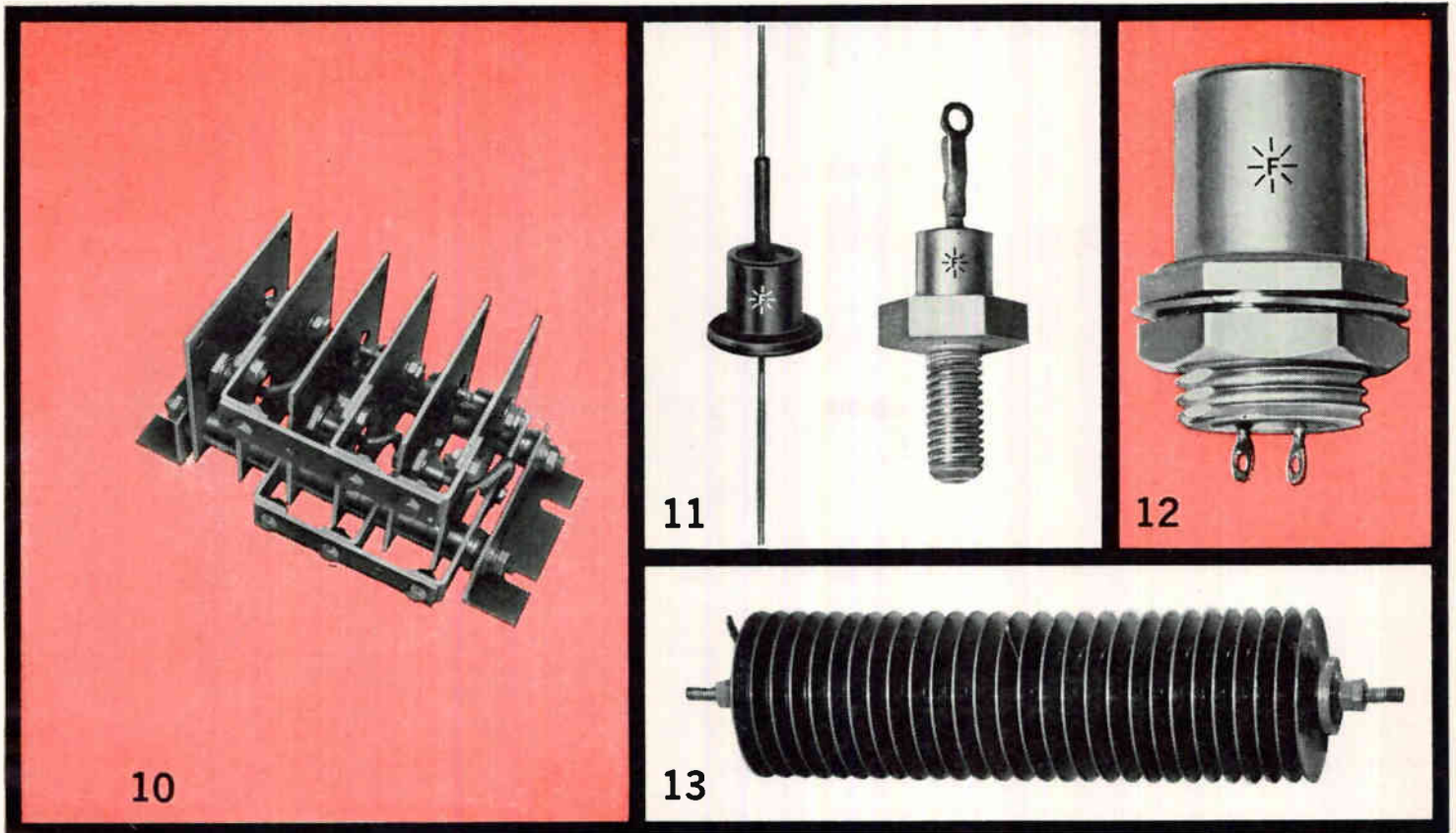
Fansteel SP Tantalum Electrolytic Capacitors offer same capacity ratings as the PP with the advantage of cylindrical cases.

7. All types of CL-64 and CL-65, conforming to MIL-C-3965B, are also available.

8. STA SOLID TANTALUM CAPACITORS

Unsurpassed performance reliability at operating temperatures up to 125°C . Hermetically sealed case affords full protection against the various environments encountered in use. A wide variety of ratings, consolidated

ELECTRONIC COMPONENTS



into four convenient sizes, cover the most complete line of solid tantalum capacitors available. Built to meet requirements of MIL-C-26655A.

FANSTEEL RECTIFIERS

Fansteel has been actively engaged in the development, engineering and production of dependable rectifiers since 1924, when Balkite Tantalum Rectifiers were introduced. As early as 1932, Fansteel conducted exploratory research work in selenium, as well as other types of metallic rectifiers. This extensive background has enabled Fansteel to continually broaden its line of rectifiers, offering designers and industrial users a full line of highly reliable components.

9. SILICON POWER RECTIFIER CELLS

Available in 20, 35, 50, 70, 160 and 240 Ampere Ratings.

10. SILICON RECTIFIER STACKS

These units provide a highly reliable d-c source for a wide range of power applications. Normally supplied in a single phase center tap, single phase bridge or three phase bridge configurations. Special assemblies can be built to specifications. (Unit illustrated has output rating of 700 volts at 147 kw.).

11. NEW! FANSTEEL SILICON ZENER VOLTAGE REGULATOR CELLS

- 1- and 10-watt power dissipation ratings
- Designed and process-selected to give sharp Zener characteristics and low dynamic resistance over entire operating current range
- Hermetically sealed
- All-welded, shock-proof cell

12. NEW! SILICON ZENER VOLTAGE REFERENCE ELEMENTS

- For applications from -55°C to $+165^{\circ}\text{C}$
- High voltage stability
- Rugged construction

13. SELENIUM RECTIFIER STACKS

Practically unlimited life with no maintenance—instantaneous power with negligible leakage. Over 400,000 different stack combinations readily available in a broad range of power ratings. Selenium is still a practical semiconductor used by many designers where peak reverse voltages are troublesome.

Get more information on these new Fansteel Zener Diodes and other Fansteel components at the IRE Show. Visit us in Booth 4021-4022.

*Trade Mark
0312-101



Fansteel Metallurgical Corporation, North Chicago, Illinois, U.S.A.

WHERE RELIABILITY DICTATES STANDARDS

SWEEP AUDIO FREQUENCIES and HIGH-Q FILTER CIRCUITS

with the Ease and Precision of RF Sweep Techniques

NEW **KAY** *Sona-Sweep* MODEL M



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- Variable Center Frequency
- Variable Sweep Width Built-In Attenuators
- Zero Reference Line
- All-Electronic

SPECIFICATIONS

Frequency Range: 20 cps to 200 kc, variable.

Sweep Width: 20 cps to 20 kc, variable.

Repetition Rate: 0.2 to 25 cps., variable.

Price: \$895.00, plus \$22.00 per marker FOB factory (\$985.00 plus \$25.00 per marker, FAS, N. Y.)

KAY *Ligna-Sweep*[®] MODEL **SKV**

**ALL ELECTRONIC—AUDIO, VIDEO, VHF
SWEEPING OSCILLATOR
COVERS WIDE RANGE 200 CPS TO 220 MC.**

FEATURES

- From 10 mc Down to 1 kc in One Wide Video Sweep.
- Highly Stable, Narrow-Band Video Frequency Sweeps (20 kc on Variable Bands, 200 cps on Fixed).
- Logarithmic Sweep for Low-End Expansion. Linear Sweeps 0.2 cps to 30 cps; Linear Sweep Locked to Line Frequency.
- Audio Sweep—200 cps to 20,000 cps. 8 Fixed, Narrow-Band Video Frequency Sweeps for Repetitive Operations.
- Fundamental Frequency 10 mc to 220 mc. (Widths to 30 mc Plus.)
- Continuously Variable Center Freqs. Direct-Reading Dial 10 kc to 220 mc.
- High-Level RF Output—1.0-V rms Into 70 ohms. AGC'd to ± 0.5 db Over Widest Sweep.
- Price: \$1295.00 FOB Factory (\$1425.00, FAS New York).



For high-frequency work, the Kay Ligna-Sweep Model SKV provides 9 sweep bands, operating at fundamental frequencies, for wide, stable sweeps from 10 to 220 mc. At the low end of the spectrum, an audio-frequency sweep from 200 to 20,000 cps is provided.

For checking high-Q circuits and low-frequency response characteristics, variable rep-rates down to 0.2 cps are available. This wide choice of sweep rates (continuous to 30 cycles, and fixed 60-cycle lock) makes it easy to select that highest rep-rate which gives both an accurate response display and easiest, brightest viewing on the scope screen. A nominally logarithmic 30-cycle sweep, most useful for studying audio and video low-pass circuits, provide an expanded view of the low-frequency end, while showing over-all frequency characteristic.

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Booths 3512-3518

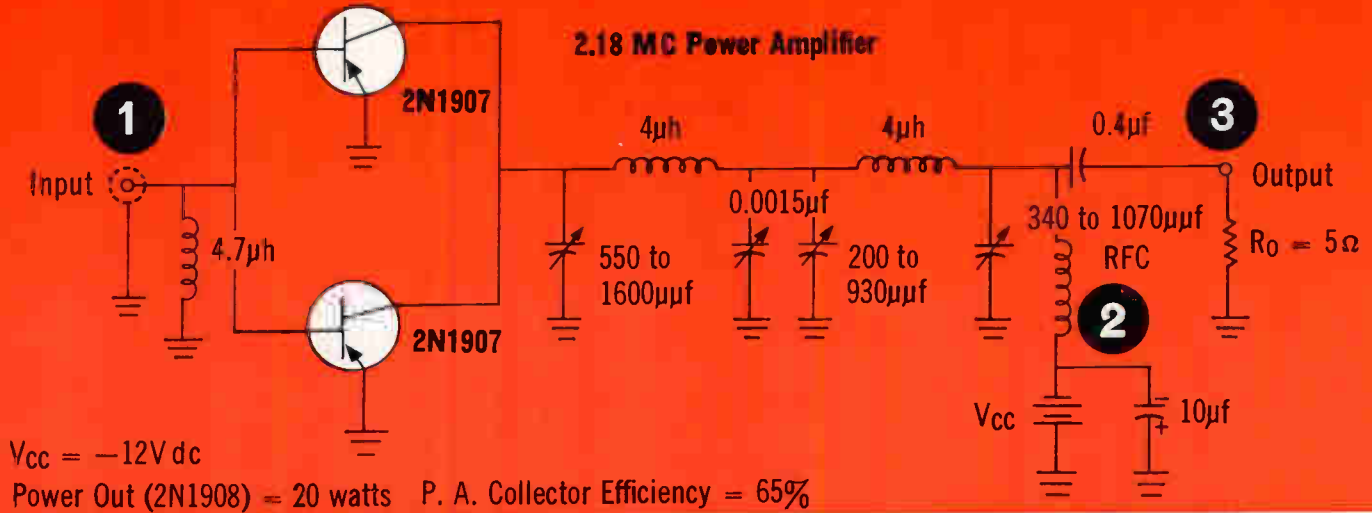
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HOW TO DESIGN 66% EFFICIENT RF AMPLIFIER

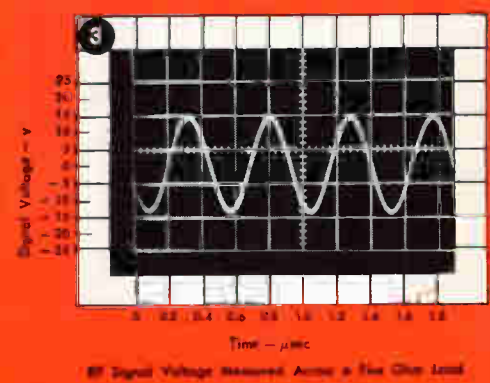
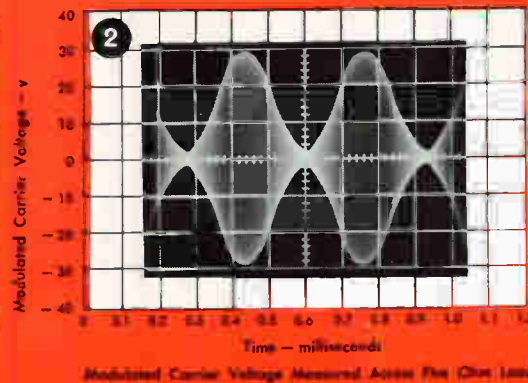
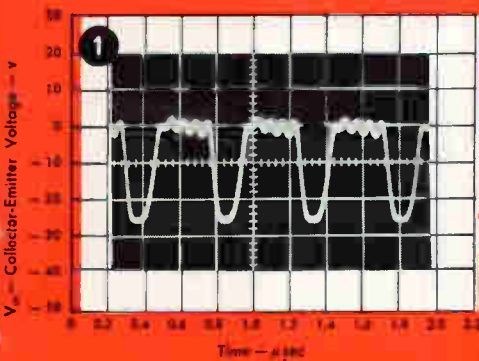
With high frequency / high current / high power TI 2N1907 Germanium Transistors

2.18 MC Power Amplifier



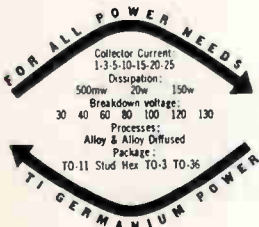
Texas Instruments 2N1907 devices provide: ■ Guaranteed max thermal resistance — $0.5^{\circ}\text{C}/\text{watt}$...allowing highest power dissipation. ■ Guaranteed AC beta of 2 @ 10mc...ideally suited for high power RF amplifiers. ■ Typical switching time of $2.5 \mu\text{sec}$ @ 5 amp...for high speed DC to DC converters in ultrasonic operations. ■ Guaranteed min $h_{FE} = 50$ @ 5 amps and 10 @ 15 amps...reducing input current requirements. ■ Guaranteed $V_{CE(sat)} 0.4v$, $I_C = 5.0a$, $I_B = 0.5a$...providing cooler device operation under saturated current condition.

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Write today on your company letterhead for this new application note, "Germanium Transistorized Marine Transmitter".

Device	I_C	BV_{CBO}	BV_{CEO}	$V_{CE(sat)}$ $I_C = -5a$ $I_B = -500 \text{ ma}$	Min h_{FE}		
					@ $I_C = 2.5a$	@ $I_C = 5a$	@ $I_C = 15a$
2N1907	20 amp	100 volts	40 volts	0.4v	100	50	10
2N1908	20 amp	130 volts	50 volts	0.4v	100	50	10



SEMICONDUCTOR-COMPONENTS DIVISION

TEXAS



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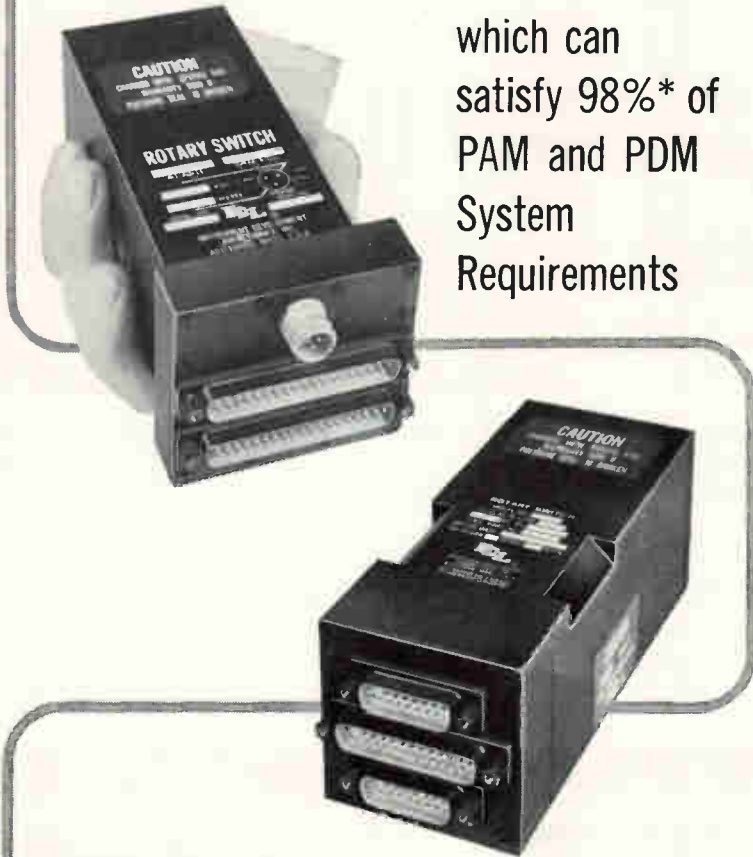
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IDL offers "STANDARD" TELEMETERING COMMUTATORS

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PAM and PDM
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Within these two case configurations, IDL will provide sampling rates, channel density, low noise level operations and motor characteristics specified by IRIG requirements in telemetry systems. The possible combinations offered by this production plan are so numerous that most telemetry requirements can be met.

To the systems designer, these "Standard" Telemetry Commutators offer tremendous advantages:

1. Uniform installation requirements
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period... comes to you
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and accurate.

gives more to all 4!

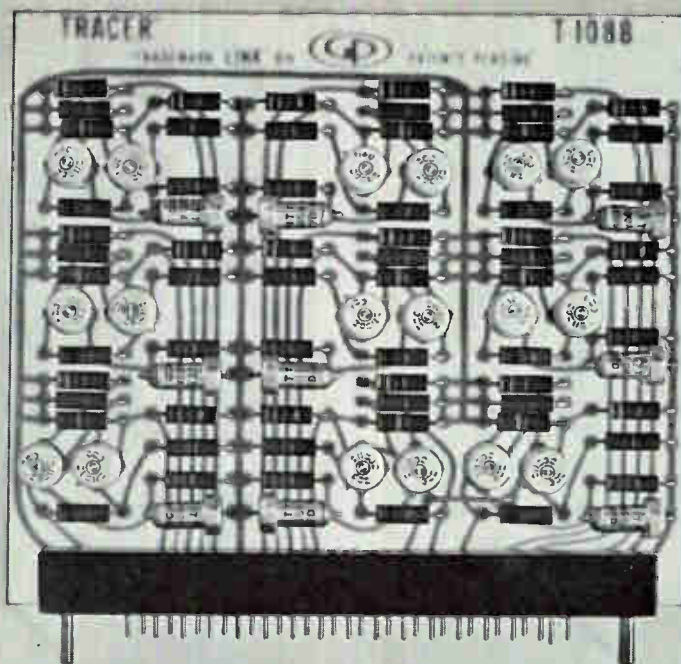
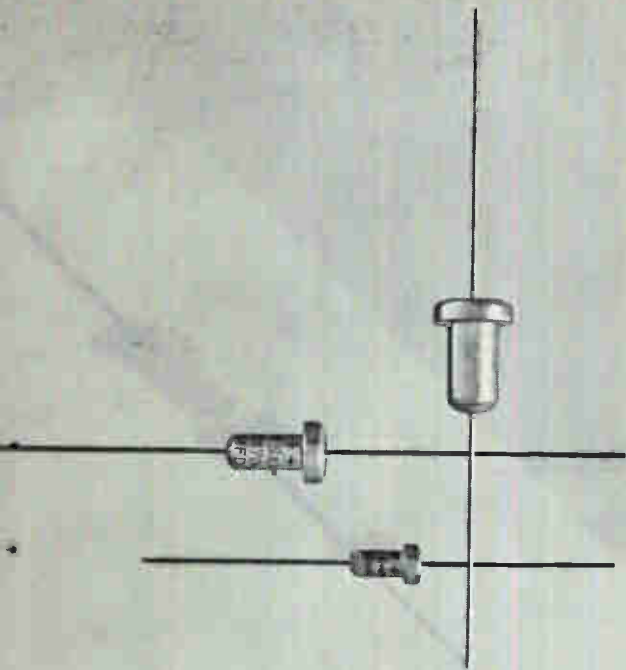


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Subsidiary of Royal McBee Corporation

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Link Division of General Precision, Inc. specified ITT capacitors for this vital portion of its Tracer Identification and Control System, which demands utmost reliability and long life expectancy from every component.

TOTAL PROCESS CONTROL AND DISCIPLINED PRODUCTION DELIVER

HIGH-RELIABILITY WET-ANODE TANTALUM CAPACITORS FROM ITT

ITT wet-anode tantalum capacitors meet MIL-C-3965B—a fact proved by independent laboratory qualifications tests on ITT capacitors. The reliability and long life expectancy of these competitively-priced capacitors are direct results of ITT's total process control and disciplined production procedures, above and beyond testing standards more stringent than normal industry practice—and backed by ITT's world-wide facilities and experience.



COMPONENTS DIVISION
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION
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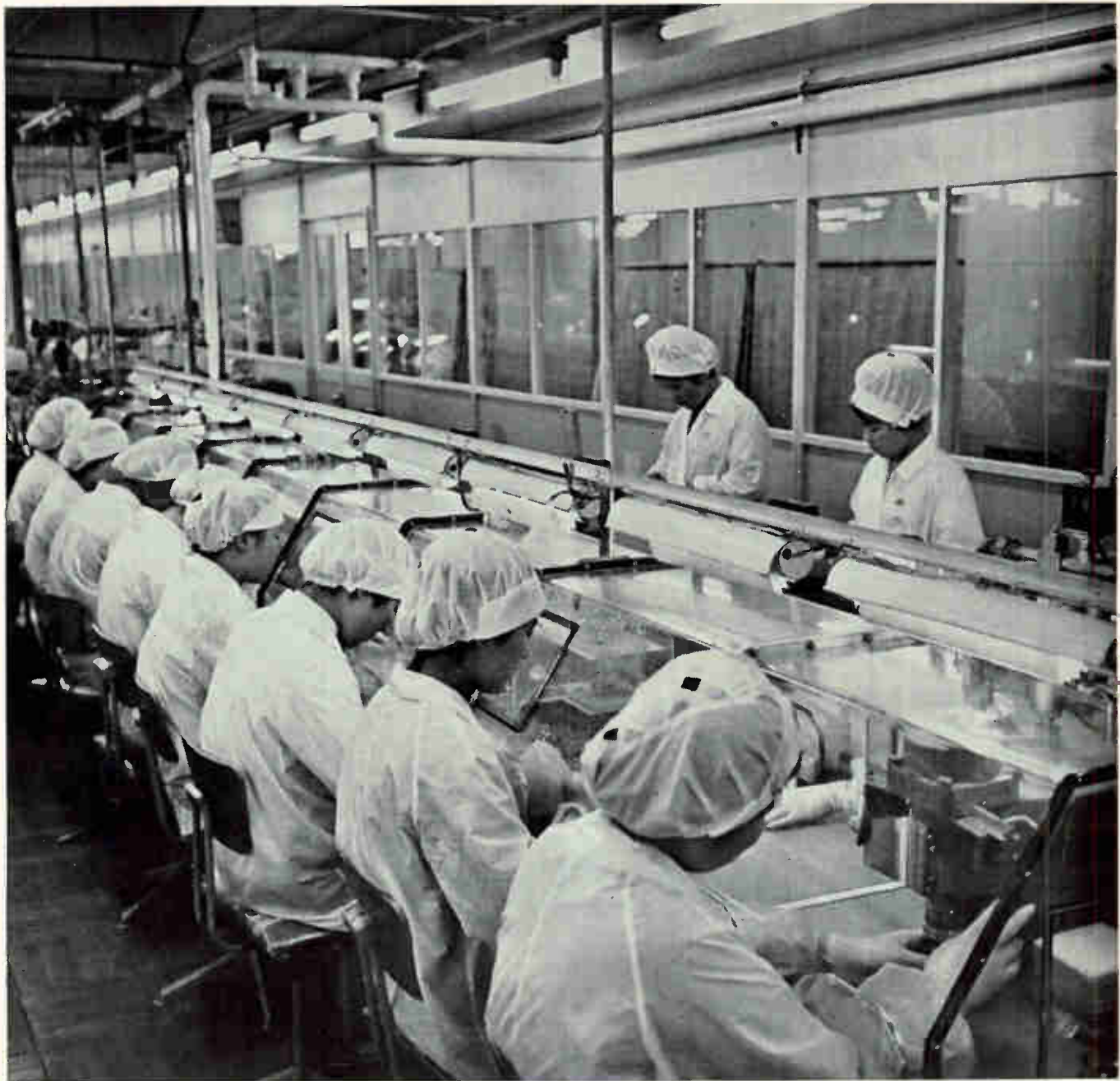
Albuquerque AX 9-8013	Los Angeles HI 6-6325
Boston CA 7-2980	Miami MI 4-3311
Chicago SP 7-2250	Minneapolis WE 9-0457
Cleveland GR 5-3080	New York LO 5-1820
Dallas EM 1-1765	Philadelphia TR 8-3737
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IN STOCK AT ITT DISTRIBUTORS:

- TWO TYPES—M-Type and P-Type, for applications from -55 to 85 and 125 C. respectively
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- COMPACT AND RUGGED—sintered tantalum slug in fine-silver cases for 2000-hour life at maximum temperature and working voltage
- GUARANTEED—to 80,000 ft. and accelerations of 20 G's with a 0.1 in. excursion in 50-2000 cps range
- LONG STORAGE LIFE—tantalum-oxide dielectric is completely stable; assures trouble-free operation

COMPLETE SPECIFICATIONS ON ITT wet- and solid-anode tantalum capacitors are available on request. Write on your letterhead, please, to the address below.

ENGINEERS: Your ITT representative has a complete set of qualifications and quality control tests for your inspection.



An NEC semiconductor device for every circuit application

The range of semiconductor products at NEC is perhaps the widest of any manufacturer. Entertainment or industrial, standard broadcast frequencies to microwave — NEC has a semiconductor device with the ratings and characteristics for your application. There's a wide selection of current ratings, operating temperatures, and mountings.

These are produced in NEC's

new semiconductor plant where crystal surfaces are cleaned by 100 tons of hyper pure water daily. Every seal is tested in krypton isotopes, providing a failure rate suitable for the most critical applications.

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- PNP super-grown Germanium transistors
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- Silicon rectifiers
- Silicon controlled rectifiers
- Silicon capacitors
- Zener diodes
- Germanium point-contact minidiodes
- Silver-bonded diodes
- Microwave mixer diodes
- Silicon junction mini-diodes

Reliability The first NEC transistorized carrier telephone system was an NT & T installation in 1958 between Toyama and Takaoka, a distance of 15 miles. It consists of 15 miles. It consists of two terminal stations and a repeater station with 240 channels using 1,600 transistors. During last 14,000 hours of operation transistor failure has caused only two channel faults. This corresponds to a failure rate of 0.009% per 1,000 hours.

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Communications Systems / Electronic Components



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Tokyo, Japan

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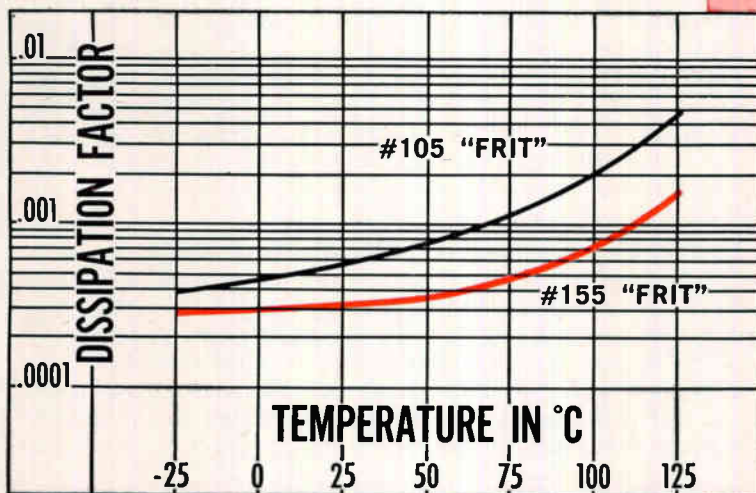


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CAPACITORS**

with NEW #155 "FRIT"

ASSURE 10 TIMES BETTER PERFORMANCE AFTER A LIFE TEST 10 TIMES MORE DEMANDING!

Three years of intensive product research, and the desire to impose a more exacting quality control during production, have resulted in the development of a new porcelain "frit." Completely formulated and produced within our own plant, this high quality dielectric material, utilized throughout the entire "VY" Porcelain Capacitor line, has produced dramatic results. After a Life Test, which has been made 10 times more stringent, both Dissipation Factor and Insulation Resistance have been improved by a factor of 10!



NOTE: Offered Exclusively For MIL-C-11272B Requirements.

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Axial Series
(Conforms with MIL-C-11272B)

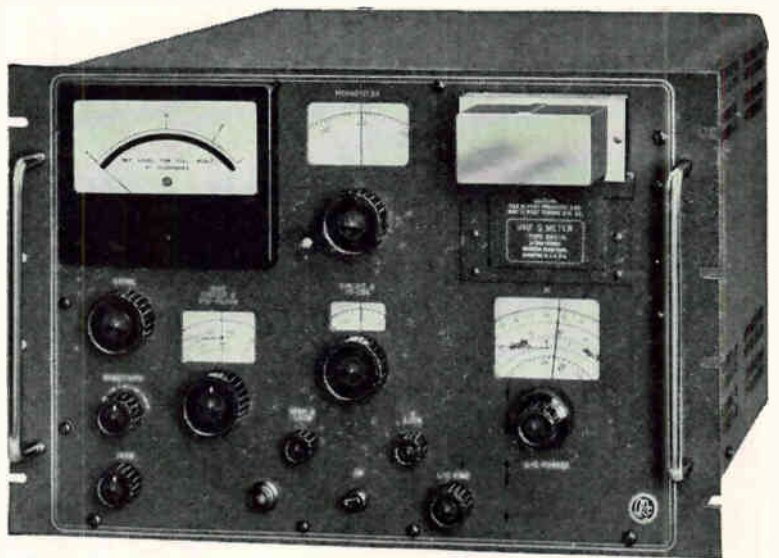
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Radial Series

End Radial Series

The exceptional performance of the new #155 "frit" is sharply drawn by this Comparison Curve. Low losses, particularly at high temperatures, do not increase significantly with life.

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UHF Q METER 210-

—measures **COMPONENTS,**
CAVITIES, SEMI-CONDUCTORS

Description

The new UHF Q Meter Type 280-A is a unique self-contained instrument for measuring the RF characteristics of components in the UHF range. The instrument consists of a specially designed oscillator, Q measuring circuit, and resonance indicator and, in application, is similar to its counterparts in the lower frequency ranges. In addition to performing conventional Q Meter measurements, in which the unknown component is resonated with the internal calibrated capacitor, the output of the oscillator and the input of the resonance indicator are available externally for directly measuring the Q of self-resonant devices.

The UHF Q Meter differs from conventional Q Meters in that it measures the actual percentage bandwidth of the resonance curve and, from this data, computes and reads out circuit Q. The test circuit is first tuned to resonance by adjusting oscillator frequency and/or resonating capacitance. The circuit is then detuned from the half-power point on one side of the resonance curve to the opposite half-power point by adjusting a calibrated dial, coupled to the oscillator frequency control, which directly reads out circuit Q.

Precision Electronic Instruments
since 1934



BOONTON RADIO

BOONTON, NEW JERSEY • Tel. DEERFIELD 4-3200

Specifications

Radio Frequency Characteristics

RF RANGE: 210 to 610 MC

RF ACCURACY: $\pm 3\%$

RF CALIBRATION: Increments of approximately 1%

RF MONITOR OUTPUT: 10 mv. minimum into 50 ohms*
*at frequency monitoring jack

Q Measurement Characteristics

Q RANGE:

Total Range: 10 to 25,000*

High Range: 200 to 25,000*

Low Range: 10 to 200

*10 to approx. 2,000 employing internal resonating capacitor

Q ACCURACY: $\pm 20\%$ of indicated Q

Q CALIBRATION:

High Q Scale: Increments of 1—5% up to 2,000

Low Q Scale: Increments of 3—5%

Inductance Measurement Characteristics

L RANGE: 2.5 to 146 m μ h*

*actual range depends upon measuring frequency

L ACCURACY: ± 11 to 15%*

*accuracy depends upon resonating capacitance

L CALIBRATION: Increments of approx. 5%

Resonating Capacitor Characteristics

CAPACITOR RANGE: 4 to 25 μ f

CAPACITOR ACCURACY: $\pm (5\% + 0.2 \mu$ f)

CAPACITOR CALIBRATION:

0.05 μ f increments, 4-5 μ f

0.1 μ f increments, 5-15 μ f

0.2 μ f increments, 15-25 μ f

Measurement Voltage Level

RF LEVELS: 25, 40, 80, 140, 250 mv. nominal*

*across measuring terminals

Physical Characteristics

MOUNTING: Cabinet for bench use; by removal of end covers, suitable for 19" rack mounting.

FINISH: Gray wrinkle, engraved panel (other finishes available on special order).

DIMENSIONS: Height: 12-7/32" Width: 19"

Depth: 17"

WEIGHT: Net: 72 lbs.

Power Requirements

280-A : 105-125/210-250 volts, 60 cps, 140 watts

280-AP: 105-125/210-250 volts, 50 cps, 140 watts

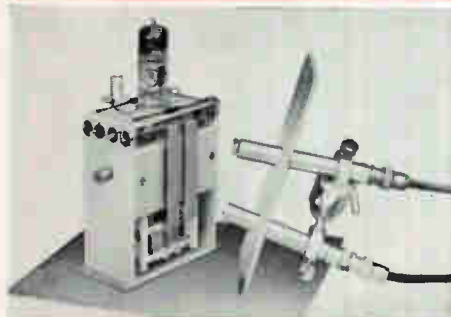
Price: 280-A: \$2,375.00 280-AP: \$2,375.00

F.O.B. Boonton, N. J.

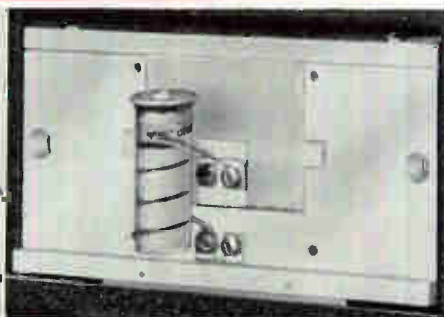
- 10-25,000 TOTAL Q RANGE
- SELF-CORRECTING UHF RESONATING CAPACITOR
- DIRECT-READING INDUCTANCE SCALE
- 25 MV RF MEASURING LEVEL
- MEASURES "IN-CIRCUIT" Q OF SELF-RESONANT CIRCUITS

-610 MC

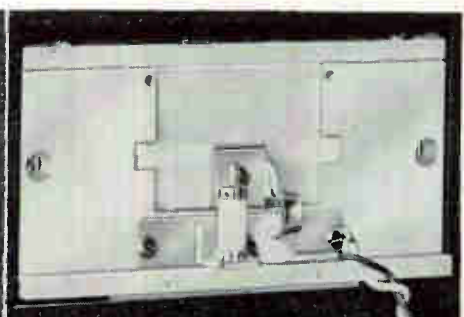
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"IN-CIRCUIT" Q MEASUREMENT



COIL MEASUREMENT



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CORPORATION



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March 10, 1961

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* MYLAR-PAPER DIPPED CAPACITORS

TYPE MFD

ASSURE A LOW FAILURE RATE OF Only 1 Failure in 7,168,000 Unit-Hours for 0.1 MFD Capacitors*

14,336,000

Setting A New High Standard Of Performance!

★ Life tests have proved that El-Menco Mylar-Paper Dipped Capacitors — tested at 105°C with rated voltage applied — have yielded a failure rate of only 1 per 1,433,600 unit-hours for 1.0 MFD. Since the number of unit-hours of these capacitors is inversely proportional to the capacitance, 0.1 MFD El-Menco Mylar-Paper Dipped Capacitors will yield ONLY 1 FAILURE IN 14,336,000 UNIT-HOURS.

CAPACITANCE AND VOLTAGE CHART

• Five case sizes in working voltages and ranges:

200 WVDC —	.018 to .5 MFD
400 WVDC —	.0082 to .33 MFD
600 WVDC —	.0018 to .25 MFD
1000 WVDC —	.001 to .1 MFD
1600 WVDC —	.001 to .05 MFD

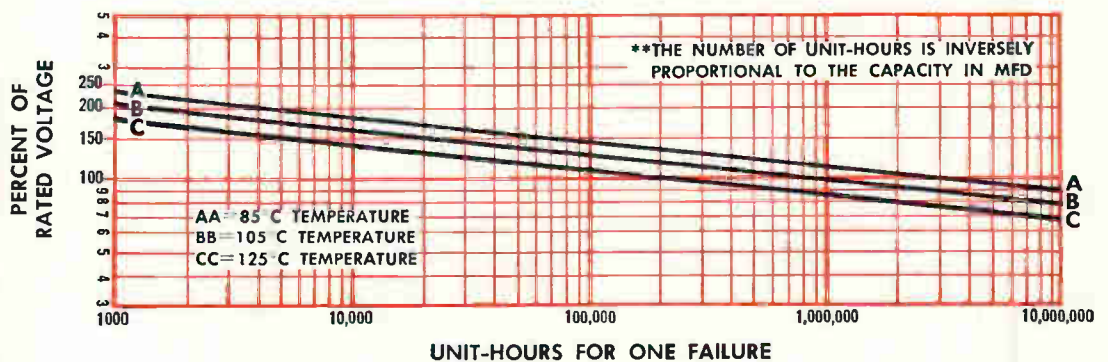
SPECIFICATIONS

- **TOLERANCES:** 10% and 20%. Closer tolerances available on request.
- **INSULATION:** Durez phenolic, epoxy vacuum impregnated.
- **LEADS:** No. 20 B & S (.032") annealed copper clad steel wire crimped leads for printed circuit application.
- **DIELECTRIC STRENGTH:** 2 or 2½ times rated voltage, depending upon working voltage.
- **INSULATION RESISTANCE AT 25°C:** Far .05MFD or less, 100,000 megohms minimum. Greater than .05MFD, 5000 megohm-microfarads.
- **INSULATION RESISTANCE AT 105°C:** Far .05MFD or less, 1400 megohms minimum. Greater than .05MFD, 70 megohm-microfarads.
- **POWER FACTOR AT 25°C:** 1.0% maximum at 1 KC

These capacitors will exceed all the electrical requirements of E. I. A. specification RS-164 and Military specifications MIL-C-91B and MIL-C-25C.

Write for Technical Brochure

MINIMUM LIFE EXPECTANCY FOR **1.0 MFD* MYLAR-PAPER DIPPED CAPACITORS AS A FUNCTION OF VOLTAGE & TEMPERATURE



*Registered Trade Mark of DuPont Co.

THE ELECTRO MOTIVE MFG. CO., INC.

Manufacturers of El-Menco Capacitors

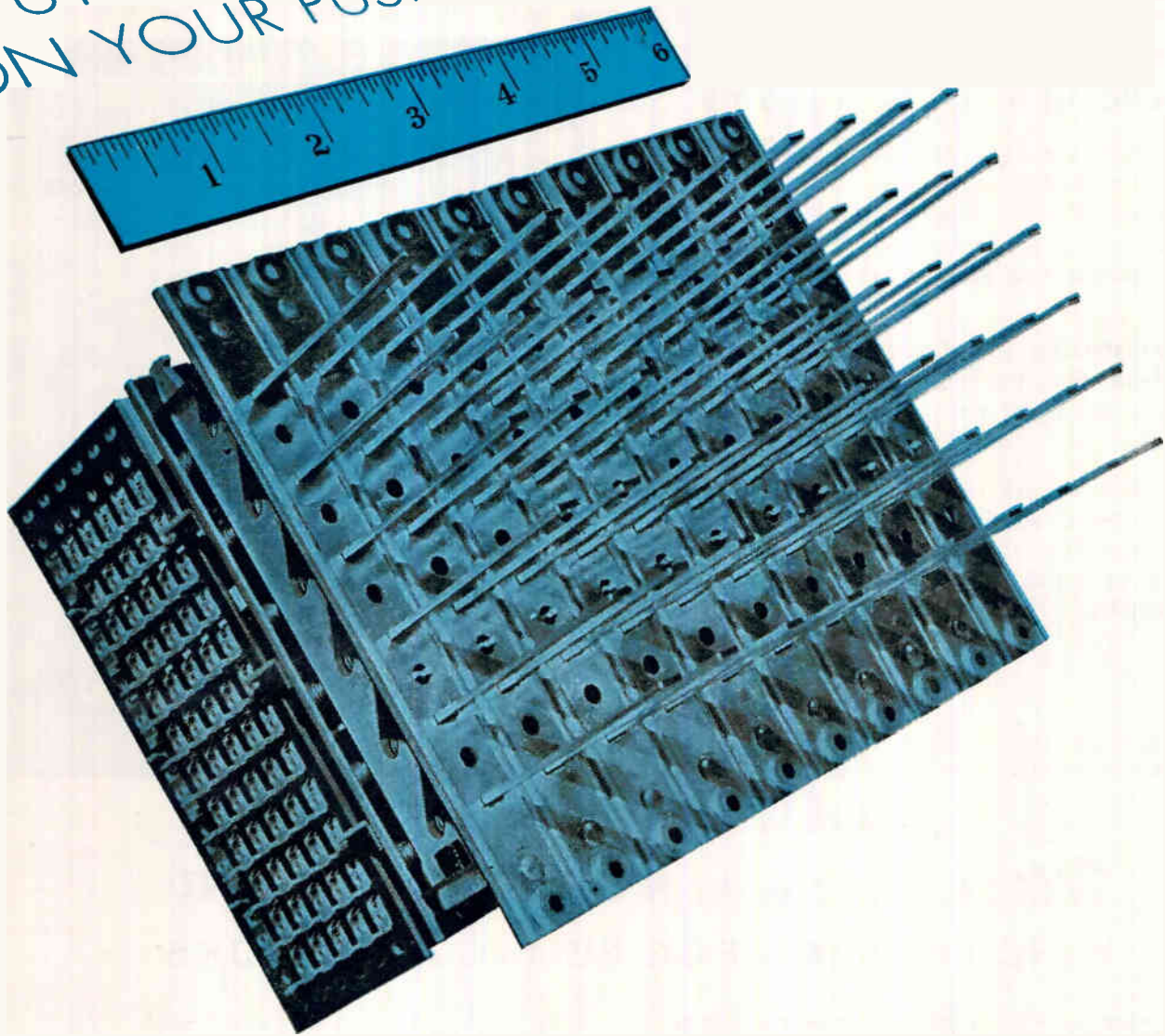
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OAK TYPE 131 PUSHBUTTON SWITCHES will help you make the most of limited panel space. Only $\frac{1}{8}$ -in. thick, these switches can be mounted on $\frac{1}{16}$ in. centers; a stack of 10 separate gangs of switches requires only $6\frac{13}{16}$ -in. of panel space. Use Type 131 switches for handling low-power switching in computers, office equipment, communications devices, automatic coin-operated machines and many other military or commercial applications.

Available with from one to 12 buttons having up to 14 contacts per button. "Floating slider" design operates at lighter pressure per number of contacts than conventional pushbutton switches. Oak's vigorous research and testing, careful selection of materials, precision manufacture and quality control assure long operating life with minimum failure. Contact your local Oak sales representative or write for Oak's comprehensive 4th Edition General Switch Catalog.



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HEADED WIRES by ASTRON

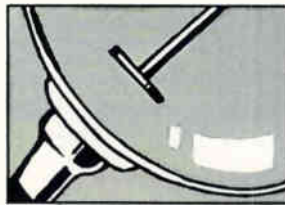

FOR QUARTZ-CRYSTALS AND SEMI-CONDUCTORS

Headed Wires are used as current leads on quartz crystals. The head is soldered or fixed to a silver or alloyed layer. Material temper, flatness of head and general uniformity are highly critical. Extensive control during manufacturing assures users of constant high quality.

Standard material used is bronze, either silver or gold plated. Head diameter is 2-3 times the diameter of wire size. A variety of sizes are available from stock, gold plated.

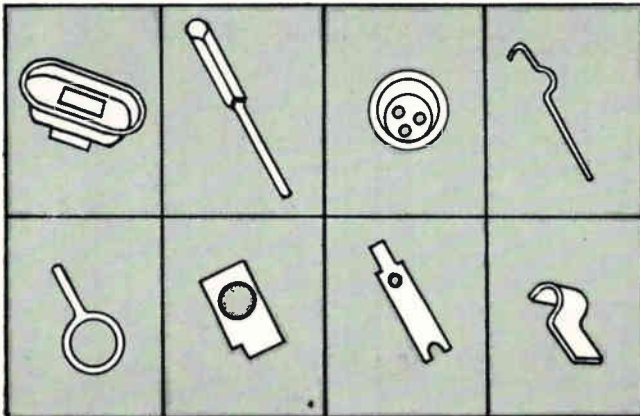
Upon request we are ready to manufacture headed wires produced of special alloys in any desired dimension or shape. The table shows the dimensions of the headed wires which generally are used in the electronic industry.

Illustration at right shows the high quality and precision in head flatness

Stock sizes in inches		
A - 10%	B + 2%	C + 0.020"
2-3xB	0.0035	1/2 to 1"
2-3xB	0.005	1/2 to 1"
2-3xB	0.006	1/2 to 1"
2-3xB	0.0063	1/2 to 1"
2-3xB	0.008	1/2 to 1"
2-3xB	0.010	1/2 to 1"
2-3xB	0.012	1/2 to 1"
2-3xB	0.016	1/2 to 1"
2-3xB	0.020	1/2 to 1"
2-3xB	0.024	1/2 to 1"

Ultra Precision METAL STAMPING AND WIRE FORMING FOR SEMI-CONDUCTORS



Magnified 5 to 20 times are a few of the many minute parts we fabricate in large quantities for the semiconductor and associated industries.

Made to close tolerances at low cost are, tubulated wires - spring leads - angle wire - caps - base tabs - clips and leads.

We are proud of our 25 years of experience in serving the electronics industry.

ASTRON
PARTS DIVISION

ELECTRO-DYNAMICS CORP.

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HIALEAH, FLORIDA

Telephone MU 1-4613

Cable: ASTRODYN



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TYPE AVAILABLE

The world-famous **AEROCOM 1046 TRANSMITTER**

1000 W CARRIER POWER WITH HIGH STABILITY

The AeroCom 1046 Transmitter is designed to give superior performance for all point-to-point and ground-to-air communications. It is now in use throughout the world in climates ranging from frigid to tropical (operates efficiently at -35° to $+55^{\circ}$ Centigrade).

As a general purpose High Frequency transmitter, the 1046 supplies 1000 watts of carrier power with high stability (above -10° Centigrade: $\pm .003\%$ for telegraph and telephone. Temperature controlled oven for FSK). Multi-channel operation is provided on

telegraph A1, telephone A3 and FSK (Radio Teletype). It can be remotely controlled using one pair of telephone lines plus ground return with AeroCom Remote Control Equipment. Front panel switches and microphone are included for local control.

Four crystal-controlled frequencies (plus 2 closely-spaced frequencies) in the 2.0 - 24.0 megacycle range can be used one at a time, with channeling time only two seconds. Operates into either balanced or unbalanced loads. The power supply required is nominal 230 volts, 50 - 60 cycles, single phase.

The housing is a fully enclosed rack cabinet of welded steel, force-ventilated through electrostatic filter on rear door.

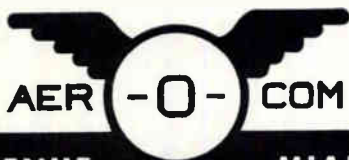
Telegraph keying (A1): Up to 100 words per minute. Model 1000 M Modulator (mounts in trans-

mitter cabinet) is used for telephone transmission; a compression circuit permits the use of high average modulation without over-modulation. Model 400 4 Channel exciter is used for FSK.

Output connections consist of 4 insulated terminals (for Marconi antenna) and 4 coaxial fittings Type SO-239, which can be used separately or in parallel in any combination. For 600 ohm balanced load, Model TLM matching network is used, one for each transmitter channel.

As in all AeroCom products, the quality and workmanship of Model 1046 are of the highest. All components are conservatively rated. Replacement parts are always available for all AeroCom equipment.

Complete technical data on AeroCom Model 1046 available on request.

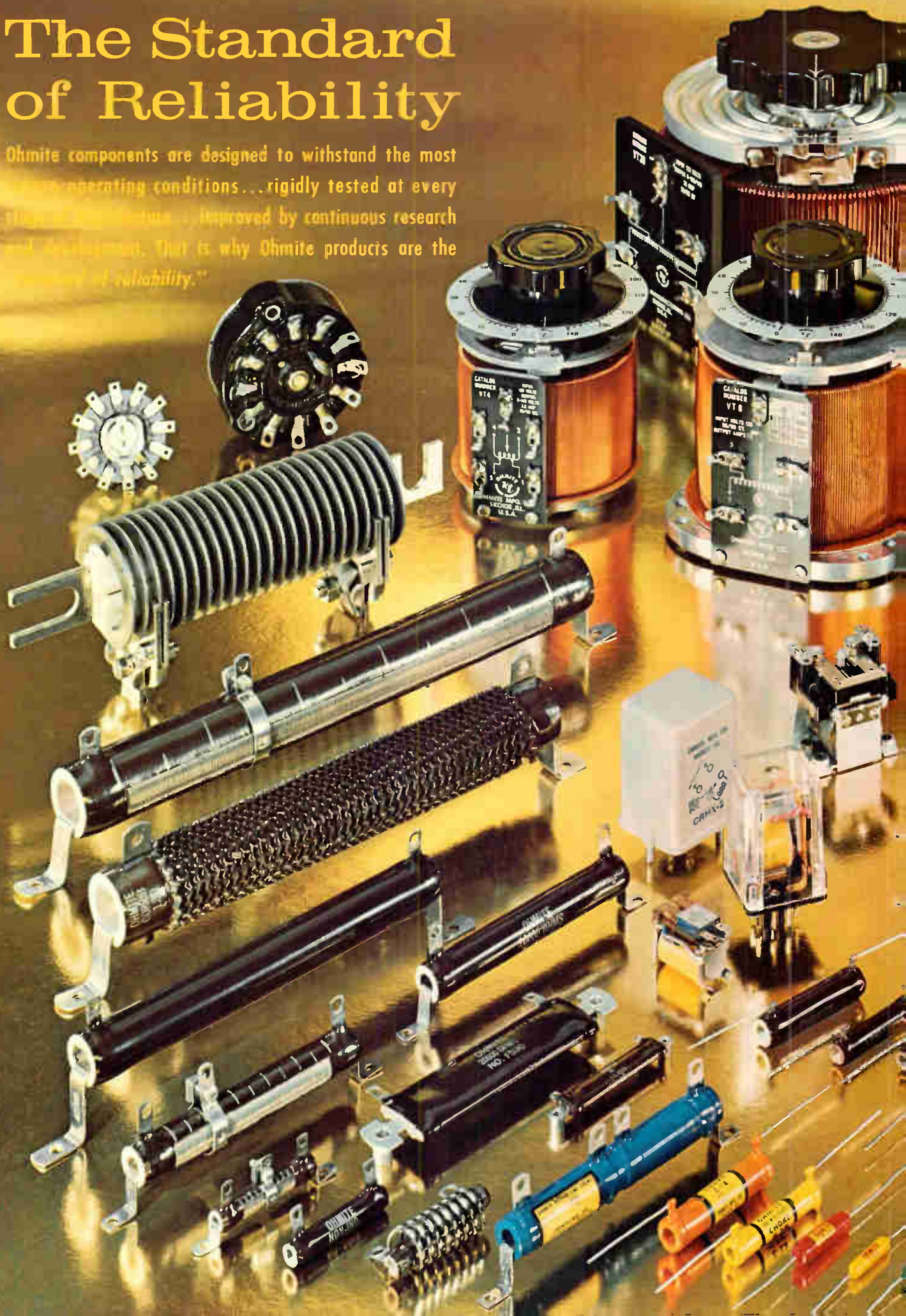


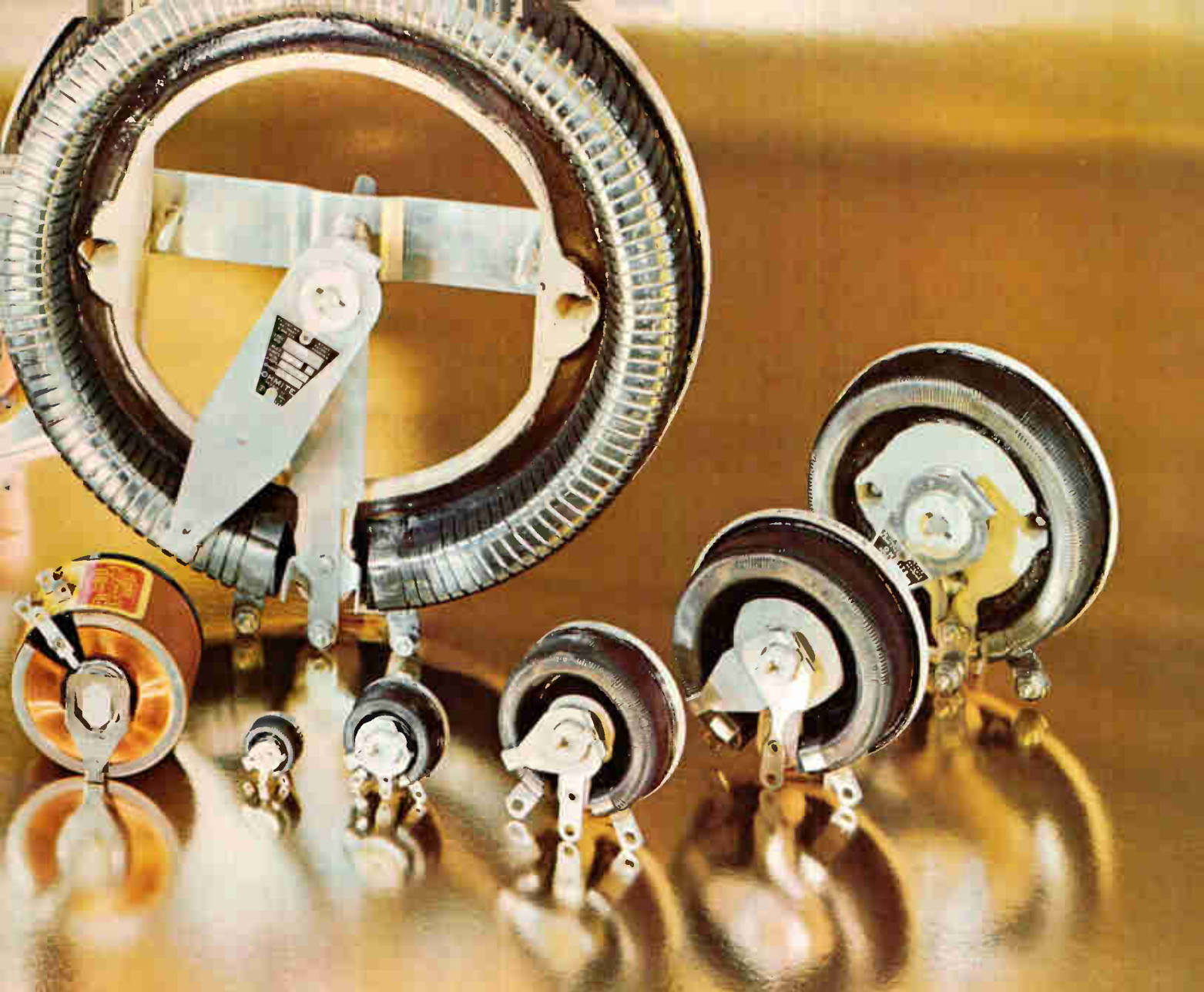
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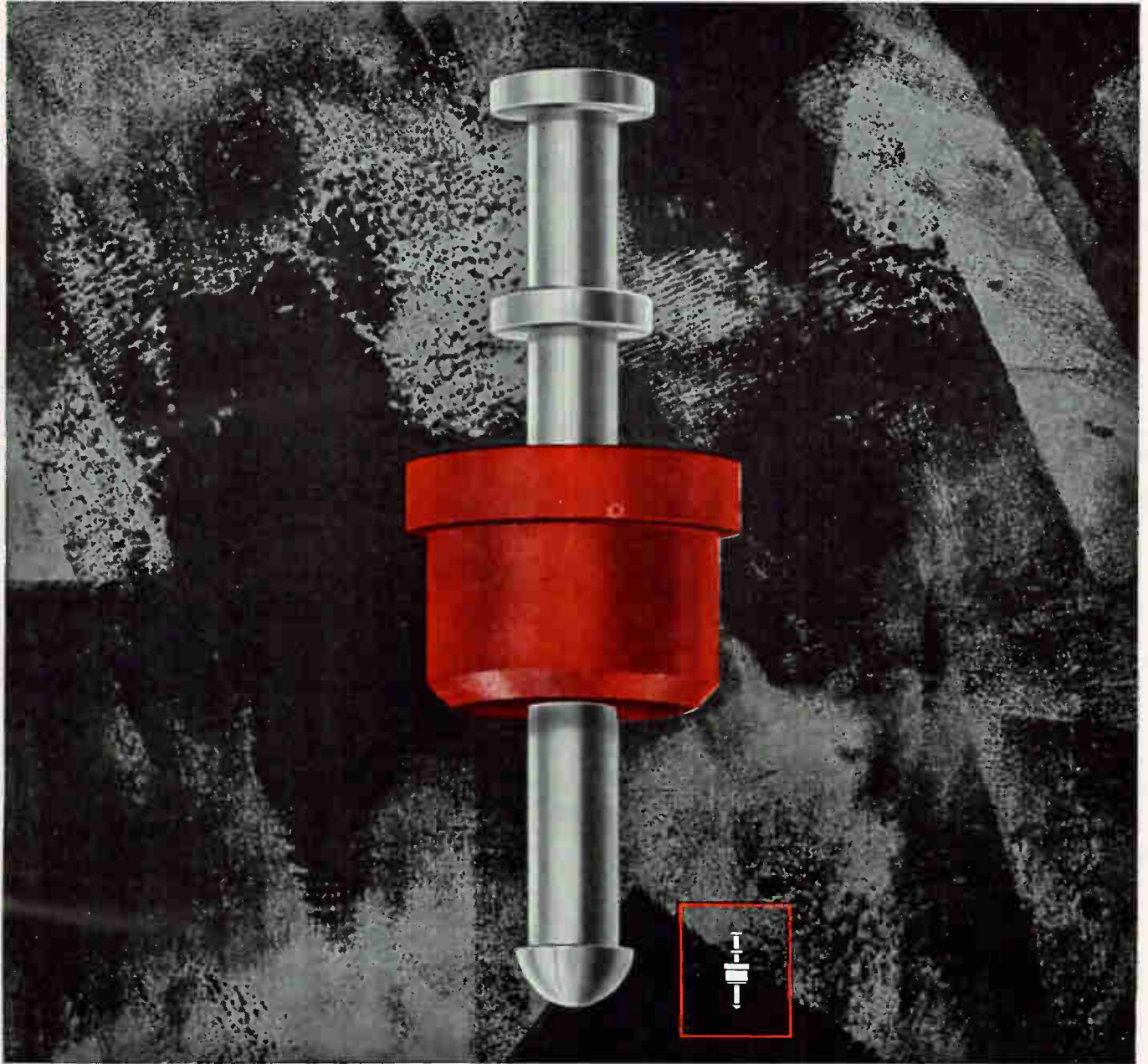
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Serving the Top-of-the-South with 2,086,000 kilowatts—due to reach 2,720,000 kilowatts by 1963.



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*Reg. T.M. of E. I. DuPont de Nemours & Co., Inc.

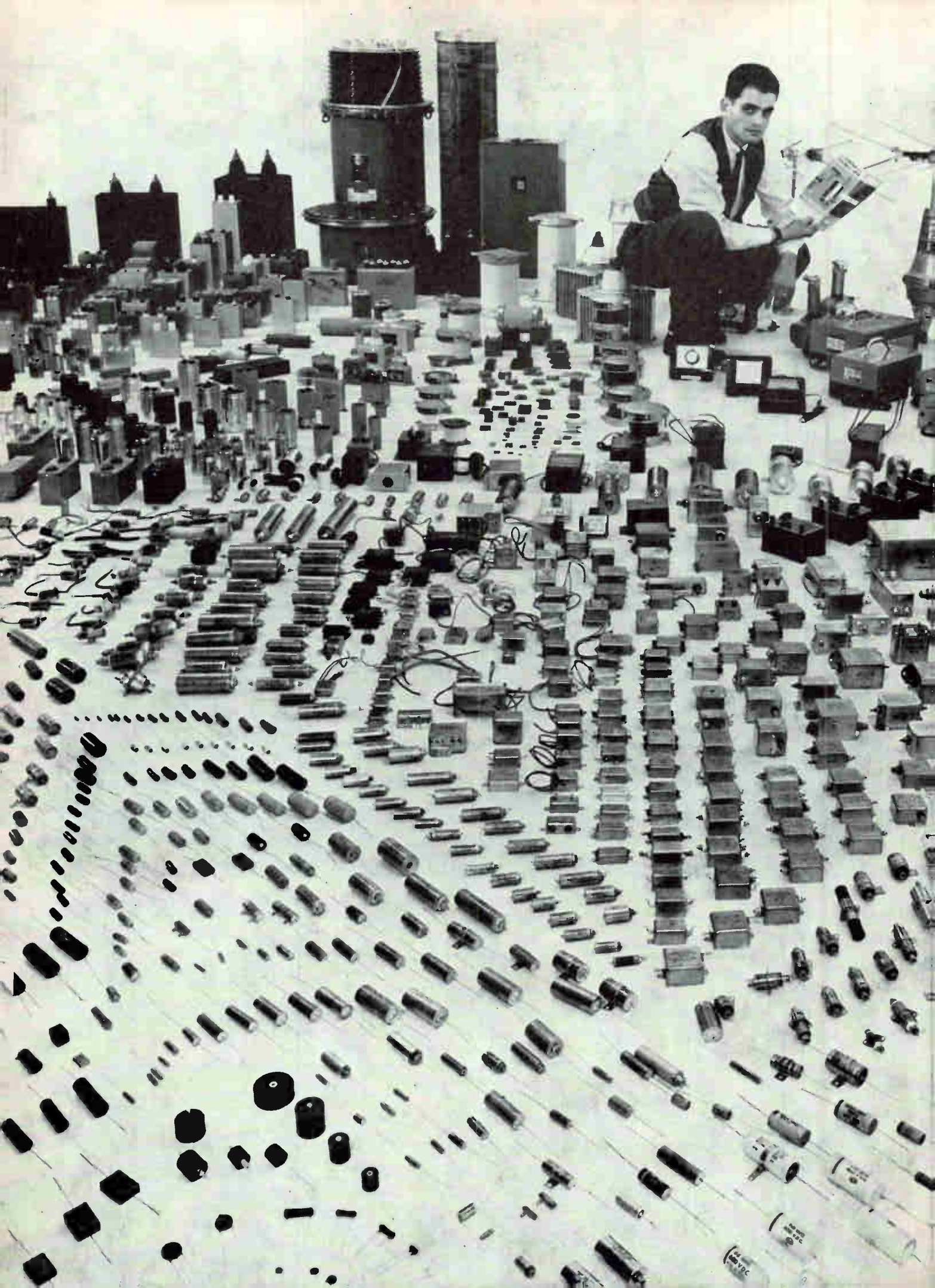


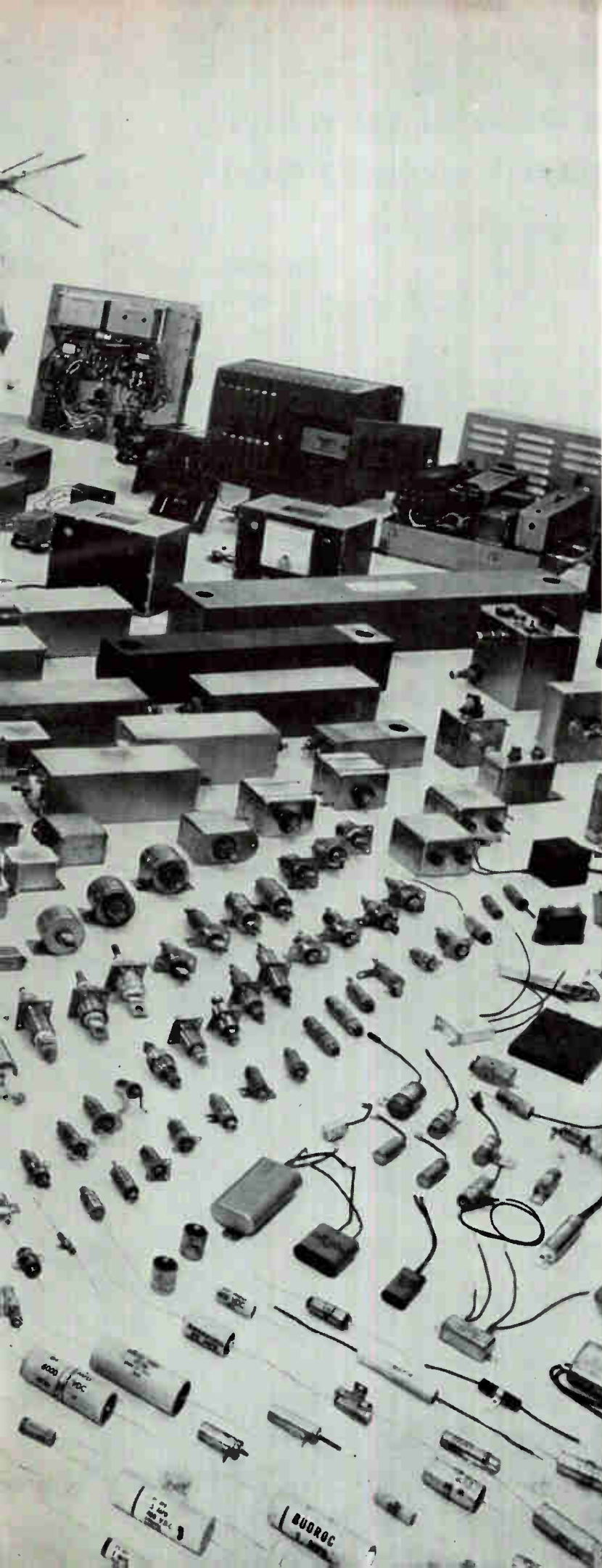
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over
3,500,000,000
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For over fifty years, Cornell-Dubilier has specialized in the design, production and distribution of capacitors. William Dubilier is regarded throughout the world as the "Father of the Capacitor Industry." From a modest beginning in 1910, CDE has continued as the leader in this important phase of electronic components pioneering.

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NEW! Self-Check Rate of Turn Gyro Tells you "GO!" or "NO GO!"


Here is built-in reliability you can depend on. Just prior to flight, when it really counts, you can determine whether the new Honeywell Rate of Turn Gyroscope, Model JRS Series, is functioning properly by just pressing a switch . . . Green light — "GO!" . . . Red light — "NO GO!" It's just that simple. In missile applications, it can be even simpler. Manual "press-to-test" can be eliminated by programming an automatic gyro integrity check into the countdown network.

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Viscous damping is temperature compensated to maintain a virtually constant damping ratio over the entire operating temperature range of -65°F to $+160^{\circ}\text{F}$.

Honeywell inertial components and engineering experience are available to assist in the solution of your gyro problems. Write for Bulletin JRS to Minneapolis-Honeywell, Boston Division, Dept. 7, 1400 Soldiers Field Road, Boston 35, Mass., or call your local Military Products Group office. Sales and Service offices in all principal cities of the world.

Honeywell

 *Military Products Group*



Honeywell Rate Gyro,
Type JRS Series.
Shown approx. 1/2 size

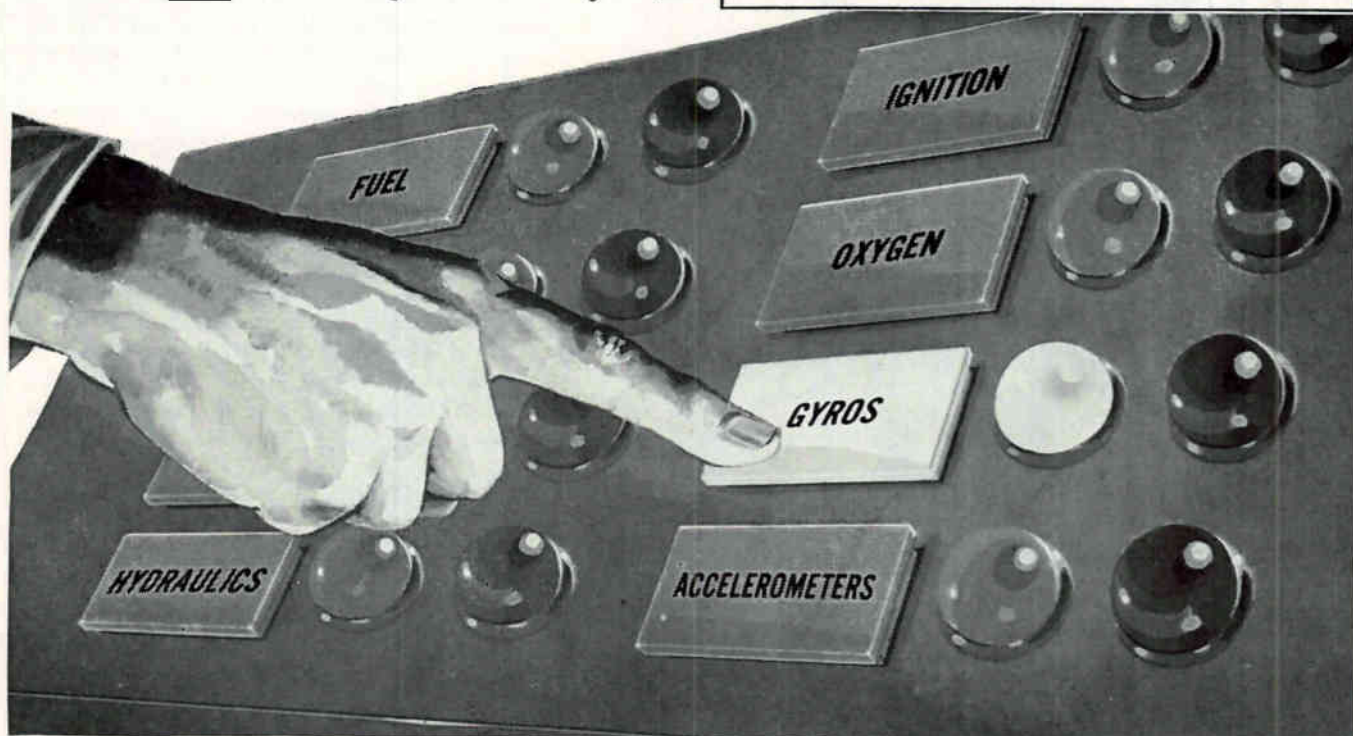
PERFORMANCE DATA

- **EXCELLENT LINEARITY:** As low as 0.25% of full scale
- **LOW HYSTERESIS:** Less than 0.1% of full scale
- **LOW THRESHOLD:** Less than 0.01 degree/second
- **MICROSYN PICKOFF:** Variable reluctance type providing infinite resolution and high signal-to-noise ratio
- **FULL SCALE RATE:** As low as 10 degree/second
- **FULL SCALE OUTPUT:** Up to 15 volts
- **RUGGED:** Withstands 100 G shock
- **VIBRATION:** Operates at 12 G to 2,000 cps
- **SIZE:** 2.11" diam. x 4.60" long
- **WEIGHT:** 2.2 lbs.

Consult Honeywell for your specific gyro requirements

Self-Check Feature Is Used to Determine that:

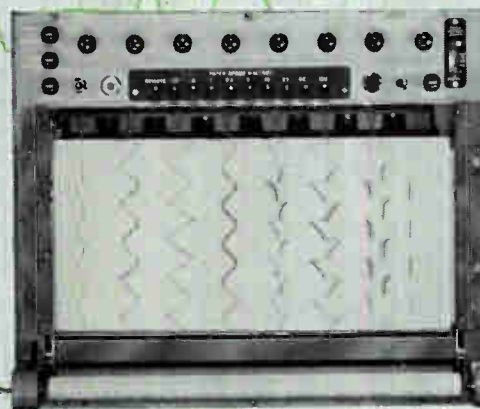
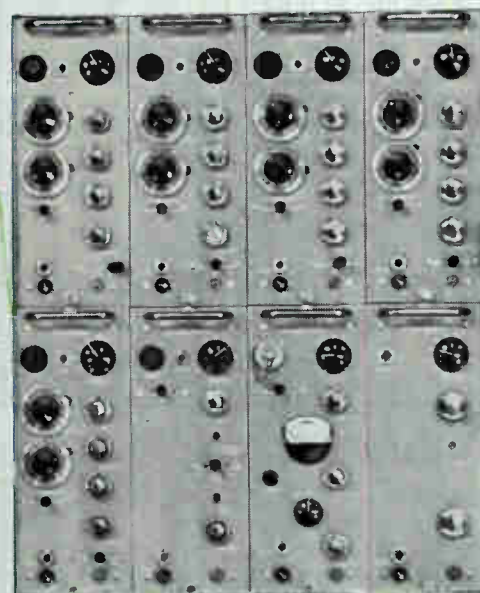
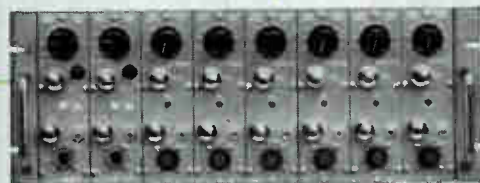
- (a) Gimbal is free to rotate
- (b) Restraining Spring is able to return gimbal to zero position
- (c) Pickoff generates proper signal, proportionate to gimbal deflection
- (d) Gimbal Deflection is proportionate to given torque exerted upon it
- (e) Gyro Wheel rotates at proper speed
- (f) Damping Ratio of gyro is within acceptable limits



Sanborn

has probably already designed
your "custom"
oscillographic
recording system

"Building block" recorder and amplifier design permits maximum flexibility to meet specific application needs



950 Series — truly low cost — identical channels

6 or 8 identical DC recording channels — either high gain, 10 uv/div; medium gain, 0.5 mv/div; or low gain, 10 mv/div. Medium and high gain types are completely transistorized, have floating and guarded input circuits. Frequency response DC to 150 cps within 3 db, 10 div peak-to-peak with low and medium gain systems, to 100 cps with high gain system. Amplifier panel space only 7" x 19", recorder 17½" x 19".

850 Series — economical, flexible — miniature plug-in preamps

Interchangeable plug-in preamps, eight to a 7" high module, available in Phase Sensitive Demodulator, DC Coupling, Carrier and Low Level types. System response to 150 cps within 3 db, 10 div peak-to-peak, depending on preamps used. Input circuits single-ended, push-pull, or floating and guarded, depending on choice of preamp.

350 Series — versatile, high performance — interchangeable preamps

Provides greatest possible application flexibility, with interchangeable preamps in Carrier, DC Coupling, Phase Sensitive Demodulator, Differential DC, Low Level, Logarithmic and Frequency Deviation types. System response DC to 150 cps within 3 db at 10 div peak-to-peak — input single-ended, floating and guarded, or push-pull — depending on pre-amplifier used. Eight preamps in two 4-unit modules occupy 21" x 19" of panel space; usable separately with individual power supplies to drive meters, 'scopes, etc.

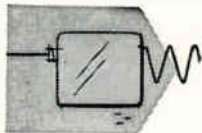
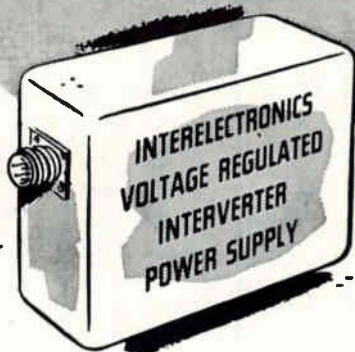
"350" style Recorder Assembly — used in all the above systems. Provides transistorized, plug-in, current-feedback power amplifiers . . . low impedance, velocity feedback damped galvanometers . . . 8" of visible record . . . 9 electrically controlled chart speeds . . . inkless traces on rectangular coordinate charts . . . flush front recorder, vertical chart plane. Recorders with horizontal chart plane also available for 350, 850 and 950 systems.

Sanborn oscillographic recording systems also include the tube-type 1- to 8-channel "150" Series with 12 plug-in preamplifiers; and the "650" 1- to 24-channel optical oscillograph with response to 5 KC and 8-channel amplifier available separately for driving any galvanometer. For complete data contact one of the Sanborn Sales-Engineering representatives located in principal cities throughout the United States, Canada and foreign countries.

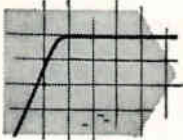
SANBORN COMPANY
INDUSTRIAL DIVISION;
175 Wyman Street, Waltham 54, Massachusetts

SEE THIS EQUIPMENT AND OTHER SANBORN OSCILLOGRAPHIC RECORDING SYSTEMS, AMPLIFIERS AND TRANSDUCERS ON DISPLAY AT BOOTHS 3701-03-05, I.R.E. SHOW, NEW YORK COLISEUM, MARCH 20-23.

**PROVEN RELIABILITY—
SOLID-STATE POWER INVERTERS,**
over 260,000 logged operational hours—
voltage-regulated, frequency-controlled,
for missile, telemeter, ground support,
135°C all-silicon units available now—



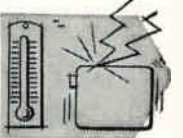
Interelectronics all-silicon thyatron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.



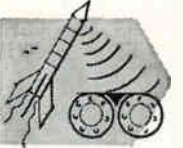
Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. High conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry.)



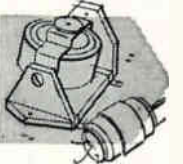
Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.)



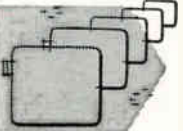
Complies with MIL specs. for shock (100G 11 msec.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).



AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit or actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.



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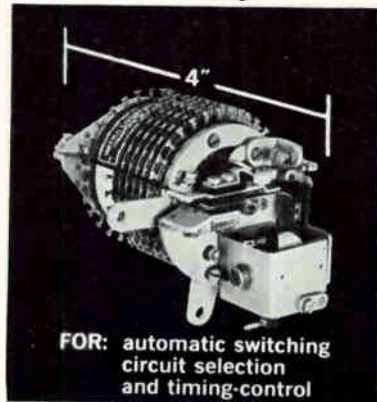


Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how—has designed and delivered more working KVA than any other firm!

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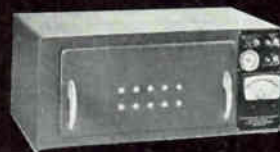
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ACCURATE TEMPERATURE CONTROL, without overshoot and without drift.

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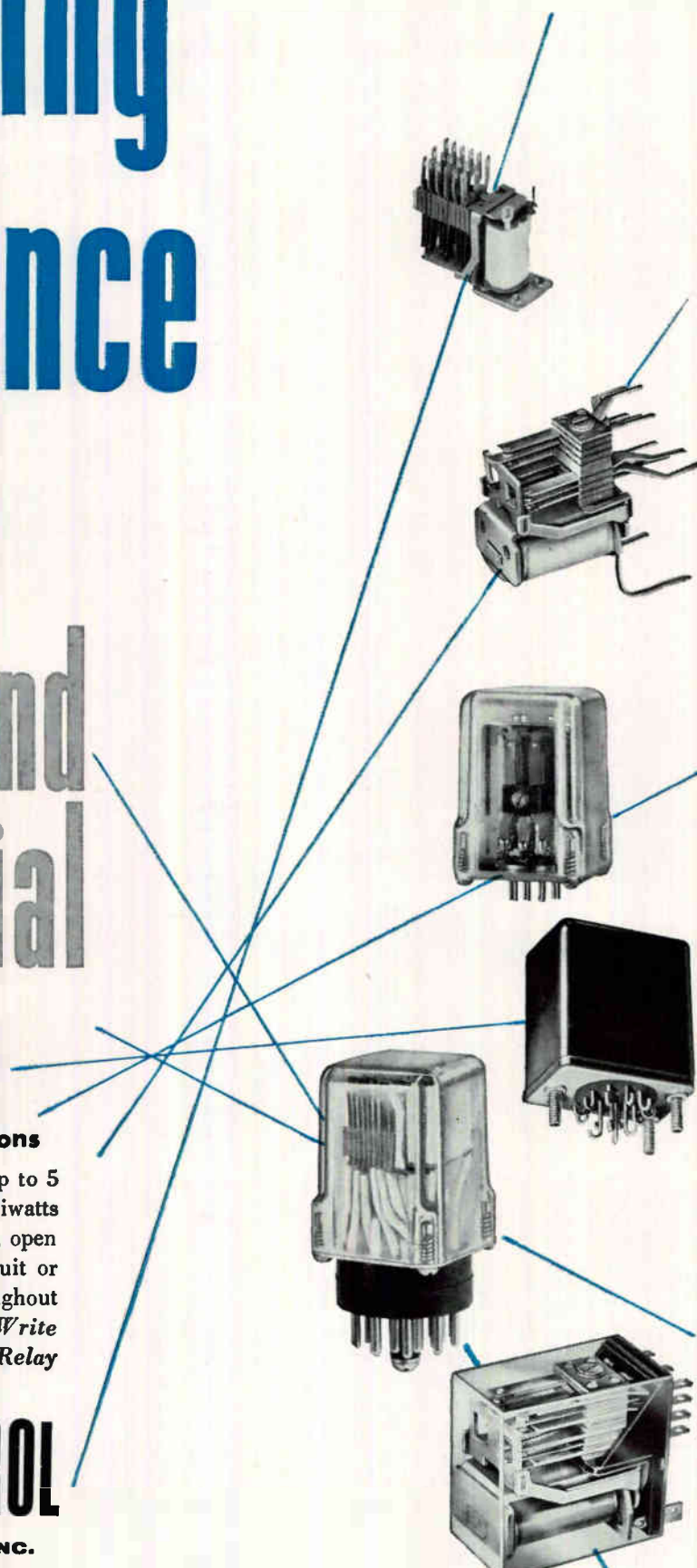
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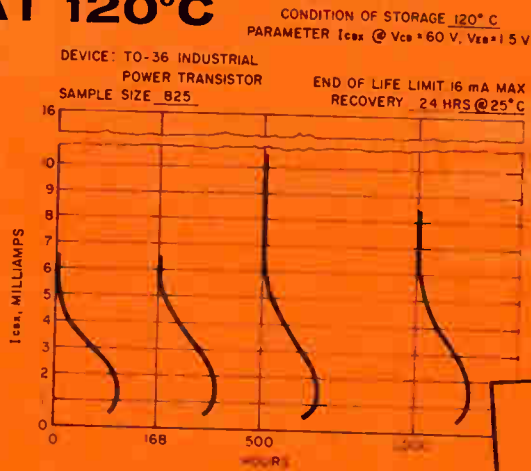


AL810

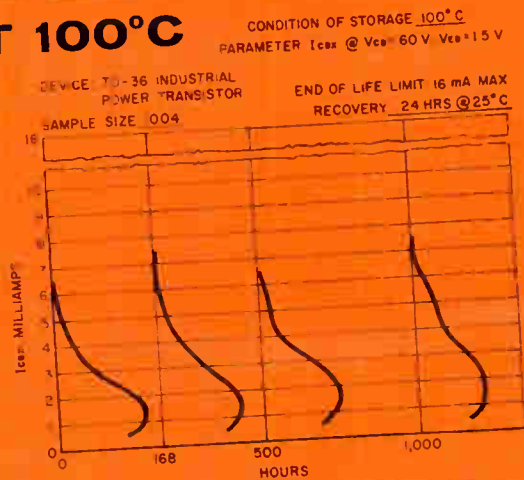
UNVARYING HIGH-QUALITY PERFORMANCE EVEN AT 20°C ABOVE T_J MAX.



AT 120°C



AT 100°C



MOTOROLA POWER TRANSISTORS

The parameter distribution shown in these 1000-hour 100°C and 120°C storage life tests exhibits a high degree of stability... the key to product reliability and dependability in your circuits. Even after extended life testing at an elevated temperature of 120°C (20°C above the suggested maximum rating), these units continue to exhibit tight distribution within originally stated limits... positive assurance of unvarying high-quality performance of Motorola Power Transistors.

This data, taken on random samples of production lots of Motorola 2N174 power transistors, is typical of the 100%

lot life-tests conducted as part of Motorola's multi-million dollar reliability program. Starting with power transistors designed for reliability, Motorola follows through with unique production know-how, intensive quality control and comprehensive life and environmental testing.

Successful equipment design demands dependable components. When you use Motorola Power Transistors you know you are obtaining outstanding product reliability... a quality assured by one of the industry's most advanced reliability programs.

PERFORMANCE LEADERSHIP

Motorola power transistors offer you outstanding design advantages. The "low silhouette" TO-36 devices offer the industry's highest power dissipation for germanium power transistors... 150 watts, with an exceptional maximum thermal resistance of 0.5°C/W and a typical thermal resistance of 0.35°C/W. The TO-3 devices offer a 90 watt power dissipation capability and 0.8°C/W maximum thermal resistance... industry's best for this package design. Both units are rated for 100°C continuous junction operation.

WIDE SELECTION

Motorola provides a *standard* power transistor for nearly all of your design requirements. Over 100 different devices are offered in both the TO-3 "diamond" and TO-36 "doorknob" packages. Current ratings of 3, 5, 10, 15, and 25 amps, available with collector voltages to 120 volts. You have your choice of a variety of gain/voltage combinations to match your specific amplifier or switching circuit demands.

COMPLETE SPECIFICATIONS

Complete design information is available on each Motorola industrial power transistor. The industry's most comprehensive specification data sheets provide all essential details including: voltage characteristics, typical product traits, safe operating areas and power derating. In addition, Motorola provides competent applications assistance through published bulletins and personal consultation.

IMMEDIATE AVAILABILITY

Motorola industrial power transistors are available from stock in quantities up to 999 from 24 industrial distributors. Military-qualified units are also available through authorized distributors.

FOR ADDITIONAL INFORMATION



on Motorola Power Transistors write for technical literature. Address inquiries to Technical Information Department, Motorola Semiconductor Products Inc, 5005 East McDowell, Phoenix, Arizona. Please specify information desired.

MOTOROLA "LOW SILHOUETTE" TO-36 POWER TRANSISTORS



- 40 to 100 volts • 0.5°C/W maximum thermal resistance
- 150 watt power dissipation • 100°C junction temperature

15 AMP

h_{FE}	BV_{CEB}				
($V_{CE} = 2V, I_C = 5A$)	40 V	50 V	60 V	80 V	100 V
20 - 40	2N441	2N442	2N443	2N174**	2N1100**
35 - 70	2N277	2N278	2N173	2N1099	—

** h_{FE} 25 - 50

MOTOROLA TO-3 POWER TRANSISTORS



- up to 120 volts • 0.8°C/W maximum thermal resistance
- 90 watt power dissipation • 100°C junction temperature

3 AMP

h_{FE}	BV_{CEO}			
($V_{CE} = 4V, I_C = 1A$)	50 V	80 V	100 V	120 V
60 - 140	2N1360	2N618	2N1363	2N1365
35 - 90	2N1359	2N375	2N1362	2N1364

5 AMP

h_{FE}	BV_{CEO}				
($V_{CE} = 2V, I_C = 3A$)	40 V	60 V	80 V	100 V	120 V
75 - 150	2N1544*	2N1545*	2N1546*	2N1547*	2N1548
50 - 100	2N1539*	2N1540*	2N1541*	2N1542*	2N1543
35 - 70	2N1534*	2N1535*	2N1536*	2N1537*	2N1538
20 - 40	2N1529*	2N1530*	2N1531*	2N1532*	2N1533

10 AMP

h_{FE}	BV_{CEO}			
($V_{CE} = 2V, I_C = 10A$)	40 V	60 V	80 V	100 V
10 - 30 **TO-3 with solder lugs	2N627**	2N628**	2N629**	2N630**
10 - 30	MN61A	MN62A	MN63A	MN64A

15 AMP TO-3 packages with solder lugs also available

h_{FE}	BV_{CEO}			
($V_{CE} = 2V, I_C = 10A$)	40 V	60 V	80 V	100 V
50 - 100	2N1557*	2N1558*	2N1559*	2N1560*
30 - 60	2N1553*	2N1554*	2N1555*	2N1556*
10 - 30	2N1549*	2N1550*	2N1551*	2N1552*

25 AMP TO-3 package with solder lugs available

h_{FE}	BV_{CEO}		
($V_{CE} = 1V, I_C = 25A$)	50 V	80 V	100 V
15 - 65	2N1162*	2N1164*	2N1166*

MOTOROLA MILITARY POWER TRANSISTORS

	BV_{CEO}	h_{FE}/I_C		BV_{CEO}	h_{FE}/I_C
JAN 2N174	80 V**	40-80/1.2A	2N1120 (Sig C)	80 V	10-50/10 A
2N297A (Sig C)	80 V	20 min/2 A	2N1120	80 V	10-50/10 A
2N297A	80 V	20 min/2 A	2N1358 (Sig C)	80 V**	40-80/1.2 A
2N1011 (Sig C)	80 V	30-75/3 A	2N1412 (USN)	100 V**	25-50/5A
2N1011	80 V	30-75/3 A			** BV_{CB}



*An "A" series of these devices is offered under the Motorola "Meg-A-Life" program... providing certified military-quality units for industrial applications.



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Semiconductor Products Inc.

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Regardless of its size,
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any crystal
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McCoy
can be relied upon to
deliver the ultimate
in frequency control
despite wide temperature
variations and
extreme conditions
of shock
and vibration.

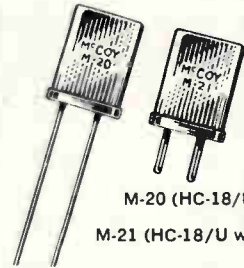


M-1 (HC-6/U)

The crystals that made the name of McCoy a synonym for quality. Metal encased, HC-6/U size is available in frequencies from 500.0 kc to 200.00 mc.

METAL ENCASED STANDARD SIZE AND MINIATURE CRYSTAL UNITS

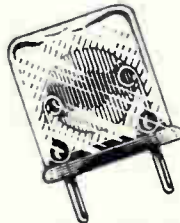
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M-20 (HC-18/U)

M-21 (HC-18/U w/pins)

Fills the need for miniature crystals in frequencies from 2.5 mc to 200.0 mc. Meets specs MIL-C-3098B and ARINC No. 401.



G-1 (Military HC-27/U)

This vacuum sealed, hard glass crystal unit possesses all of the quality features for which the McCoy M-1 is so famous. It has long term frequency stability five times better than the conventional metal types. Available in frequencies from 500 kc to 200 mc.

ALL GLASS STANDARD SIZE AND MINIATURE CRYSTAL UNITS

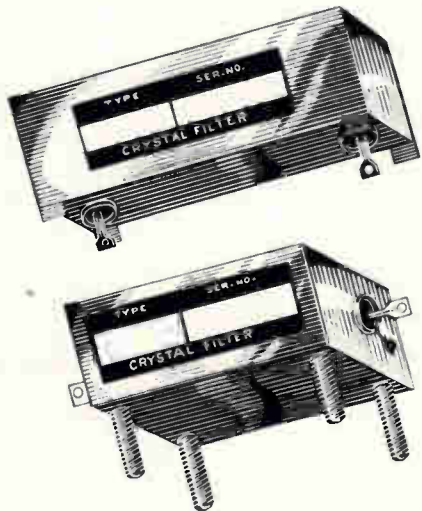
shown actual size



G-20 (Military HC-26/U)

G-21 (Military HC-29/U)

This vacuum sealed, hard glass crystal unit meets the new CR-73/U and CR-74/U specifications. It has long term frequency stability five times better than the conventional metal type. Available in frequencies from 5000 kc to 200 mc.

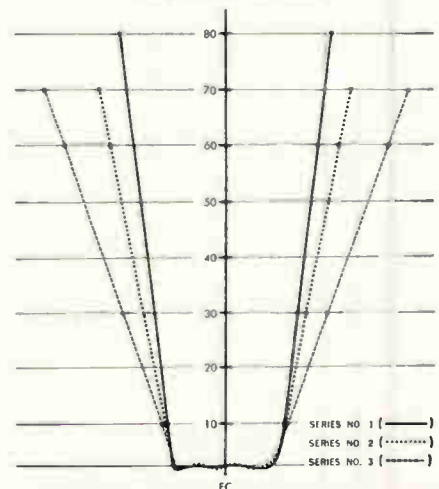


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frequency range: 7000 kc to 200 mc
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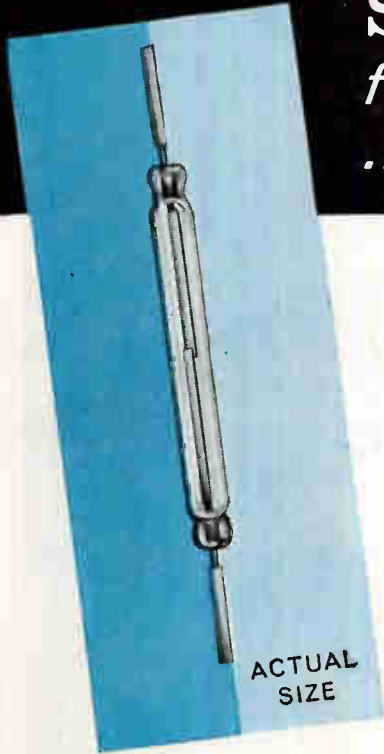
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for contamination-free operation
...positive on-off switching



CLAREED solves the vexing problem of contact contamination. Its sealed, gold-plated contacts operate indefinitely in an in-built ideal environment, give positive on-off switching for up to millions of cycles. It is a relay you can install and forget.

This maintenance-free operation makes CLAREED sealed contact relays ideal components for such critical applications as transistor drives, computers, data processing equipment and many other high-speed devices.

CLAREED design is simplicity itself—a pair of magnetically operated contacts, hermetically sealed in an atmosphere of inert gas within a glass capsule. Compact size permits almost unheard-of flexibility of assembly and application.

Typical space-saving Clareed Relay Assemblies



This cylindrical can contains one, two or three CLAREED switch capsules which form the core of a common coil. Numerous variations of this design are possible to meet customer requirements.



CLAREED relay consists of 12 switch capsules enclosed in a rectangular container and mounted on printed circuit board. Varied coils and contact arrangements available.



Here is a CLAREED relay module for printed circuits. Quick, convenient mounting on your own prototypes or assembly line. High component density. Sturdy steel cover provides magnetic shielding.



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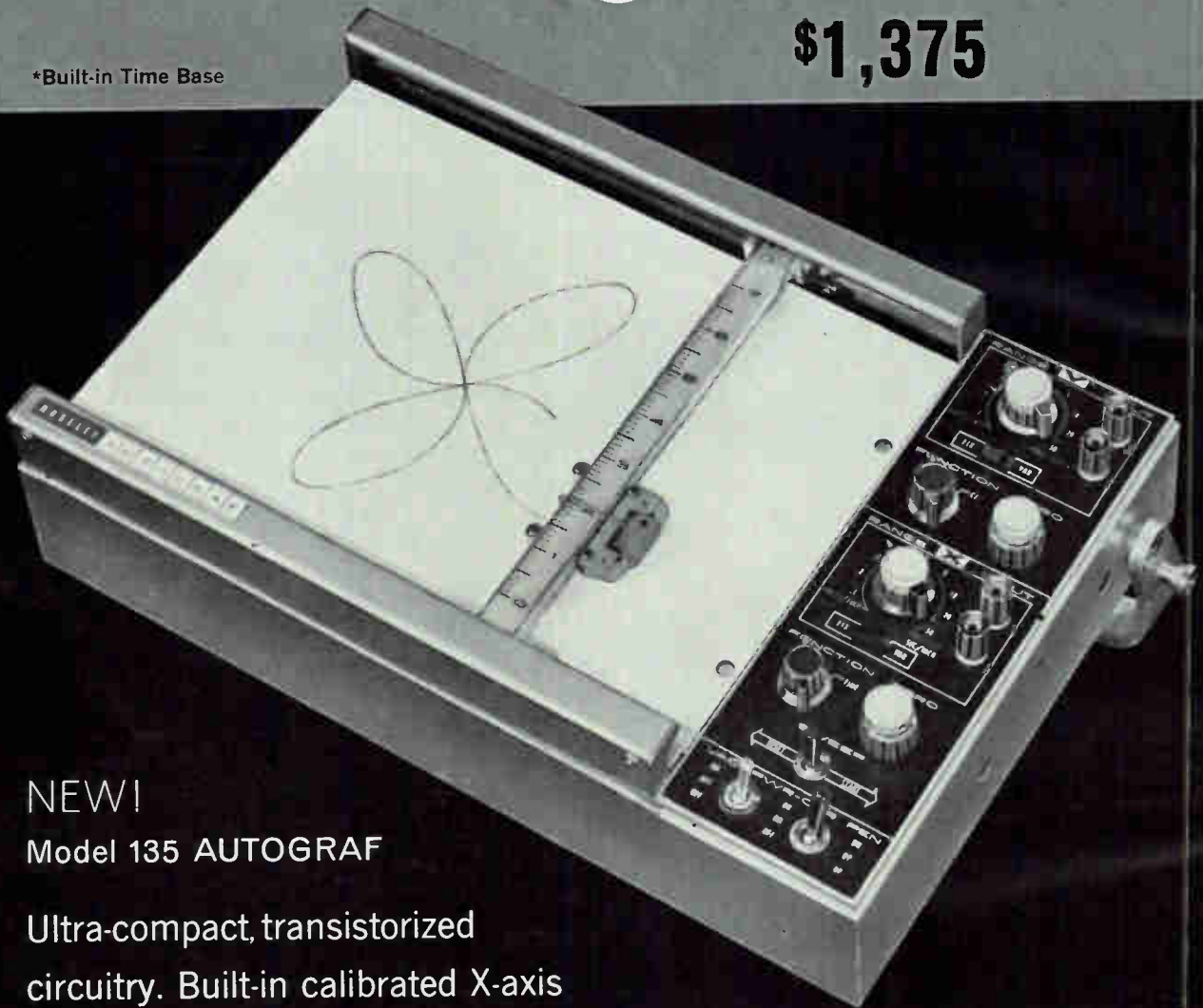
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Control Components*

If you use relays, it will pay you to know all about CLAREED relays ...an entirely new concept in relay design. To obtain Bulletin CPC-10, address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Limited, 840 Caledonia Road, Toronto 19, Ontario. Cable Address: CLARELAY.

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*Built-in Time Base

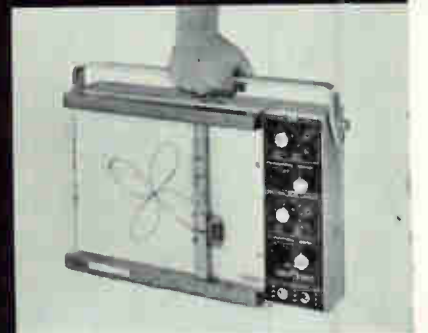


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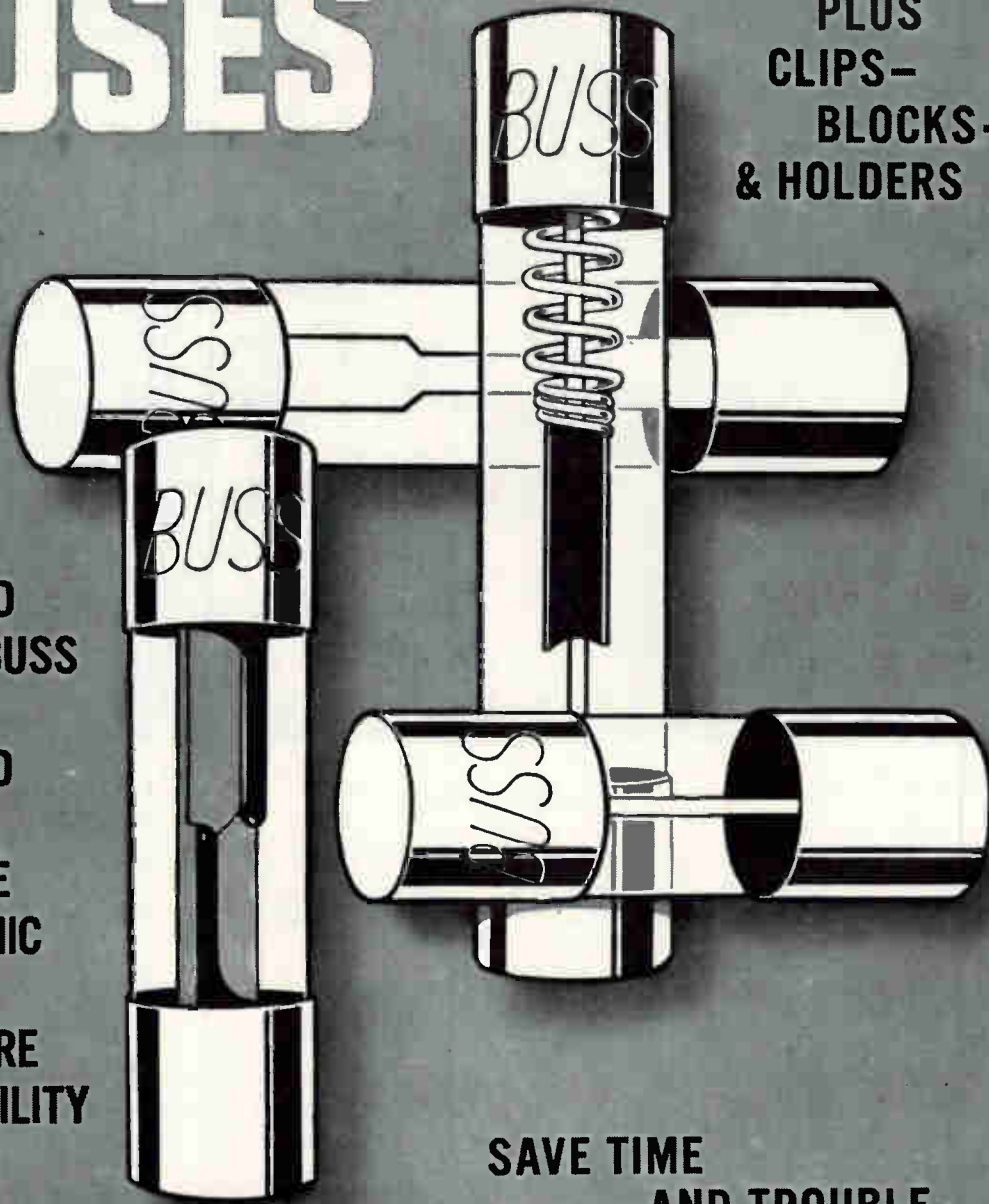


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115-325 volts DC out
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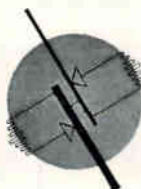
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Current Range (amps)	0-5	0-15	0-30	0-1.5	0-1.5	0-1.5
AC Input (Volts)	105-125	105-125	105-125	105-125	105-125	105-125
AC Input (CPS)	50-60*	50-60*	50-60*	50-60*	50-60*	50-60*
Regulation-Line (105-125V)	0.025%	0.025%	0.025%	0.1%	0.1%	0.1%
Regulation-Load (0 to full load)	0.05%	0.05%	0.05%	0.1%	0.1%	0.1%
Cooling	Free Air Convection	Forced Air	Forced Air	Forced Air	Forced Air	Forced Air
Ripple (RMS) in Millivolts	1	1	1	3	3	3
Panel Height	3½"	5¼"	8¾"	5¼"	5¼"	5¼"
Price	\$525	\$825	\$1375	\$685	\$710	\$750

(Note: If meters not desired deduct \$30 and drop "M" from model number)
*400 cps available on order

Specify POWER SOURCES BY



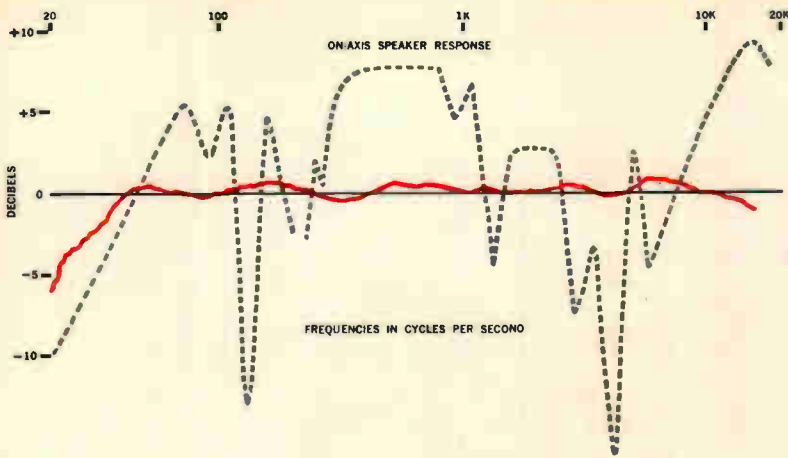
POWER SOURCES, INC.
BURLINGTON, MASSACHUSETTS

See a demonstration. 1961 IRE Show. Booth 1719.



Reliability in volume...

CLEVITE TRANSISTOR
WALTHAM MASSACHUSETTS



New transistorized speaker-amplifier system sets high standards in fidelity

A significant new design advance by Intergrand uses a unique servo-feedback between speaker and amplifier. Result: an amazing reduction in acoustic distortion.

By ROBERT CHASE — Applications Engineer Clevite Transistor

Utilizing servo feedback techniques, this new integrated sound reproducing unit treats the amplifiers loud speaker and enclosure as one electromechanical-acoustic network. The frequency requirements of this feedback system would have required prohibitively expensive output transformers had tubes been used. Inherent properties of power transistors that makes them suitable for output transformerless design made a reality of what was formerly considered an uneconomical but ideal acoustic theory.

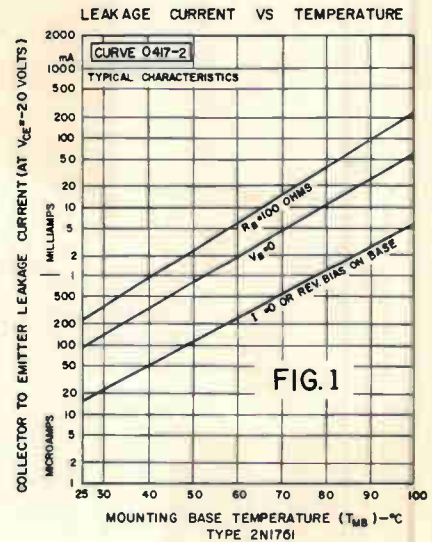
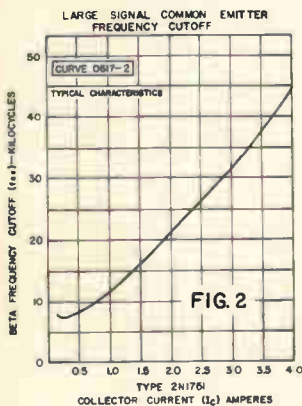
The degree of success in this design is clearly shown by the curves that compare the pressure response of this system with a high quality, low efficiency speaker driven by a quality tube amplifier. The total technical specifications of this achievement are too detailed to be presented here. Crosby Teletronics of Syosset, Long Island, New

York, has become exclusive sales and manufacturing agent for this system. This firm can supply all details.

Key elements in this design were power transistors incorporating precise electrical characteristics and extreme reliability. These were found in the Clevite 2N1761 units.

The three transistor amplifiers used to cover the entire audio spectrum must meet stringent requirements as to gain, stability, frequency response and power output.

The transistors that help meet these requirements are



Clevite type 2N1761 (see chart). These are relatively new, fully specified at high temperatures to allow stable, predictable operation in DC coupled circuits. Figure 1 shows leakage current versus temperature for various common emitter operating conditions. The Clevite Spacesaver transistor exhibits low phase shift at high audio frequencies, allowing its use in systems having large amounts of negative feedback. Frequency response of the 2N1761 versus collector current is shown in figure 2.

A pair easily provides 10 watts output at 20 Kc with low distortion. Designers of high fidelity amplifiers, series regulated power supplies, DC to DC converters, servo motors and computer equipment requiring fast switching at high current will find the Clevite Spacesaver series of interest. Send for Bulletin TB226-2.

Electrical Characteristics	Symbol	Measurement Conditions	2N1761			Units
			Min	100	Max	
D C Current Gain	β_{FE}	$I_C = 0.5 A$ $V_{CE} = -2.0 V$	60	100	150	
Base Input Voltage	V_{EB}	$I_C = 3.0 A$ $I_B = 200 mA$		0.5	1.0	Vdc
Collector to Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = 3.0 A$ $I_B = 300 mA$		0.3	0.7	Vdc
Large Signal Cutoff Frequency	f_{β}	$I_C = 1.0 A$ $V_{CE} = -2.0 V$	10	15		Kc
Thermal Resistance	R_{θ}			1.4	2.5	$^{\circ}C/W$
Collector to Base Breakdown Voltage	BV_{CBO}	$I_{CBO} = 3.0 mA$	80			Vdc
Emitter to Base Breakdown Voltage	BV_{EBO}	$I_{EBO} = 3.0 mA$	30			Vdc
Collector to Emitter Sustain Voltage	$V_{CES(SUS)}$	$I_C = 300 mA$ Shorted Base $V_{EB} = 0$	85			V
Collector to Emitter Sustain Voltage	$V_{CE(SUS)}$	$I_C = 500 mA$ Open Base $I_B = 0$	55			V
Collector Cutoff Current	I_{CBO}	$25^{\circ}C$	40 Vdc			mAdc
			80 Vdc			
			70 Vdc	4.0	7.0	
			100 Vdc			
Collector Cutoff Current	I_{CBO}	$V_{CB} = -2V$		25		uAdc

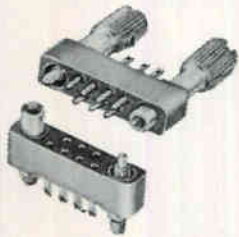


CLEVITE TRANSISTOR Waltham, Massachusetts



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PRECISION
CONNECTORS**

**These Precision Electronic Connectors provide proven reliability
in your critical commercial and military applications—
COMPUTERS...MISSILES...AIRCRAFT...COMMUNICATIONS**



**MICRO-MINIATURE
SERIES MM22**

Ruggedized to withstand shock and vibration extremes. Available in 5, 7, 9, 11, 14, 20, 26, 29, 34 and 44 contacts, with guide pins and sockets, polarizing screwlocks* and aluminum hoods.



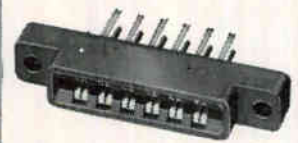
**SUB-MINIATURE
SERIES SM-20**

Available in 5, 7, 11, 14, 20, 26, 29, 34, 42, 50, 75, and 104 contacts, with guide pins and sockets, polarizing screwlocks*, aluminum hoods, protective shells and hermetic plugs.



**MINIATURE
SERIES 20**

A larger size than MM22 and SM20, available in 4, 5, 7, 8, 9, 11, 14, 18, 20, 21, 26, 34, 41, 42, 50, 75 and 104 contacts. Hexagonal plug and socket seal models, and hermetic seal plugs are also available.



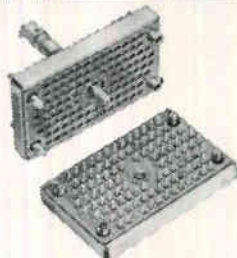
**PRINTED CIRCUIT
SERIES 600**

Receptacle types for 1/2", 3/4", 1/8", 3/16" and 1/4" printed circuit boards. Available in single and double row construction, in sizes up to 210 terminals. Wiring styles include eyelet lug, wire-wrap and taper tab.



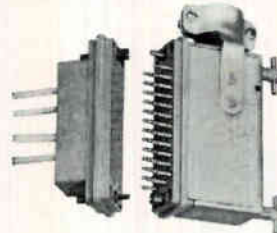
**POWER SERIES
14, 16, EZ, 250**

For heavy duty applications requiring high current, dielectric strength, and voltage carrying capacities. Various contact sizes, aluminum hoods and polarizing screwlocks* available.



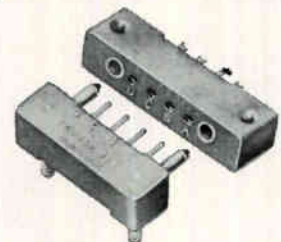
**CENTER SCREWLOCK
SERIES 1900**

Available in 152, 104, 78 and 34 contacts. Feature double lead thread action center screwlock, closed entry contacts for increased reliability and reinforcing stainless steel channels.



**REMOVABLE CONTACT
SERIES 2500**

Improved, removable contacts with crimp termination eliminates connector soldering operations. Closed entry cartridge protects socket against pin damage. Available with 14, 26, 34, 50, 75 and 104 contacts.



**RIGHT ANGLE
PRINTED CIRCUIT**

Plug and socket types with right angle pins for dip soldering to printed circuit board or tape cable are available. Variety of contact sizes, moldings, terminations, and polarizing screwlocks* can be specified.

*Pat. No. 2,746,022

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Highlights important features and specifications of Continental Connector's complete line of printed circuit, micro-miniature, miniature, power and special design connectors for missile, aircraft, computer and communication applicators.

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CIRCLE 107 ON READER SERVICE CARD 107



Dependability PROVED!

...in tests at **5 Times**
mil specs for
**shock, vibration
and acceleration**



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Type K



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Type G and
Type L



Adjustable
Fixed Resistors
Type R



Hermetically Sealed
Ceramic Encased Resistors
Type TS Type CS Type ES



About the test

At the United States Testing Co., Inc.* the above Allen-Bradley resistors and potentiometers were subjected to a constant acceleration of 300g, impact shock of 150g and vibration of 50g from 55 to 2,000 cps. All tests were conducted in accordance with procedures outlined in the latest Mil Specs.

*Test Report #71801, Sept. 1960

In these severe tests, Allen-Bradley resistors and potentiometers have demonstrated their complete dependability in environmental extremes.

The ruggedness of A-B fixed resistors is obtained through an *exclusive* process in which the resistance element and the insulating jacket are hot molded into an integral unit of unusual mechanical strength. This unit is then hermetically sealed in a ceramic tube. Also, please remember, A-B fixed resistors are *completely free from catastrophic failures*.

A-B potentiometers have the resistance elements molded into, and are an integral part of, the base; therefore, they are virtually indestructible. In addition, operation is quiet and smooth when the potentiometer is new, and these characteristics improve with use.

For maximum reliability under severe operating conditions, insist on Allen-Bradley *quality* electronic components.

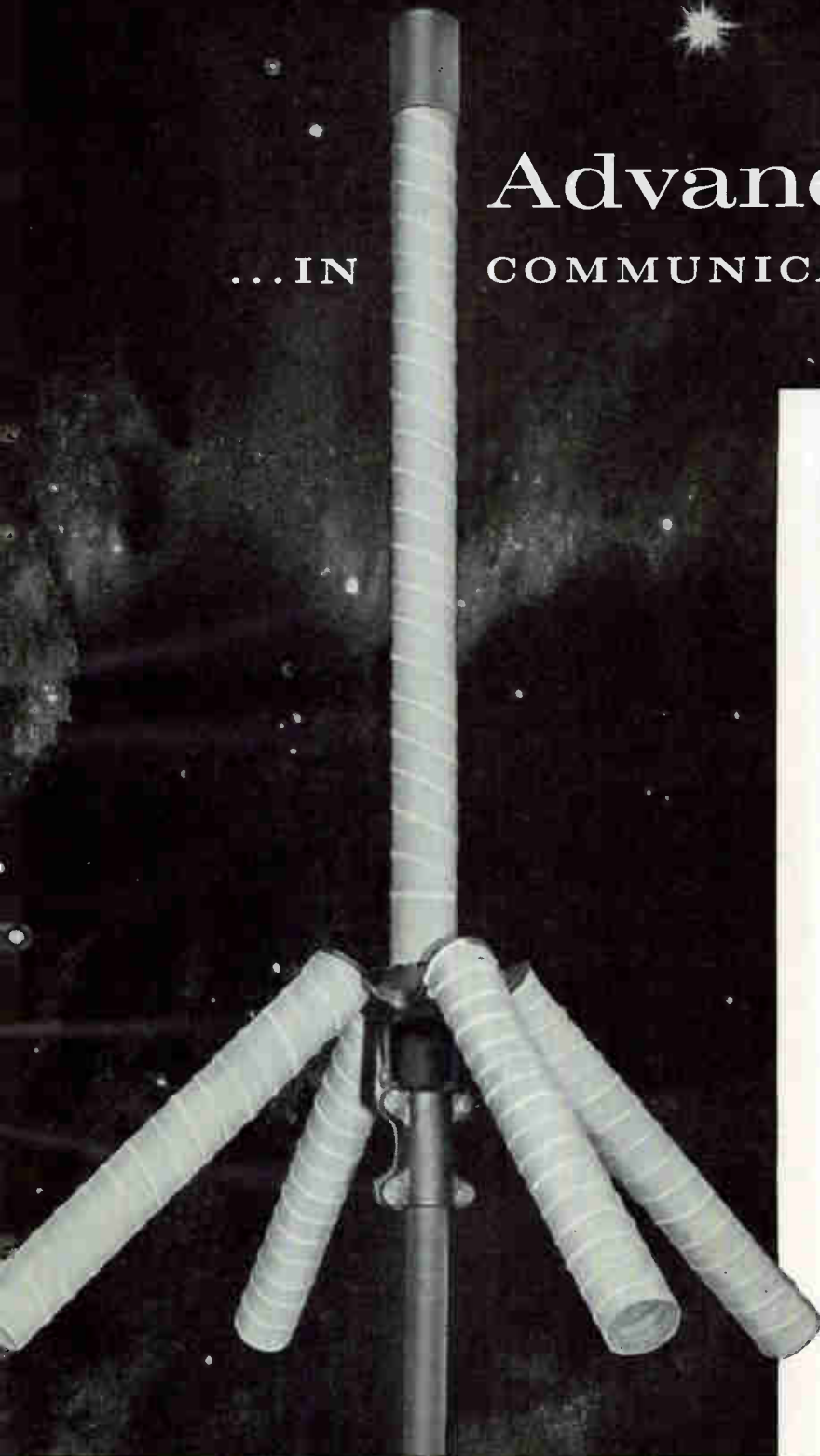
Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN - BRADLEY

**QUALITY
ELECTRONIC
COMPONENTS**

...IN

Advanced design COMMUNICATION ANTENNAS



HELIPOLE

The ANDREW Type 902 HELIPOLE* is the first basically new 30-50 mc fixed station antenna to appear on the 2-way radio scene in the past 12 years. Type 902 employs a new design concept that combines improved performance with mechanical convenience. It is the result of an extensive ANDREW development program.

HELIPOLE CONSTRUCTION

The foreshortened radiator employs a bifilar helical element which is encased in Fiberglass for strength, durability and corrosion resistance. One helix is grounded, providing a static drain path. The other is fed. Ground rods employ single helix conductors which also are embedded in Fiberglass. Size reduction is shown by comparing the 57 inch radiator of Type 902 with 101 inches of a conventional antenna at 30 mc. Ground rods are also shortened by a proportionate amount.

Lightweight and strong — with a maximum total weight of 13 pounds, Type 902 is designed to withstand 30 psf load with $\frac{1}{2}$ inch of radial ice. The focal point of this mechanical strength is found in an aluminum casting to which ground rods and radiator are bolted with stainless steel hardware. Direct mounting is provided for members from $1\frac{3}{4}$ to $2\frac{1}{2}$ inches in diameter. VSWR of this unity gain antenna is less than 1.5.

Economically priced ANDREW Type 902 is the best performing, corrosion resistant high wind load antenna on the market.

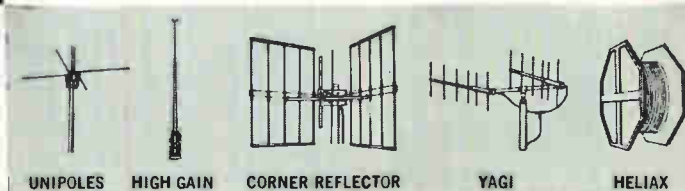
Write or call your ANDREW sales engineer for complete information or request Bulletin 8467.

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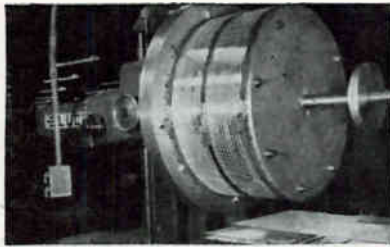
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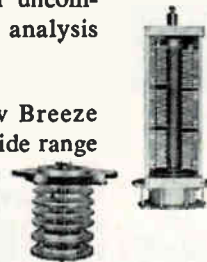
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IN THE DESIGN OR PRODUCTION OF CUSTOM SLIP RING ASSEMBLIES...

... at Breeze. With the depth of design and production capabilities and facilities at Breeze Corporations, your slip ring requirements are met without compromise. Breeze produces custom slip ring assemblies by *all* of the reliable methods and techniques, thus assuring you of a unit tailored to meet your unique requirement.

Let Breeze provide you with an uncompromised design and production analysis before you buy.

You'll want a copy of the new Breeze catalog 66SR which describes a wide range of custom units as well as Breeze standard slip ring assemblies.



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off
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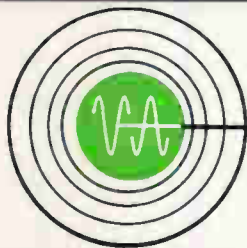
ULTRA-HIGH VACUUM SYSTEMS

Varian's new Ultra-High Vacuum System is now available as catalog-item equipment. Provides base pressures to 10^{-9} mm Hg or lower. Eliminates necessity for custom design of complex systems. A completely integrated system, ready-to-operate. Optional power and electronic accessories are available for special installation requirements. Applications: hyper-altitude simulation, vacuum evaporation, vacuum firing and brazing, etc.

Varian's revolutionary VacIon® pump is a major component. No necessity for liquid nitrogen traps or continuous mechanical pumping. VacIon pumps are all-electronic: pumpdown cycles are automatically fail-safe.

SYSTEM COMPONENTS ■ 400 Litre/second VacIon Pump ■ Ultra-High Vacuum Chamber ■ Instrumentation ■ Cabinet and Controls ■ Bakeout Oven ■ Roughing Manifold for Mechanical Pump or VacSorb® Pump

If your design or processing requirements demand integrated equipment producing extremely low pressures, Varian's Ultra-High Vacuum System may be just what you're looking for. For full technical data, write Vacuum Division.



VARIAN associates

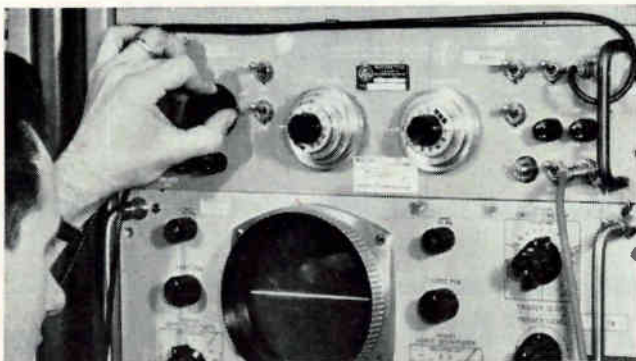
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Test Instrumentation Specialists

Now you can have the precision voltage and phase indicator that meets military specifications for advanced ground support systems

NAVAPI



NAVAPI, North American's Voltage And Phase Indicator, is designed for highly accurate measurement of voltage and phase in 380- to 420-cps signals. It has had more than six years of proven in-plant use on precise electronic and electromechanical systems and is currently in use on highly sophisticated ground support systems.

NAVAPI operation is fast and simple. You just adjust two potentiometers and set a few simple switches to obtain null between test signal and reference voltage.

In-phase error is less than 0.1% of maximum reading per range; quadrature error less than 1.0%. NAVAPI offers a high resolution reading accuracy: in-phase, 0.008% of maximum reading per range; quadrature, 0.08%.

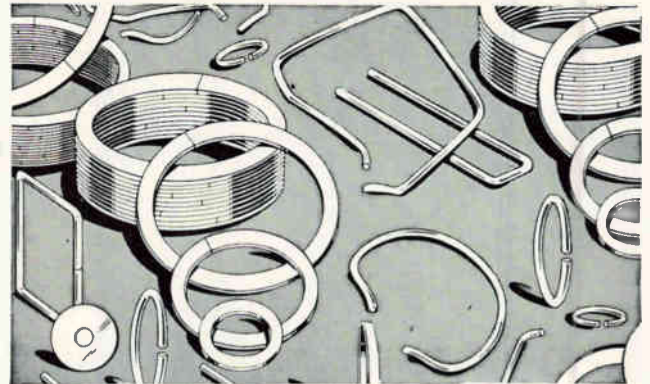
Immediate delivery is available now. Complete unit includes input and output amplifiers, summing circuit, in-phase and quadrature voltage circuits, and power supply. Write for NAVAPI catalog with full information.

NOTE: for an instantaneous response to your TWX inquiries, use TWX CPT-6137.

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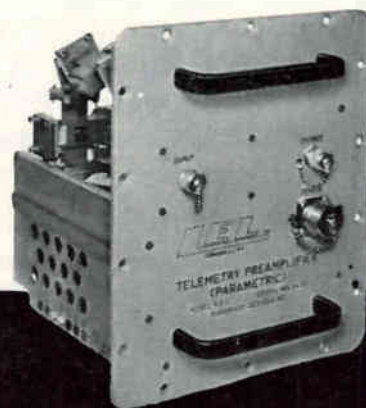
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PARAMETRIC Telemetry Preamplifier



SPECIFICATIONS:

Passband	225-260mc
Gain	25db
Noise Figure	1-2db
Load Impedance	50 ohms
Power Input	115v, 60cps

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AMirville 4-2200

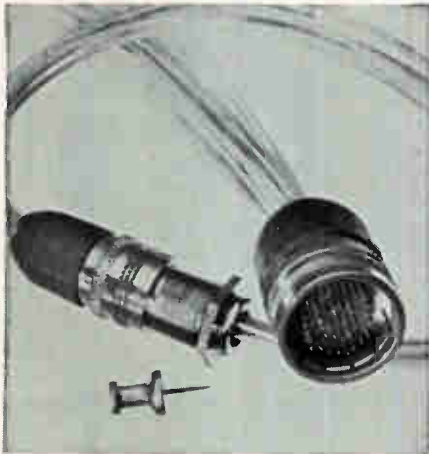
(Advertisement)

© 1961 MICRODOT INC.

Microdot Appoints Avnet for Multi-Pin

LOS ANGELES — An exclusive long term agreement for the distribution of Microdot's new microminiature Multi-Pin connector series has been awarded by Microdot to Avnet Electronics Corporation.

Microdot's Multi-Pin is only one-quarter the size of present "miniature" types and features complete interchangeability of parts. Multi-Pin inserts are available in a variety of straight power, straight coaxial, and combination power-coaxial layouts. Power contacts are interchangeable without changing inserts, allowing hermaphroditic contact arrangements to be set up (a mixture of male and female contacts within the plug or receptacle, allowing hot leads to both plug and receptacle).



Available in three shell sizes, Microdot's Multi-Pins can contain up to 61 power or 19 coaxial contacts in a 1 1/4" shell.

According to Microdot, Avnet will supplement Microdot's sales engineers and seventeen sales representatives with their own sales engineering staff and provide an extremely well organized and broad based national distribution from Avnet's eight stocking locations. The agreement applies to the standard line of cylindrical Multi-Pin connectors, with a separate non-exclusive agreement covering other types and Microdot's coaxial connectors and cable. Present distributors for Microdot will continue to carry the standard line of coaxial connectors and cable on a non-exclusive basis.

Avnet currently has a large initial Multi-Pin stocking order in each of their facilities for immediate delivery. Future orders are expected to be substantial.

MICRODOT INC.



220 Pasadena Avenue
South Pasadena, California

CIRCLE 113 ON READER SERVICE CARD



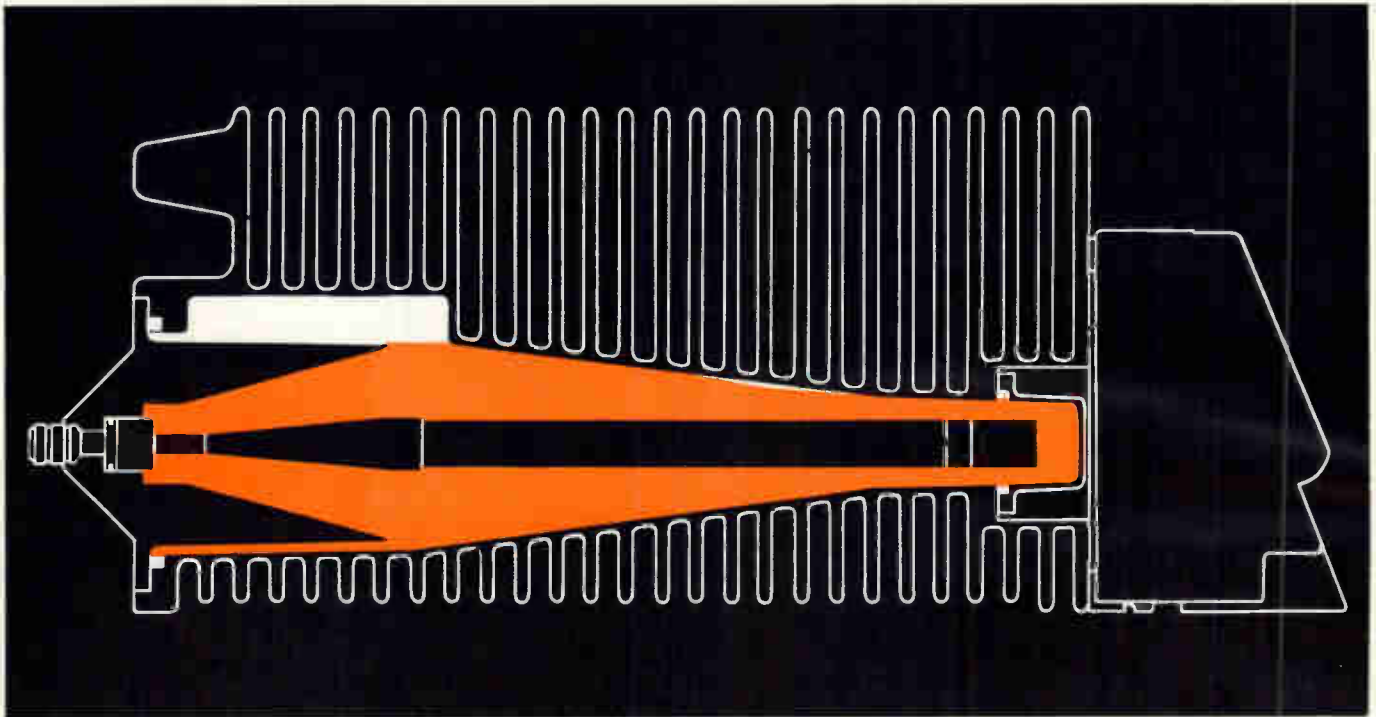
TALK IS NOT CHEAP

To negotiate the Cold War requires two costly elements:
A position of undeniable strength; and time.

That's where defense comes in. To provide the strength.
To buy the time for reason to prevail.

It must give us pause. For we in the defense business
must realize that what we do keeps fingers off buttons.
Because the real business of the defense business is survival.

How To Combat Heat

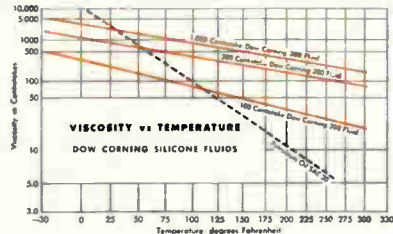


Good heat dissipation with dielectric strength are unique silicone properties

An example: Dow Corning silicone fluids are used as dielectric coolants for rapid dissipation of heat because of their thermal stability and relatively flat viscosity-temperature curves. (See chart below.) They can be pumped at high speeds without breakdown due to shear; maintain consistency from -65 to 250 C; and they will not oxidize or act as corrosives to metals even at high temperatures.

Low vapor pressure is an additional reason why Sierra Electronic Corporation, Menlo Park, California, specifies Dow Corning 200 Fluid as the heat transfer medium in their 100 and 500 watt, 50 ohm coaxial RF loads. Heat losses are dissipated through the dielectric coolant to fins on the cast housing, providing integral liquid cooling without loss of dielectric strength.

These terminations have excellent stability. Prolonged operation within their rating produces no measurable change of characteristics, even with an ambient temperature of 104°F (40°C).



From direct current to 3 mc these coaxial line loads have a low VSWR ratio of less than 1.2 . . . are compact and light in weight. And Dow Corning 200 Fluid helped Sierra engineers lick the heat problem by providing a *dielectric with good heat conduction.*



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For "Silicones for the Electronic Engineer",
Write Dept. 3515.

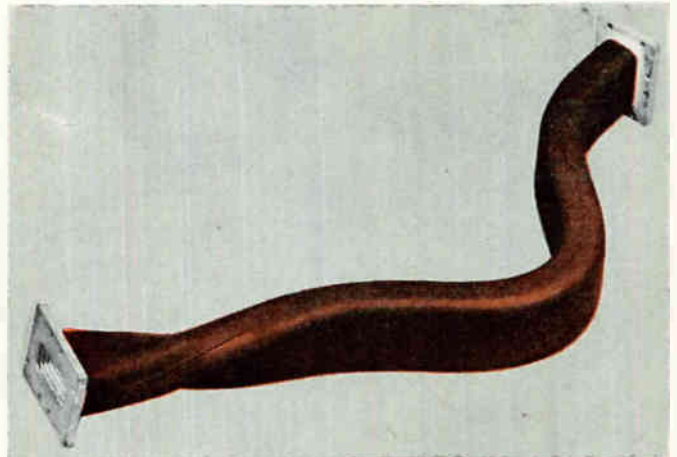


Dow Corning

... Specify Silicones

Silastic Jacket for Heat or Cold

Exposed to environmental extremes of blistering heat and bitter cold, the molded jacket of this flexible wave guide is made from Silastic®, the Dow Corning silicone rubber. According to Co-Operative Industries engineers, the Silastic jacket provides a smooth exterior over the corrugated brass of the wave guide, gives added resistance to dents, corrosion and abrasion. It also helps control flexing characteristics. Rubbery parts made of Silastic retain their physical and dielectric properties over the wide temperature span of -90 to 250 C . . . resist ozone, corona and voltage stress. Initial properties remain unchanged despite rapid thermal cycling or long term storage.



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Silicone Team "Beats" Heat

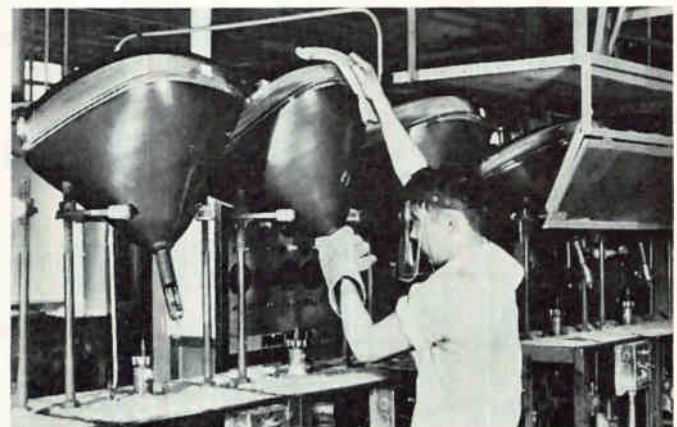
This solenoid, manufactured by Cannon Electric Company, Los Angeles, California, is subjected to high temperatures and other environmental extremes. One typical use: in pneumatic starters for aircraft turbine engines. To beat the heat, Cannon engineers specify a silicone insulation system consisting of: Dow Corning impregnating varnish; silicone-glass tape; silicone rubber impregnated glass sleeving; silicone fiber glass insulators; silicone compound for sealing terminals; and, Silastic caulking paste. Completed solenoids must withstand environmental tests including salt spray, humidity, high and low temperatures and vibration. Cannon Electric chose the *silicone team* "for its superior characteristics in resisting heat, moisture and abrasion; and, its outstanding dielectric properties."



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Heat-Stable Vacuum Pump Fluid

Dow Corning silicone diffusion pump fluids offer a combination of properties that add up to high production rates and long runs without maintenance. These properties provide heat stability, low vapor pressure, high vacua, rapid recovery, quick pump down, inertness to air and metals and resistance to gamma radiation. Silicone diffusion pump fluid is non-toxic and chemically inert . . . pump vacuum can be released without first cooling the boiler . . . decomposition does not occur when hot fluids are exposed to air. To improve the performance of your diffusion pump, specify a Dow Corning diffusion pump fluid . . . They produce vacua in the range of 10^{-5} to 10^{-7} mm of Hg.



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branches: ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D.C.

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A Complete Line of Coaxial Circulators Combining these Outstanding Features:



**Complete coverage,
200 MC to 8 KMC**

Ultra-low insertion loss

Small, compact, lightweight

Broad band coverage

Performance-proved Low cost, high value

Check the table below for the field-proved specifications of a few typical Melabs Circulator models, available now for off-the-shelf delivery. Nowhere else can you find such a complete line of circulators to meet so many of your requirements with such high performance standards.

Here are Specifications that Speak for Themselves!

Band Model Series	HF—		HU—	HL—		HS—		HC—
Frequency	200-600 mc		600-1000 mc	1.0-1.7 kmc		1.7-4.0 kmc		4.0-8.0 kmc
Typical Model	HF-400	HF-420	HU-935	HL-130	HL-145	HS-225	HS-280	HC-565
Frequency	380-420	405-445	890-960	1.25-1.35	1.4-1.5	2.2-2.3	2.7-2.9	5.4-5.9
Insertion Loss:								
Max. (at band ends)	0.6	0.5	0.4	0.3	0.3	.3	.3	.4
Typical/center	0.4	0.35	0.2	.2	.2	.2	.2	.2
Isolation:								
Min. (at band ends)	17 db	17 db	18 db	18 db	18 db	20 db	20 db	20 db
Typical/center	25 db	25 db	25 db	25 db	25 db	25 db	25 db	25 db
VSWR (outputs terminated)								
Max. (at band ends)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Typical/center	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
*Diameters (max. excluding connectors)	5¼"	5¼"	3 11/16"	3"	3"	3"	3"	2"
*Height	1⅞"	1⅞"	1⅞"	1¾"	1¾"	1⅞"	1⅞"	1⅞"
*Weight (approx.)	4 lbs.	4 lbs.	1½ lbs.	1¼ lbs.	1¼ lbs.	8 oz.	8 oz.	6 oz.
**Connectors (female)	Type N	Type N	Type N	Type N	Type N	Type N	Type N	Type N
Power:								
Average	100 w	100 w	5 w	5 w	5 w	5 w	5 w	5 w
***Peak	5 kw	5 kw	5 kw	5 kw	5 kw	5 kw	5 kw	5 kw
Price:	\$400.00		\$350.00	\$310.00		\$240.00		\$225.00

*All units can, on request, be further miniaturized to meet your specifications. Size and weight reductions of 2 to 1 have been obtained for the S and C band units.

**These circulators can, on request, be provided with High Power or TNC Connectors.

***Rated with Type N Connectors.

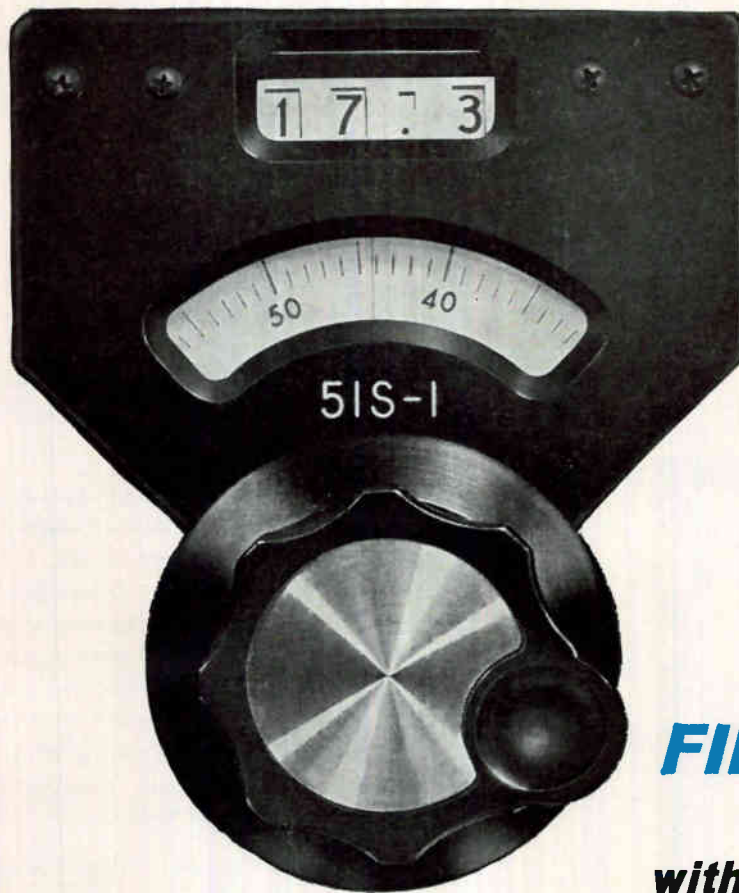


(pronounced MEL-LABS), Dept. E-3,
3300 Hillview Avenue, Palo Alto, California
DAvenport 6-9500

In addition to standard, temperature-stable units listed above, Melabs offers many circulator models to meet special requirements. Electronically tunable models HF, HU, HL Series are available with 300-500 MC tunable bandwidths. High-speed switchable models can be made to order for signal transfer or radiometer applications. Also available on special order are higher power models and individual units covering broader frequency bands. Simple modification converts these circulators to isolators with the same superior specifications.

Data subject to change without notice. Prices f.o.b. factory.

NEW FROM COLLINS — THE 51S-1



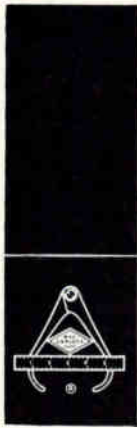
FINGERTIP TUNING

with accuracy. The latest in a series of general coverage HF receivers features single sideband and AM reception with: extreme dial accuracy, visual setting within one kc throughout the range — high frequency stability, particularly suited to receiving pre-assigned frequencies — optimum selectivity, made possible by Collins Mechanical Filters. Highest sensitivity for difficult monitoring assignments — all in one compact, lightweight, easily installed unit.

Write for descriptive brochure.

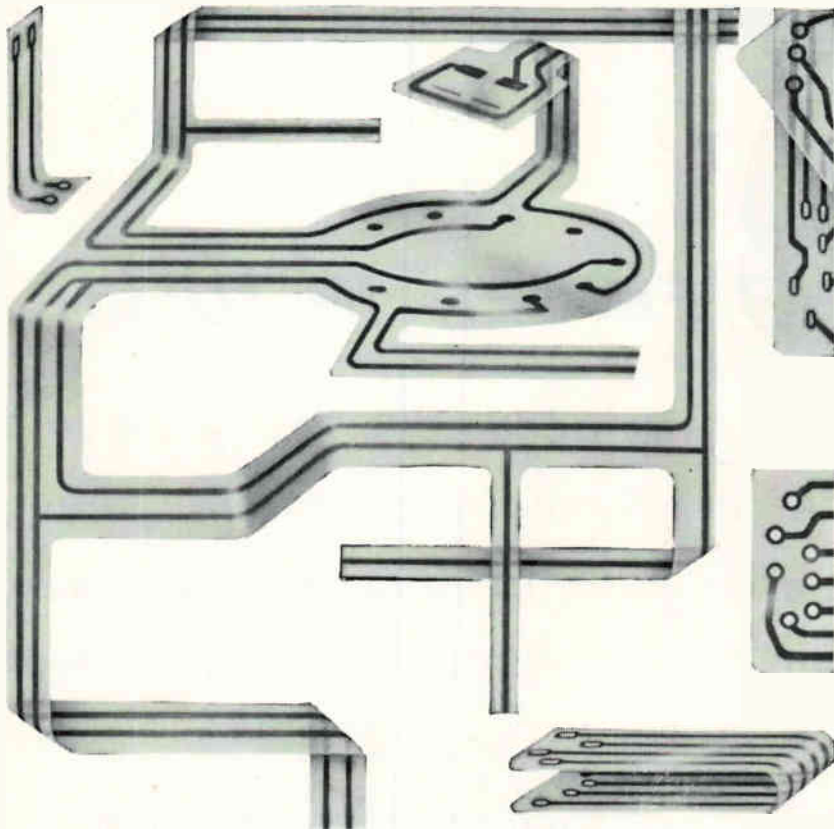


COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA
SEE THE NEW COLLINS 51S-1 RECEIVER AT THE I.R.E. SHOW MARCH 20-23



NEW FLEXIBLE PRINTED CIRCUITRY

from Garlock



Garlock flexible printed circuitry can be economically induction soldered due to high temperature resistance of Teflon FEP.

Teflon FEP*—and its outstanding electrical, physical and thermal properties—has been incorporated by Garlock into an advanced circuit design that offers many distinct advantages over conventional wiring or rigid printed wiring boards.

Greater design freedom. Garlock Flexible Printed Circuitry can be bent or twisted into any desired shape to allow design freedom without compromise to overall reliability. It can be designed to conform exactly to package contours and component parts. Garlock offers terminations adaptable to common industry standards.

Maximum reliability. Garlock Flexible Printed Circuitry is made of etched copper completely encapsulated between two layers of Teflon FEP. Permanently bonded under pressure, this encapsulation affords both line-to-line and line-to-ground protection, and will resist penetration of harmful moisture and gases. No adhesive is used to effect the bond, eliminating any possibility of breakdown through aging.

Reduced size and weight. Garlock Flexible Printed Circuitry can often cut overall package dimensions by as much as 50%. Being extremely flexible, it will hug curves, go around corners, conform to the most eccentric layout. And, because of excellent electrical properties a thinner gauge of Teflon FEP can handle the same job that requires thick gauges of other insulating materials. This, combined with the use of less copper, greatly reduces package weight.

For more information, call your nearest Garlock Electronic Products representative for more data, or write Garlock Electronic Products, Garlock Inc., Camden 1, New Jersey.

GARLOCK

ELECTRONIC PRODUCTS

Visit our Booth No. 2814-2816 at the IRE Show for the complete story of Garlock Flexible Printed Circuitry.

Canadian Div.: Garlock of Canada Ltd.
Plastics Div.: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*DuPont Trademark

(See Them at IRE Booths 2227-2229)

NEW...

® Regatron Programmable

CONSTANT-CURRENT-POWER SUPPLIES

Extremely low ripple . . . 0.1% load regulation* . . . wide operating range . . . the well-known Regatron features are incorporated in these new constant-current power supplies. Transient response time is less than a millisecond. A modulation input is a standard feature. A vernier permits continuous zero-to-maximum coverage throughout each of 16 current ranges.

These c-c supplies are programmable too. Current output can be controlled by means of a remote resistor at any convenient location. Shunt the programming terminals with the resistor and the Regatron delivers a precise value of constant-current to your load. Voltage compliance, or load voltage capability, rises above the minimum values cited in the brief table below, with decreasing current settings.



BRIEF SPECIFICATIONS

105-125 V, 50-60 CPS LINE
(Prices are F.O.B. Eatontown, New Jersey)

MODEL	OUTPUT	VOLTAGE COMPLIANCE (MINIMUM)	DIMENSIONS			PRICE
			H	W	D	
C612A	1 uA to 100 ma	100 V	3½	19	9¼	\$289
C624A	2.2 uA to 220 ma	100 V	3½	19	9¼	\$364
C621A	5 uA to 500 ma	100 V	5¼	19	15	\$479
C620A	5 uA to 500 ma	50 V	5¼	19	15	\$449

* Load regulation is 0.1% for all models except 0.2% on 1 and 2.2 uA ranges of Models C612A and C624A.

You'll find the programming feature, voltage compliance, and other performance data fully detailed in four-page Specification Sheet 3072A. Ask your local E/M representative or write . . .

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Designed for



Application



90901

**INSTRUMENTATION OSCILLOSCOPE
One Inch**

Miniaturized basic packaged panel mounting Cathode Ray Oscilloscope for instrumentation use replacing "Pointer Type" meters. Panel bezel matches 2" square meter. No. 90901 uses 1CP1 tube. No. 90911 uses 1EP1 tube. Power supply No. 90202 available where application requires.

JAMES MILLEN MFG. CO., INC.

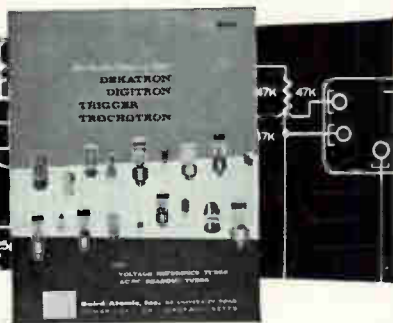
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Application data on

counting tubes

and counting tube circuits



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Cold cathode glow tube for totalizing, sorting, programming, special computing and control circuits. One of four general tube types, in 25 models.

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MODEL P-25

MODEL EW-16

MODEL FL-202

MODEL VO-38

MODEL TK-20A

MODEL TR-A

MODEL VR-2P

MODEL TR-B

MODEL TR-C


MODEL TK-70B

MODEL VTVM-500

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Metrisite... is the only  device available today

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ideal transducer characteristics. The unusual properties

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extreme resolution...  easily measures one

ten-millionth of an inch; **minute operating force...** absolute

minimum bearing friction; **negligible reactive force...** a frac-

tion of a milligram; **true linearity...** a proven accuracy of 1/10%:

high electrical output... up to 100 volts without amplifica-

tion; **wide range of shapes and sizes...** from sub-miniature

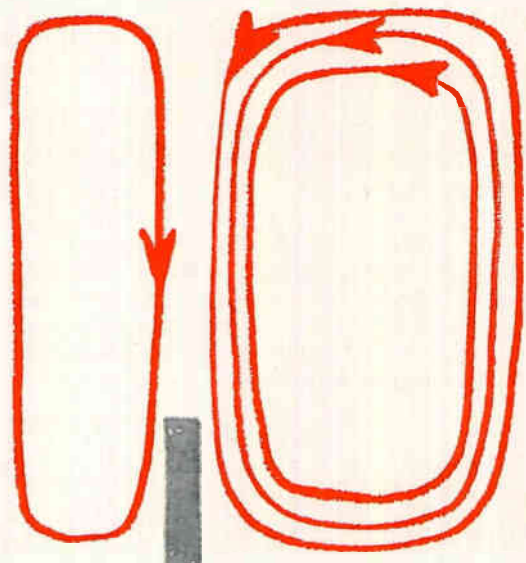
on up; **exceptional ruggedness...** can meet military shock

and vibration tests. Now, many of

the obstacles that have plagued

control technology can be elimi-

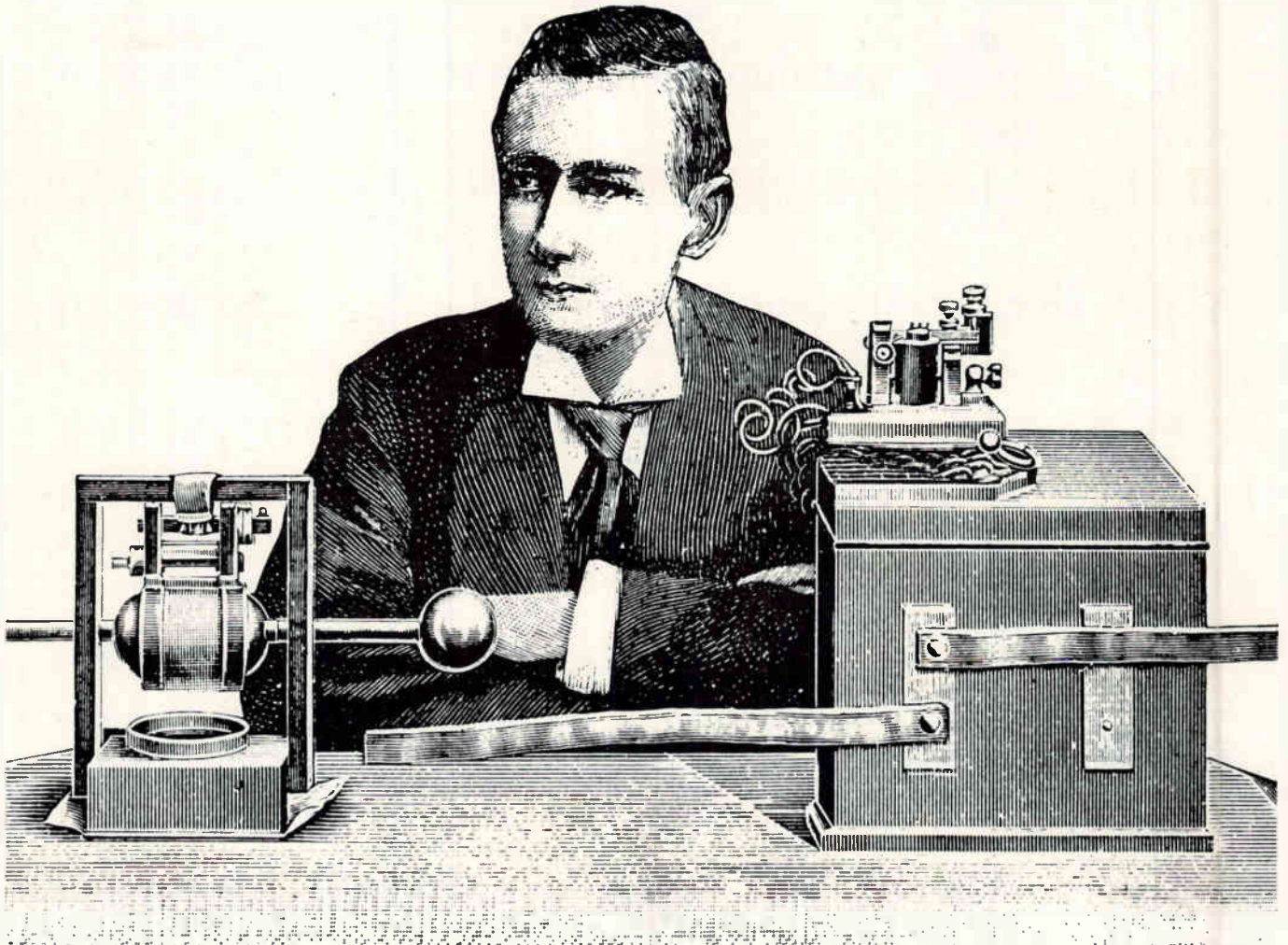
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brush INSTRUMENTS
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We've come a long way since Marconi . . .



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now where do we go from here?

Years ago, this was the first expression of a new idea . . . wireless communication. Radio and electronics have come along way in a short time.

For example, during 1960, Collins and its subsidiary, Alpha Corporation, participated in several key space and communication projects such as the X-15, Project Mercury and Echo I. These projects are indicative

of enormous strides in the development of the wireless concept.

Collins success in these space projects is the result of a large scale program of basic and applied research and development. To implement present and future projects, Collins is now seeking highly qualified R & D people.

DISCUSS YOUR FUTURE WITH COLLINS AT THE IRE SHOW

Mr. L. R. Nuss, Manager, Professional Employment, will be at the New York IRE show in the Career Center. You may telephone him at LT 1-1200 or stop in for a personal interview if you qualify for one of the following immediate openings: Advanced circuit design engineers; Commercial airborne communication and navigation equipment design engineers; Reliability analysis and design engineers; Aircraft system engineers with experience in gyro design, flight

control and/or airborne navigation equipment design; MSME in thermodynamics; Transistorized RF circuit design engineer; BSEE's with experience in transistorized pulse application or automatic fault isolation; MSEE interested in tracking, guidance and telemetry. If you are unable to attend the IRE show, send your resume immediately to Mr. L. R. Nuss, Manager, Professional Employment, Collins Radio Company, Cedar Rapids, Iowa.



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122 CIRCLE 632 ON READER SERVICE CARD

CIRCLE 123 ON READER SERVICE CARD →

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12 grades for printed circuits ...

This will give you an idea of how surely National can help you pinpoint exactly the plastic you want. National has the broadest line in the industry, including standard forms, precision-fabricated parts, and a huge stock of many grades ready for immediate shipment. For

fast help, samples, or more information, contact your nearby NVF sales office. You'll find the 'phone number in Sweet's Product Design File 2b/Na. Or write NVF, Dept. i Wilmington, Del. It's a direct line to the one best material per dollar of design performance.



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new size 11 servo motor

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SHORTER than Mark 14 Mod 0

NEW TYPE 5104-01
1.378"
BuOrd Mark 14 Mod 0
1.671"

2
LIGHTER than Mark 14 Mod 0

4.2 oz.
NEW TYPE 5104-01
4.5 oz.
BuOrd Mark 14 Mod 0

3
HIGHER TEMP than Mark 14 Mod 0

-55°C → +125°C
NEW TYPE 5104-01
-54°C → +85°C
BuOrd Mark 14 Mod 0

4
BETTER FINISH than Mark 14 Mod 0—Tests show that New Type 5104-01's passivated bright finish resists corrosion at least as effectively as black oxide.

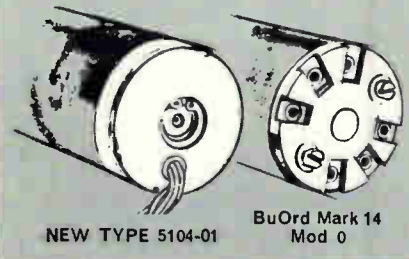
New Type 5104-01 has the same electrical characteristics as Mark 14 Mod 0

EXCITATION FREQUENCY	ROTOR INERTIA	TIME CONSTANT	MAX. STARTING VOLTAGE
400 cps	1.07 gm.cm. ²	15.6 ms	2.6%

	FIXED PHASE	CONTROL PHASE
Input Current	53 ma	53/106 ma
Input Voltage	115V	115/57.5V
Power at Stall	3.5W	3.5W
Resistance (R) at Stall	1250 Ohms	1250/312 Ohms
Reactance (X) at Stall	1780 Ohms	1780/445 Ohms
Impedance (Z) at Stall	2175 Ohms	2175/544 Ohms
Effective Resistance (R) at Stall	3800 Ohms	3800/950 Ohms
Nominal Capacity for Unity PF	0.16 mfd.	0.16/0.64 mfd.

Meets ARP 497. Stainless steel housing used.

5
HIGHER RELIABILITY at **LOWER COST** than Mark 14 Mod 0—Achieved by eliminating terminal board arrangement and utilizing lead wires.



For your higher reliability, advance design requirements in rotating components, contact your nearest John Oster office.

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Servo Mechanisms
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RMC DISCAPS



TYPE C

Temperature compensating DISCAPS meet and exceed the specifications of EIA RS-198. Featuring greater dielectric strength, Type C DISCAPS are ideal for VHF and UHF applications. Rated at 1000 working volts for a higher safety factor.



TYPE B

DISCAPS are designed for by-passing, coupling or filtering applications and they meet and exceed EIA RS-198 specifications for Z5U capacitors. Type B DISCAPS are available in capacities between .00015 and .04 MFD with a rating of 1000 volts.



TYPE JF

DISCAPS are engineered to exhibit a frequency stability characteristic that is superior to similar types. These DISCAPS extend the available capacity range of the EIA Z5F ceramic capacitor between +10°C and +85°C.



TYPE JL

DISCAPS should be specified in applications requiring a minimum of capacity change as temperature varies between -60°C and +110°C. Over this range the capacity change is only $\pm 7.5\%$ of capacity at 25°C. Standard working voltage is 1000 V.D.C.



FIN-LOCK LEADS

Designed for holes from .053 to .060 Fin-Lock DISCAPS are automatically stopped in holes over .060 by the shoulder design of the leads. Stand up positioning is assured and lead crimping is eliminated. Available on all DISCAPS of standard voltages, ratings and spacings.



TYPE SM

DISCAPS are subminiature in size and meet the specs for EIA RS-198 for Z5U capacitors and are available in values of 800, .001, .0015 GMV; .005 +80% -20% $\pm 20\%$; .01 +80% -20% +20% and .02 +80% -20%.



When in Chicago be sure to visit RMC's modern new factory and research center.

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AT
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CERAMIC
CAPACITORS

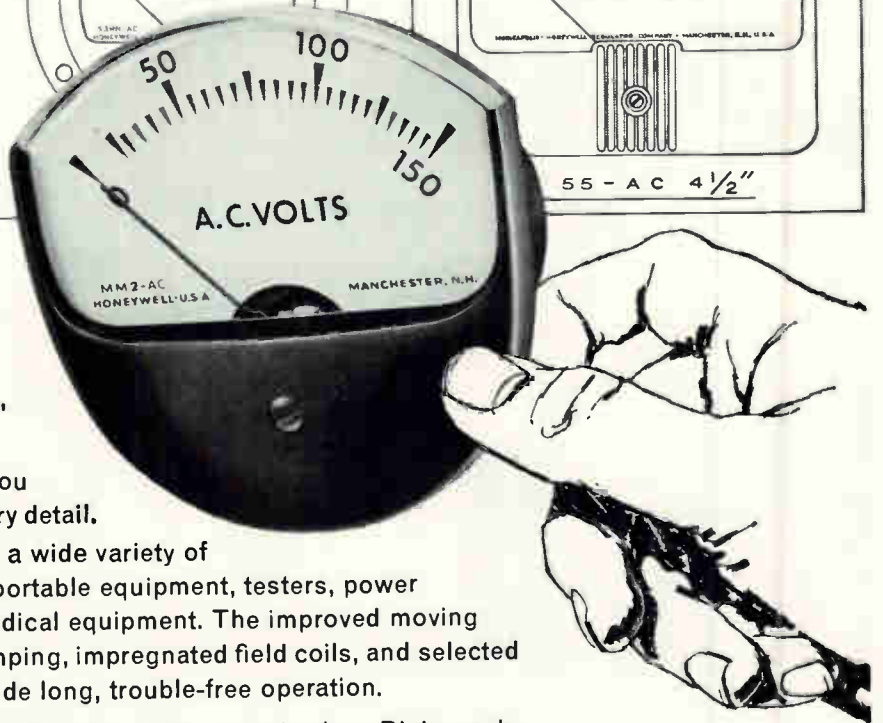
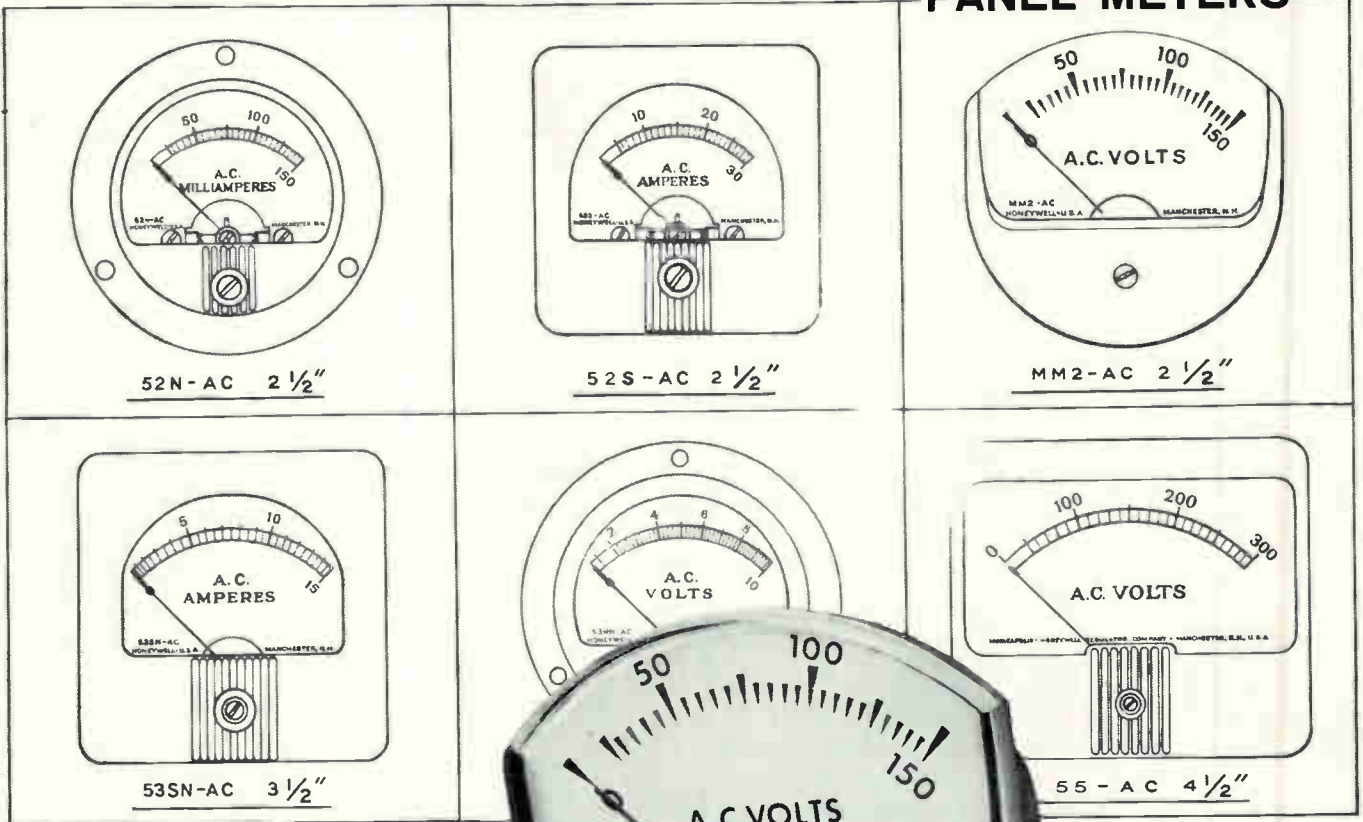
RMC

RADIO MATERIALS COMPANY

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Two RMC Plants Devoted Exclusively to Ceramic Capacitors
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ANNOUNCING THE NEW HONEYWELL IRON VANE AC

PANEL METERS



Here are the AC counterparts of Honeywell's popular DC panel meters. Iron Vane AC Meters are perfectly matched to the DC range and are available in both the Medalist and "standard" case styles. This means a minimum of trouble and expense in mounting. And you are assured of harmonious styling in every detail.

Iron Vane AC Meters are designed for a wide variety of commercial applications — including portable equipment, testers, power supplies, generator equipment and medical equipment. The improved moving iron mechanism features magnetic damping, impregnated field coils, and selected fixed and moving iron material to provide long, trouble-free operation.

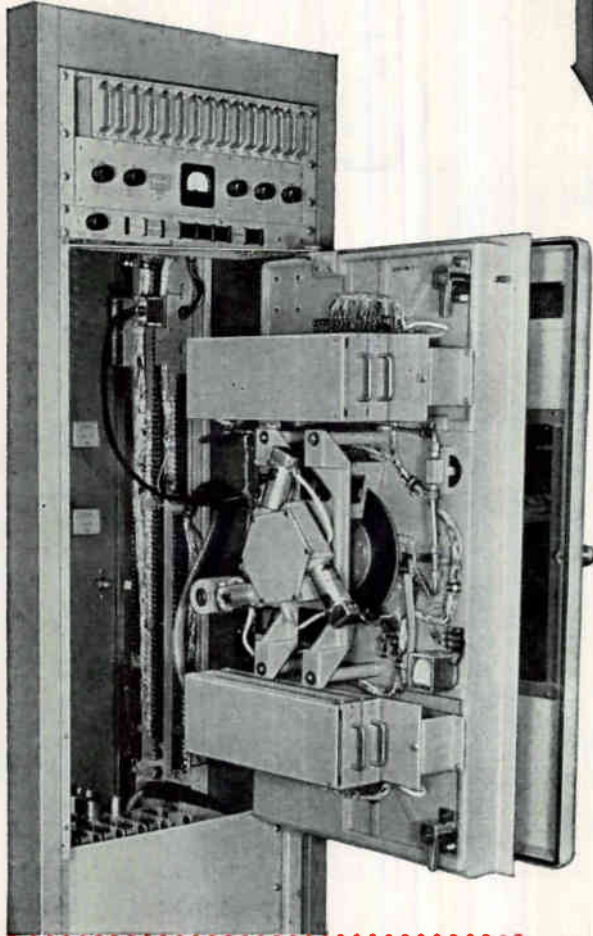
These meters are available in a wide selection of case styles and colors. Dials can be custom designed with your company name, trade-mark or other data. For full information, contact our representative in your area — he's listed in your classified telephone directory. Or us: Precision Meter Division, Minneapolis-Honeywell Regulator Co., Manchester, N.H., U.S.A. In Canada, Honeywell Controls Limited, Toronto 17, Ontario and around the world: HONEYWELL INTERNATIONAL — Sales and service offices in all principal cities of the world.

Honeywell



Precision Meters

a new concept in *speed control*



SANGAMO 460-SERIES MAGNETIC TAPE INSTRUMENTATION

Sangamo's Hare Tape Synchronized speed control reduces instantaneous and long term record-playback speed deviations to a level several times lower than other speed control systems. As a result, it is now possible to achieve magnetic tape instrumentation system accuracies heretofore considered unattainable. The Sangamo 460-Series is a fully transistorized magnetic tape Recorder/Reproducer for application in direct analog, wide band FM, PDM, and PCM instrumentation systems.

The Hare Tape Synchronized servo speed control outperforms other servo speed controls in speed of response and range of control. Since a high torque to inertia ratio is designed into the capstan drive, the servo system can respond more rapidly to changes in tape reference signal frequency than drive systems utilizing massive flywheels. For example, an instantaneous change in record tape speed of several percent will be corrected on playback in less than 40 milliseconds. Furthermore, the control is completely damped, eliminating overshoot or the necessity to average the speed. In addition, the Hare servo speed control range is $\pm 15\%$ without loss of synchronism, while conventional tape speed servos have a range of only $\pm 2.5\%$.

SANGAMO 460-SERIES PERFORMANCE and CHARACTERISTICS

Start Time: 1.0 second to synchronism @ 60 ips with servo speed control and 1" wide tape.

Stop Time: 0.2 seconds from 60 ips.

Instantaneous Time Displacement Error: Less than 25.0 microseconds (including flutter) @ 60 ips.

Long Term Time Displacement Error: $\pm 0.01\%$ standard. Higher accuracies available.

Interchannel Time Displacement Error: ± 2.0 microseconds @ 60 ips between outside tracks on 1" tape.

Servo Speed Control Range: $\pm 15\%$ nominal tape speed.

Servo Speed Control Response: $\pm 15\%$ speed change per second.

Tape Widths: Standard sizes from $\frac{1}{4}$ to 2".

Reel Sizes: 14" or smaller.

Mounting: 1 standard 19" equipment rack for a complete 14 track record/reproduce system with power supplies and servo speed control.

Power Requirements: 117 volts, 60 cps $\pm 10\%$ single phase. All D C drives. 7.0 amperes load for 14 track system.

Weight: Approximately 500 pounds for 14 track system.

➤ The Sangamo 460-Series Recorder/Reproducer can instantly be changed from reel to loop operation without rehandling the tape or making any changes in the transport. Exclusive vacuum tensioning and tape guiding provides gentle but firm and precise control of tape position and head-to-tape contact. This design, in addition to a long tape path, results in the extremely low interchannel time displacement error specified. In addition, the vacuum pad removes loose particles from the tape before it passes over the head, thus substantially reducing dropouts and oxide build-up on the head.

➤ The tape transport and fourteen (14) tracks of Record/Reproduce electronics are contained in a single standard 19" W x 71" H cabinet. This unusual compactness is achieved through transistorized electronic circuitry. The solid state circuitry means greater reliability, reduced weight, lower heat dissipation, and lower power consumption.

For the name of the technically qualified Sangamo representative nearest you, and for complete details on the Sangamo 460-Series, please write for Bulletin 3400.

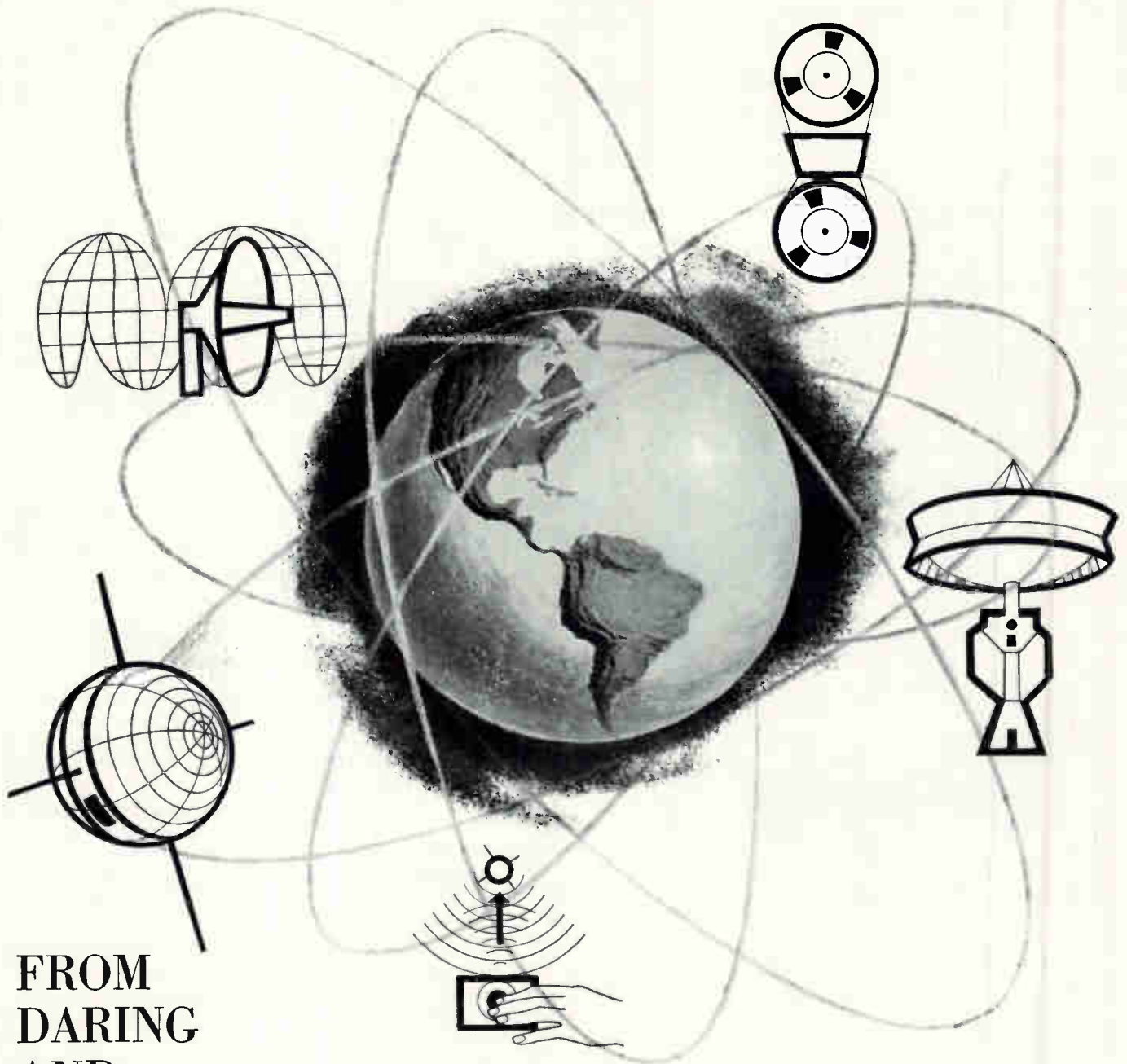


SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

SEE THE SANGAMO 460-SERIES IN BOOTH 2205-2207 AT THE IRE SHOW

CS61-4



FROM DARING AND DOING — *New space communications concepts*

Consider a career at PHILCO Western Development Laboratories, on the San Francisco Peninsula. New concepts of communications with lunar reaches and beyond can be your projects. Here you devise and "do", unencumbered by dogma or dialectics. Constantly expanding programs and new research assignments assure you personal recognition and advancement.

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include satellite instrumentation, range design and operation, missile tracking, data handling and control equipment.

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The Untouchables

Now...Single Crystal Silicon Doped to Your Specification

Single crystal silicon . . . doped to your specific needs . . . is now available from Dow Corning.

Rigid quality control of Dow Corning Silicon means greater device yield for you! And you achieve uniformity in device characteristics — the result of greater uniformity in characteristics from rod to rod, greater lateral and radial uniformity within each rod.

This high quality is the result of a completely integrated production process — a process that starts with the manufacture of trichlorosilanes and other chemicals basic to silicon production. And at every step of the way, rigid quality control assures the ultimate in quality—purity.

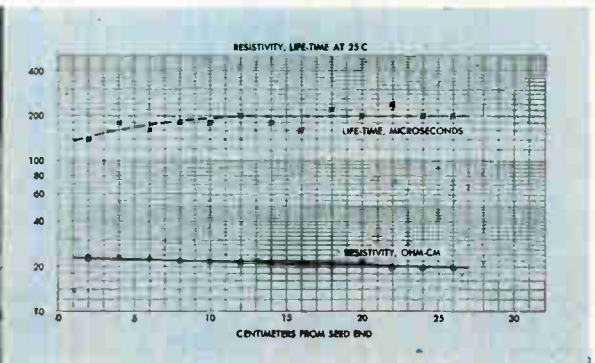
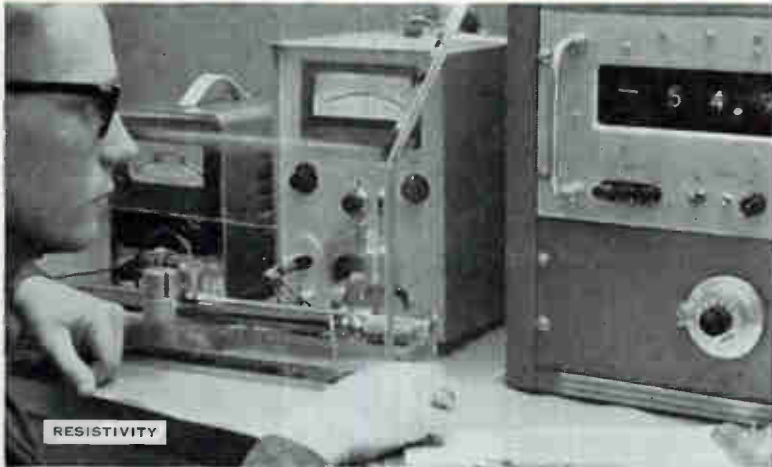
Doped to specification single crystal Dow Corning Silicon contains in the order of 0.1 atoms of minority impurity per billion atoms of P-type material . . . about 0.15 atoms of minority impurity per billion atoms of N-type material.

Low oxygen content of Dow Corning Silicon reduces the undesirable effects on lifetime associated with the diffusion process. Result — few rejects . . . increased device yield! In the picture at left, infrared transmittance at 9 microns is measured to determine oxygen content. Many materials register at pencil point—much higher than Dow Corning Silicon.

Crystal orientation is normally 111, but can be to your specification.

Specify Dow Corning single crystal silicon doped to your requirements. Specific resistivities within narrow tolerances from one to 1000-ohms centimeter P-type . . . one to 400-ohms centimeter N-type. Rod diameters from 3 to 25 mm (1/8" to 1") lengths to 250 mm (about 10").

Whatever your need — polycrystalline rod or chunk; high resistivity P-type single crystal rod; single crystal rod doped to your specifications — Dow Corning should lead your list of sources.



Write for "Hyper-Pure Silicon for Semiconductor Devices," Address Dept. 3515a.

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VISIT BOOTH 4310-12
AT IRE SHOW

NEW FROM WESTINGHOUSE AT YOUNGWOOD



New Westinghouse High Gain Transistor simplifies circuitry, increases reliability, eliminates driver stage components, reduces cost of assembly.

NEW WESTINGHOUSE SILICON POWER TRANSISTOR PROVIDES

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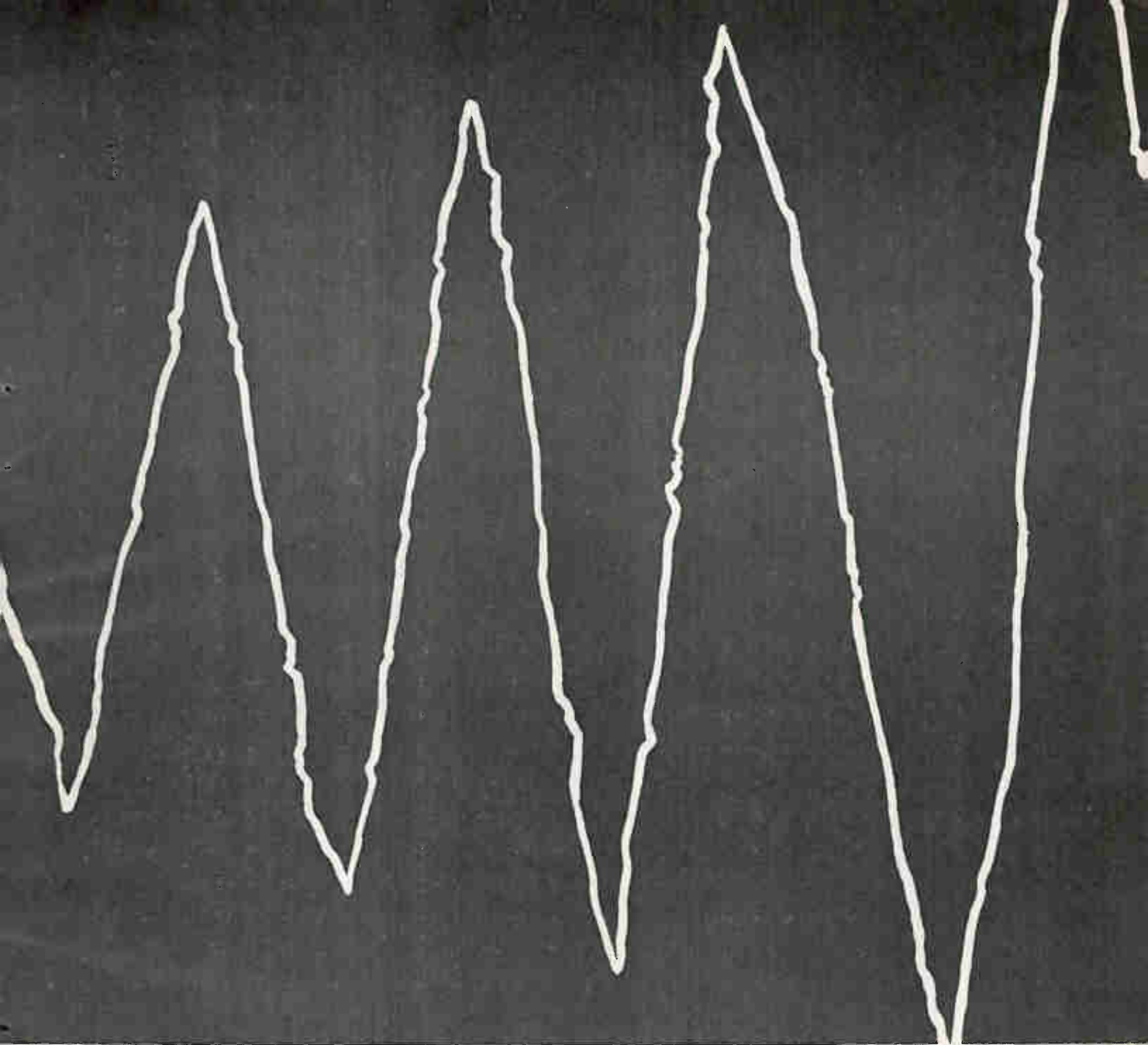
Westinghouse introduces a complete new family of High Gain Silicon Power Transistors providing a gain of 1000 or more at 2 amps . . . with guaranteed minimum gain of 400 at 10 amps (WX118X series) . . . a guaranteed minimum gain of 100 at 10 amps (WX118U series). These devices can substantially reduce circuit components, increase reliability, save space and weight.

They're ideal for application in high power, high efficiency regulators, amplifiers and switching circuits. For example, 1500 watts of power can be easily controlled with a 50 milliwatt signal! For full information call your nearest Westinghouse representative or write to Semiconductor Dept., Youngwood, Penna. You can be sure . . . if it's Westinghouse.

SC-1025

OTHER FEATURES INCLUDE

- True Voltage Ratings to 150 volts
- Power dissipation of 150 watts
- Collector current—10 amperes
- Operating temperature to +150°C.
- Low thermal impedance: .5°C/watt



1000 AT 2 amps!

Prototype quantities now available. Order from these Westinghouse Distributors.

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Westinghouse

CIRCLE 131 ON READER SERVICE CARD

The Leaders Specify **ALPHLEX**[®] ZIPPER TUBING



- constant flexibility
- cuts time and labor
- outer jacket is replaceable
- wire changing is simplified
- eliminates costly jacket extrusion
- immediate delivery from your local Alpha distributor

For all these benefits, Alphlex Zipper Tubing is used by such OEM leaders as IBM, IT&T, Librascope, Lockheed, Martin, Sperry Rand and Government agencies. Write for free Alphlex Catalog Z-2.



The new Alphlex Closing Tool (above) designed to save you time, labor and money in your cable production requirements is free with each order of 1,000 feet of Zipper Tubing.

TYPES OF ZIPPER TUBING		ZIPPER SPECIFICATIONS FOR ALL TYPES OF ALPHLEX ZIPPER TUBING
ZIP-31	fabricated from .020" polyvinyl sheet made from MIL-I-631C materials. All purpose type for general applications to 105°C. Standard colors: Clear, Black, Yellow.	Material _____ Polyvinyl Chloride
ZIP-31M	heavy duty construction. Similar to ZIP-31 type except nominal wall thickness of .040". Standard colors: Clear, Black.	Track Thickness (when closed) _____ .095"
ZIP-44	polyvinyl sheet made from MIL-I-7444B materials. Extremely flexible; for aircraft and low-temperature uses to -67°C. Standard colors: Clear (amber), Black.	Dielectric Strength, V/mil _____ 759
ZIP-44M	heavy duty construction. Similar to ZIP-44 type except nominal wall thickness of .040". Standard colors: Clear (amber), Black.	Tensile Strength P.S.I. _____ 3810
ZIP-50	"sandwich" of aluminum foil laminated between two sheets of polyvinyl. For 100% RF shielding applications to 105°C. Standard color: Silver Grey.	Ultimate Elongation _____ 255%
ZIP-90	polyvinyl bonded to woven fibreglass sheet per MIL-I-3190A. For rough usage, abrasion resistance, and high temperature uses to 130°C. Standard color: Black.	Operating Temperature, Upper Limit _____ 106°C
All types available in inside diameters from 1/4" to 2" in increments of 1/8"; and from 2" to 4" in increments of 1/4". Alphlex Zipper Tubing covered by Patents #RE24,613 and #2,558,367 and other patents.		Cold Brittleness _____ -86°C
		Fungus-proof _____ will not support fungus
		Flammability _____ self-extinguishing
		Lateral Pull Strength (unsealed) _____ 42.7 pounds/inch
		Lateral Pull Strength (permanently sealed) 59.8 pounds/inch
		Standard Colors _____ Black, Clear, Yellow

ALPHA WIRE CORPORATION Subsidiary of **LORAL** Electronics Corporation
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The serious minded scientist and engineer who is considering a career change is frequently at a disadvantage because he does not know precisely what positions are available to him. Nor, until now, has he usually been able to find out in a professional, dignified, confidential way.

To meet this professional need the Aerospace Engineering Division of Hughes Aircraft Company announces the inauguration of a new service for scientists and engineers which notifies you whenever an opening occurs which we believe may be of interest to you.

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Through Hughes' *Engineering and Scientific Register*, we know about you, what you can do and what you would like to do. When a challenging opportunity develops that fits your particular qualifications and desires, we can get in touch with you. You do not make application for employment and no contact is made with present or past employers. You merely permit us to advise you whenever an opening occurs which we believe may be of interest to you. At that time you can decide whether you wish to accept our invitation to be considered as a candidate for the position.

If you would like to be listed in our *Engineering and Scientific Register*, we cordially invite you to fill out and mail the request below.

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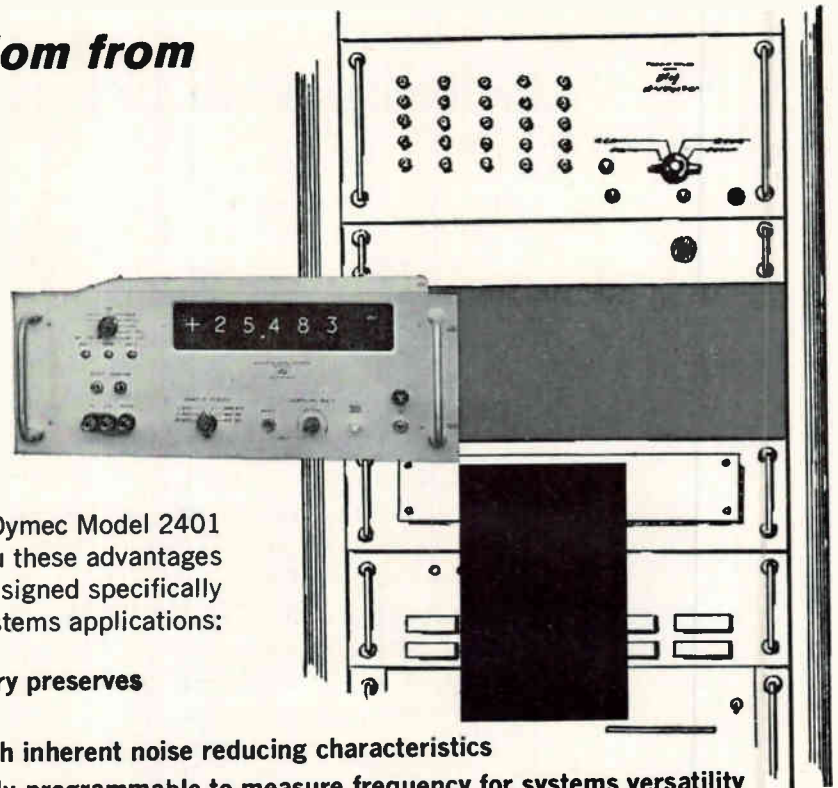
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A new measuring concept in the Dymec Model 2401 Integrating Digital Voltmeter gives you these advantages in a compact instrument, designed specifically for high accuracy in systems applications:

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- Includes counter section separately programmable to measure frequency for systems versatility
- All-electronic circuitry for reliability, easy maintenance
- Range and sampling rate programmable for systems flexibility



High accuracy in systems applications, where noise and hum pick-up are likely to be encountered, is assured by the DY-2401 measurement of average voltage over a definite, selected sample period. The DY-2401 provides the unique noise-averaging capabilities of a voltage-to-frequency converter/counter combination in one compact, accurate, reliable instrument. Both input signal pair and common mode-rejecting guard circuit may be operated at up to 500 volts above chassis ground. Range and sampling rate are programmed by external contact closures.

These brief specifications further indicate the advantages of the DY-2401 which make it superior to any other systems digital voltmeter available today.

DC Voltage Ranges:	± 0.1, 1, 10, 100, 1000 v nominal full scale. Over-ranging capability to 300% of nominal full scale on all but 1000 v range.
Overall Accuracy:	.05% nominal.
Stability:	Greater than .01%/day, 1 v range and above.
Input Impedance:	1 megohm on 1 v and higher ranges; 100,000 ohms on .1 v range.
Sampling Period:	10 ms, 100 ms, 1 sec (crystal determined), or manual by local or remote control.
Sampling Rate:	90/sec with 10 ms sampling period to 9.8/sec with 100 ms sample period. Display time is adjustable from 100 ms to 8 sec, or continuous until manually reset.
Output:	Binary-coded-decimal for each digit; two-lines for polarity indication; one line for each range and operating mode.
Electronic Counter:	Max. count rate: 300 KC. 5-digit Nixie presentation. Accuracy: ± .01% ± 1 count.
Power:	115/230 v ± 10%, 50/60 cps, 200 w.
Dimensions:	19" x 7" x 16½", weight 40 lbs.
Price:	\$3750.00

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30 ampere continuous
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VOLTAGE REGULATION:
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(whichever is greater)

RMS RIPPLE:
1% from 12 to 36 vdc; 2% below

TIME CONSTANT (12-36 v.):
full load on: 50 millisecc.
full load off: 150 millisecc.

A-C INPUT:
115 v. $\pm 10\%$, 1-Ph., 60 cps.

AMBIENT TEMPERATURE RANGE:
 -20°C to $+45^{\circ}\text{C}$

PARALLEL OPERATION:
Includes load sharing provision

VOLTAGE SENSING:
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VOLTMETER & AMMETER:
2% accuracy, $3\frac{1}{2}$ " square

ON-OFF CONTROL:
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PROTECTION:
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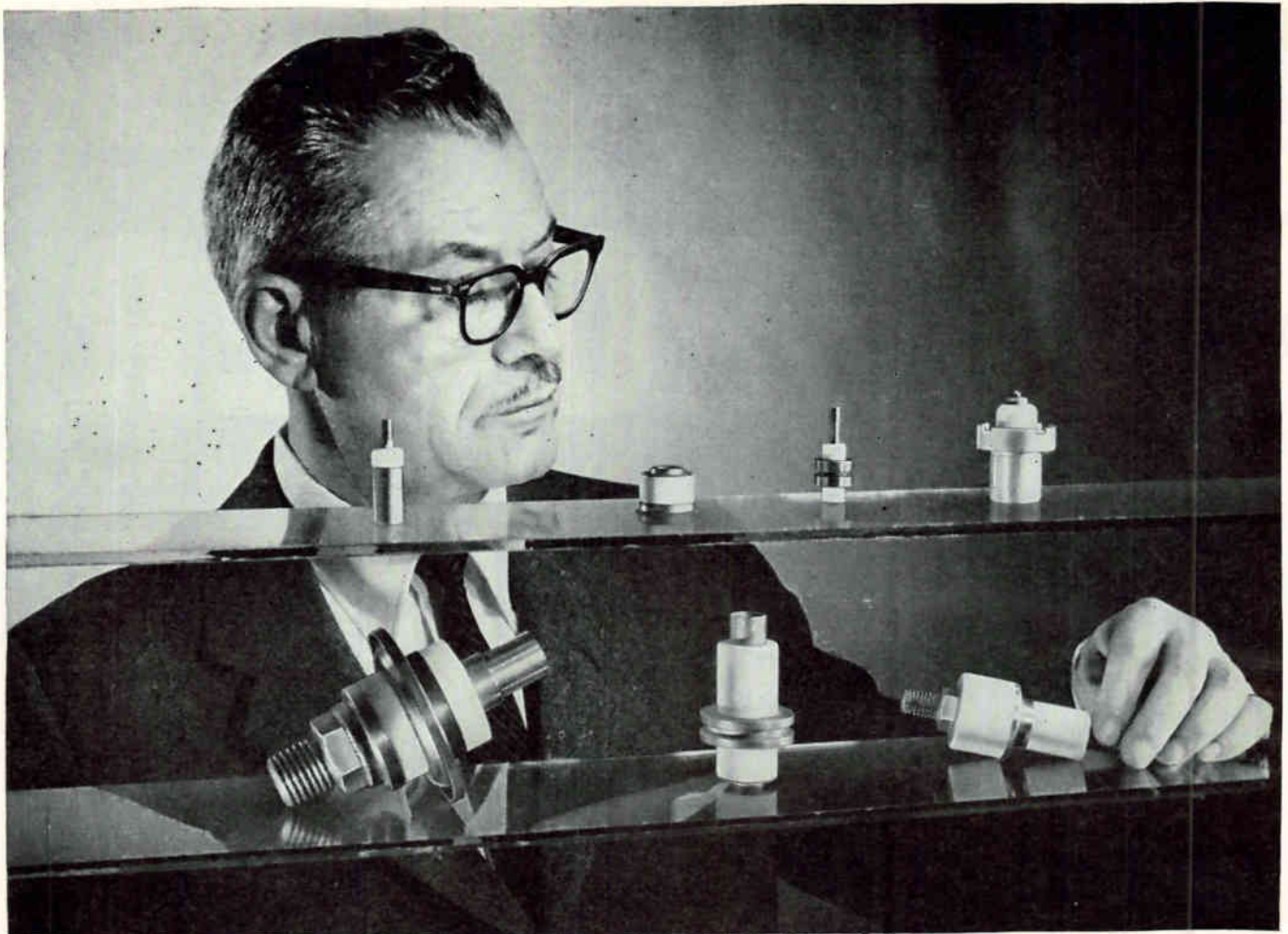
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Use KOVAR® Alloy to solve problems in sealing to ceramics

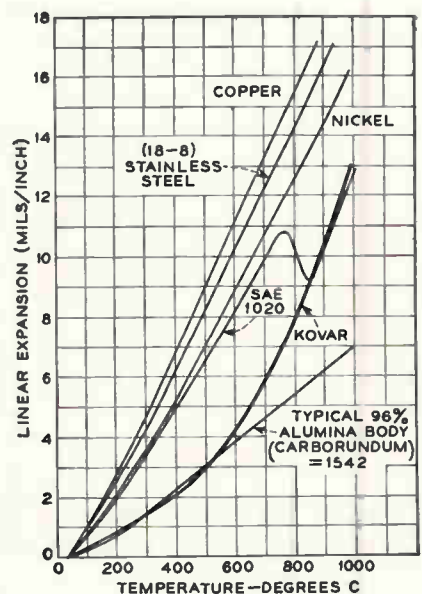
KOVAR, the original 29% nickel, 17% cobalt, 54% iron alloy, was developed for sealing to low expansion glass, but is now being used extensively for making pressure and vacuum tight seals with metallized ceramics of the low expansion type.

The curves at right show the expansion of KOVAR compared with a representative high alumina ceramic body. The expansivity match up to 500 C is very close, and the difference in expansion at higher temperatures is closer than with most common metals and alloys.

The fact that KOVAR is slightly higher in expansion at elevated temperatures is an actual advantage when the ceramic is on the inside of the unit since the resulting joint is placed in compression. The degree of compression is slight compared with that resulting from the use of a metal of higher expansion.

While a considerable difference in expansivity can sometimes be tolerated with the metal on the outside of thick sections of ceramic, this is not the case when the ceramic section is thin. Closer compatibility of expansivity, such as is obtained with KOVAR, is also required when the metal is on the inside of the ceramic or for sandwich or end type seals where both tensional and shear stresses must be kept to a minimum.

KOVAR alloy is stocked in a variety of sizes of rod, wire, tubing, sheet, cups and eyelets. Your inquiries are invited for prices, technical information and recommendations on specific problems. Write Dept. E-31 Latrobe Plant, Refractories Division, The Carborundum Company, Latrobe, Pa.

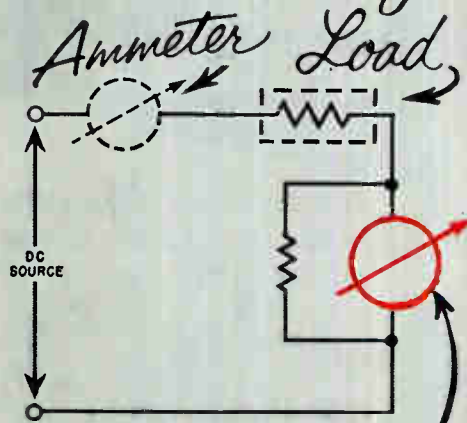


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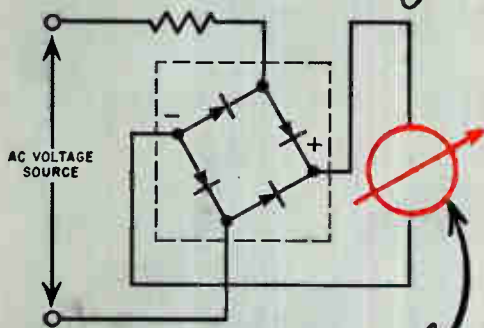
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AC voltage relay



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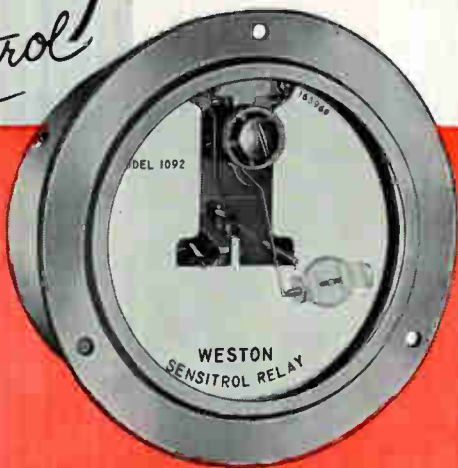
Model 1092—the most versatile, all-purpose relay...especially useful in prototype circuitry.

A truly all-purpose relay, the Weston Model 1092 Sensitrol® is serving diverse applications from commercial display to production line control. This meter-type relay with magnetic contacts is also used for continuous pulsing control and in circuits for holding variables such as temperature, voltage and light levels within critically narrow limits.

Simplicity of operation is an important factor in the growing popularity of Model 1092. A single adjustment screw controls a wide range of accurately repeatable DC values . . . from 0.50 microamperes, or comparable span of 0-100 millivolts. This instrument can be mounted on magnetic or non-magnetic panels, thanks to special Weston Cormag® self-shielded movement. It can handle up to 100 milliamperes at 120 volts AC or DC without chatter.

Many economies are possible with low-cost Model 1092 — another factor contributing to its wide application. Because it can be adjusted for an almost infinite number of settings, it eliminates the need for stocking a variety of relays in production work.

Call your Weston representative for full information about "Sensitrol" Relays, or write: Daystrom, Incorporated, Weston Instruments Division, Newark 12, New Jersey. International Sales Division: 100 Empire St., Newark 12, N. J. In Canada: 840 Caledonia Rd., Toronto 19, Ontario.



Model 1092 Sensitrol® Relay has built-in reset mechanism operated with 120 volts AC, continuous. Reset time: 0.25 sec. Response time: approximately 0.5 sec. Size: 3.5" diameter flush case for panel mounting.

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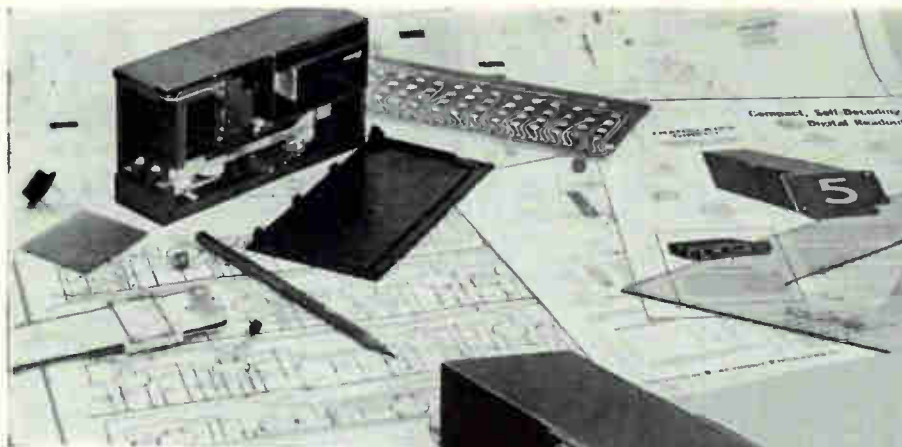
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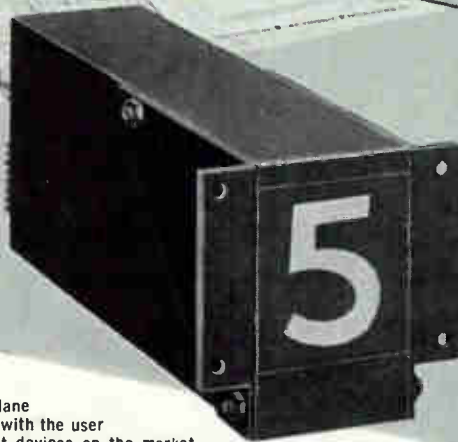
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BINA-VIEW



Now, with the new Bina-View, digital readouts take on an added dimension. Here is a readout that operates direct from binary input, has its own retentive memory, and offers one-plane in-line presentation. Realistically priced and designed with the user in mind, it is not to be confused with other readout devices on the market. The Bina-View Digital Readout fills the long-standing need for a fast, accurate, binary operated display in the fields of digital computers, missile checkout systems, ground support equipment, etc. Its ability to operate within a wide range of binary codes makes it the most versatile readout available today.

Representatives in principal cities.



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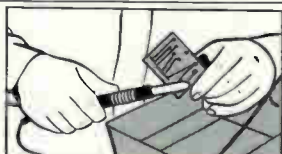
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With the advent of the SELECTRON Process, selective plating, a technique formerly limited to the hobby shop, has now come of age.

SELECTRON is now being used in field repairs, in R & D, and in light manufacturing. Typical applications include gold or rhodium plating of printed circuits, silver plating of bus bar and electrical contacts, repair of flanges on wave guides, precision fitting of bearings for electromechanical devices, and improvement of solderability of stainless steel, aluminum and semi-conductors.

Automated SELECTRON installations are finding use in production plating on isolated areas of trans-

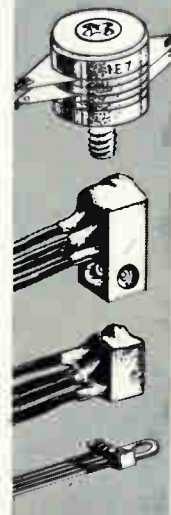


sistor tabs and for gold plating of capacitor leads. One ever-expanding use for SELECTRON is for prototype work. SELECTRON units—occupying only the area of a desk top—are currently electrodepositing almost any platable metal or alloy, from antimony to zinc, upon any conductive basis material.

An information-packed 8-page booklet on its many advantages is available on request from SELECTRON, Ltd. 520 Fifth Ave., New York 36, N. Y.



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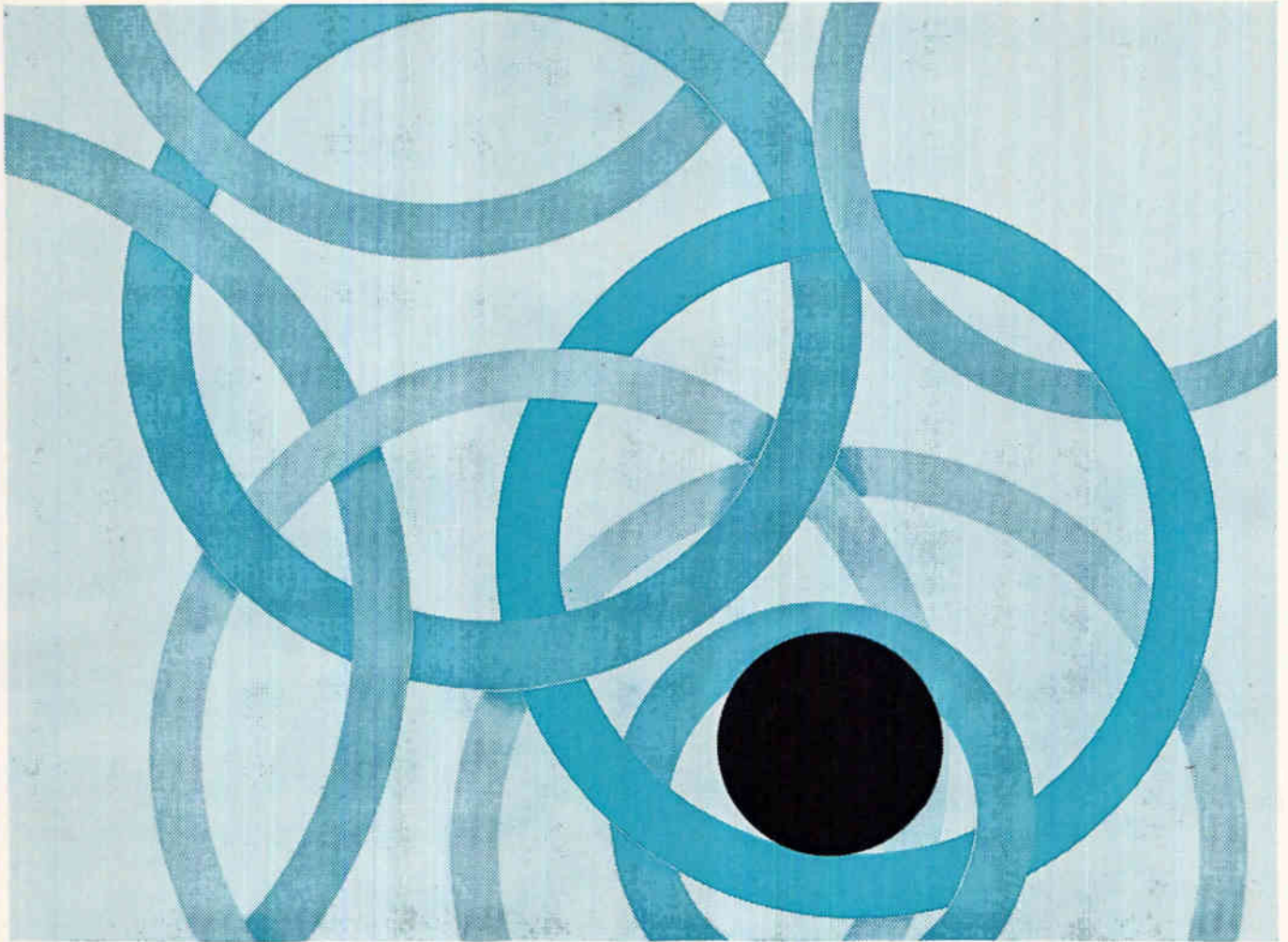
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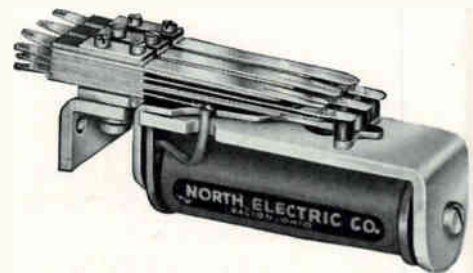


Milestones in Engineering

The rolling characteristic of round objects—the principle of the wheel—was probably discovered by primitive man watching a stone roll down hill or having a log roll under his foot. The first application of this principle is lost in antiquity. Yet today, countless centuries later, the principle involved remains absolute, fundamental and inviolate.

The discovery of such principles was the foundation for the science of engineering, since engineering is based upon the application of principles rather than theories, on the use of proven truths rather than hypotheses.

As surely as this stands as a basic engineering philosophy, so then does sound engineering result in products and equipment that have one thing in common—dependability!



Typical of the dependability engineered into every North Electric product, the North 100 and 200 Series Relays have a record of dependability established over billions of operations in countless applications. Basically "Telephone Quality" Relays, the North 100 and 200 are fast acting, multi-purpose relays—the 100 Series for general duty application, the 200 Series for heavy duty applications.

For detailed specifications on these relays, write

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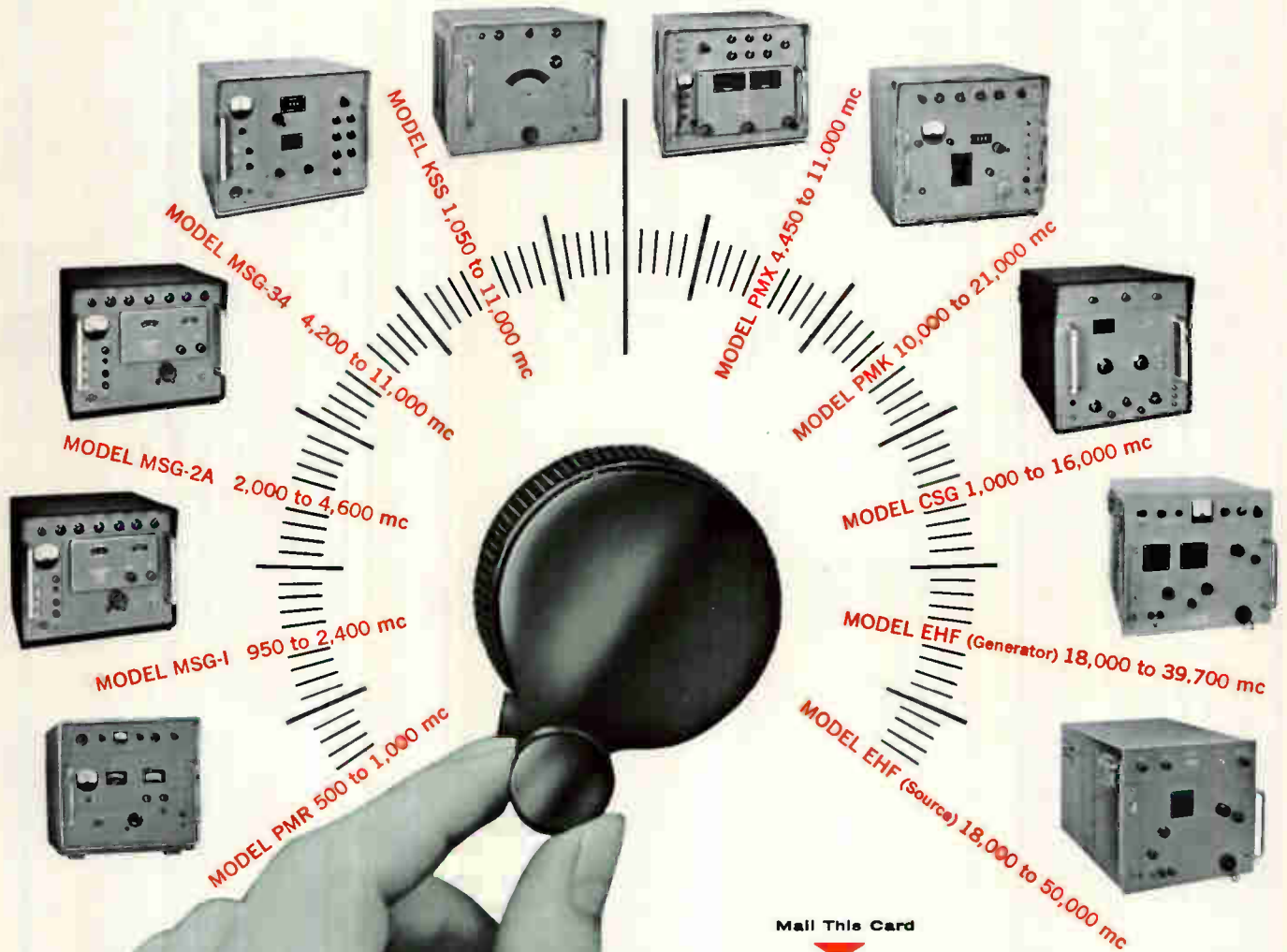
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Now — one basic instrument serves for general communications as well as for detection and complete quantitative analysis of microwave energy.

Polarad Model R Receiver accepts all microwave signals: AM, FM, CW, MCW and pulse. Power and frequency are read directly on front panel indicators.

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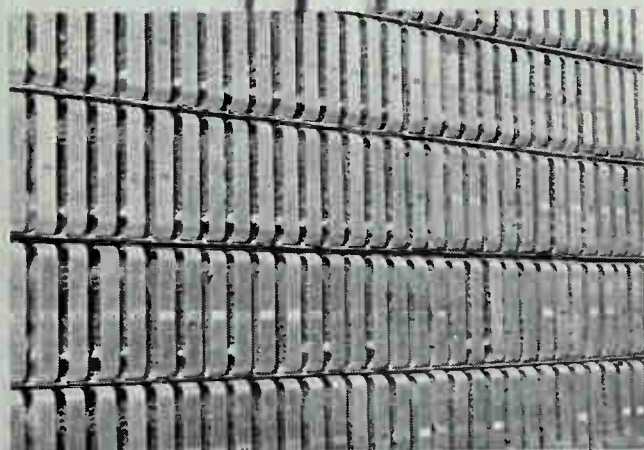
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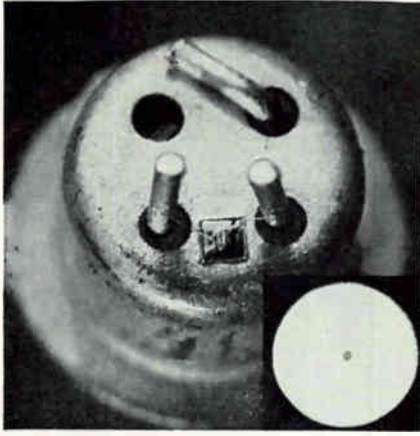
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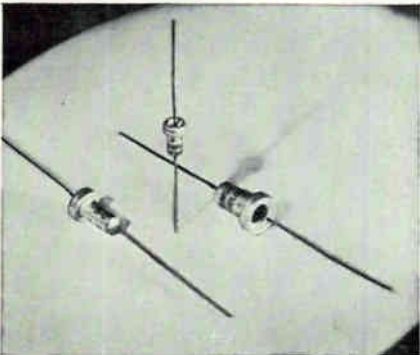
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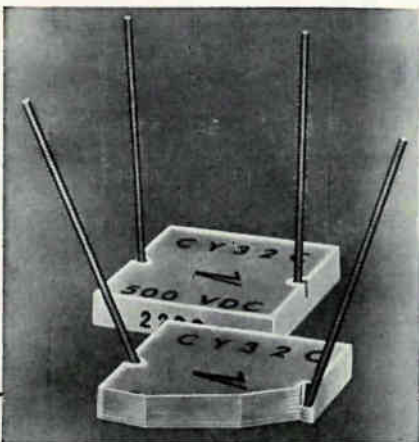
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TRANSISTORS—Shown here in magnification is a Mesa transistor with fine gold wire. Handy & Harman manufactures this whisker wire to exact tolerances and highest purity standards. The cap is gold plated from Handy & Harman fine gold anodes. Photo courtesy of Western Electric.



CAPACITOR CANS—These tantalum electrolytic capacitors are completely leaktight and highly resistant to corrosion. The containers that are also used to seal the liquid and internals are drawn from Handy & Harman fine silver sheet. Photo courtesy of Fansteel Metallurgical Corporation, North Chicago, Ill.



CAPACITORS—Electrodes in these solid-state porcelain capacitors are formed from silver paste derived from Handy & Harman silver flake. Other types of capacitors for high-temperature applications have lead wires of Handy & Harman Consil 998, a nickel-bearing alloy. Photo courtesy of Vitramon, Incorporated, Bridgeport, Conn.

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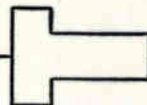


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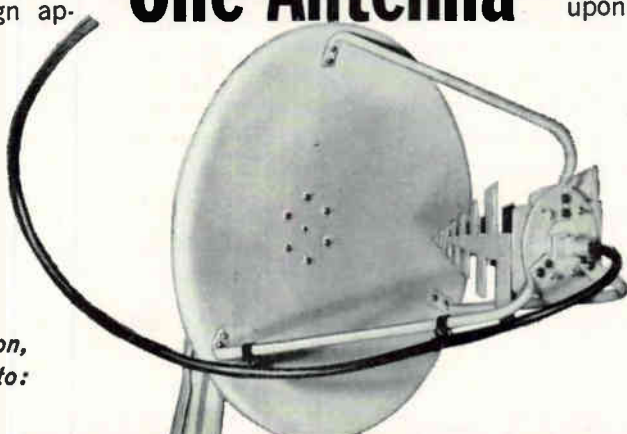
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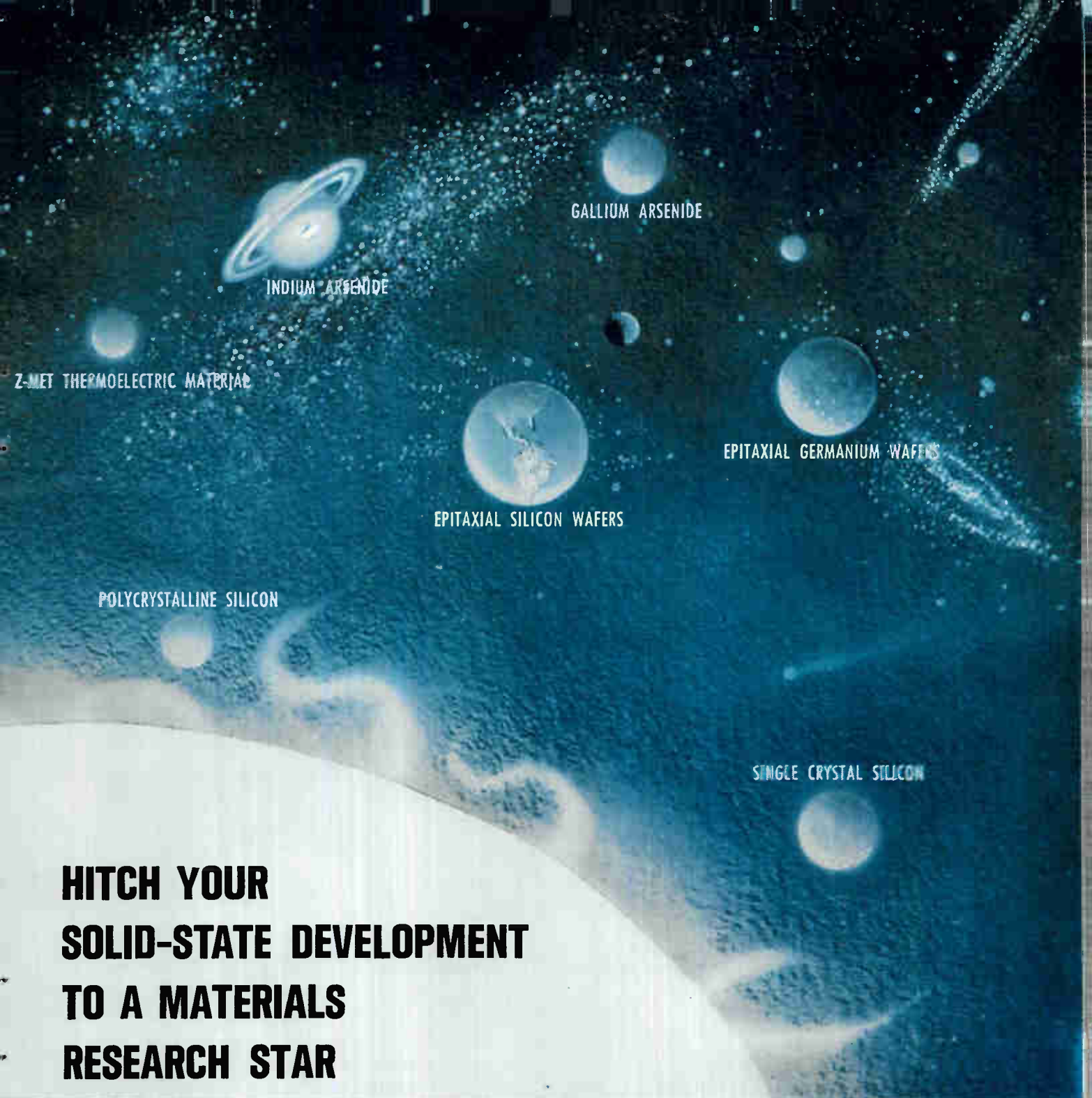
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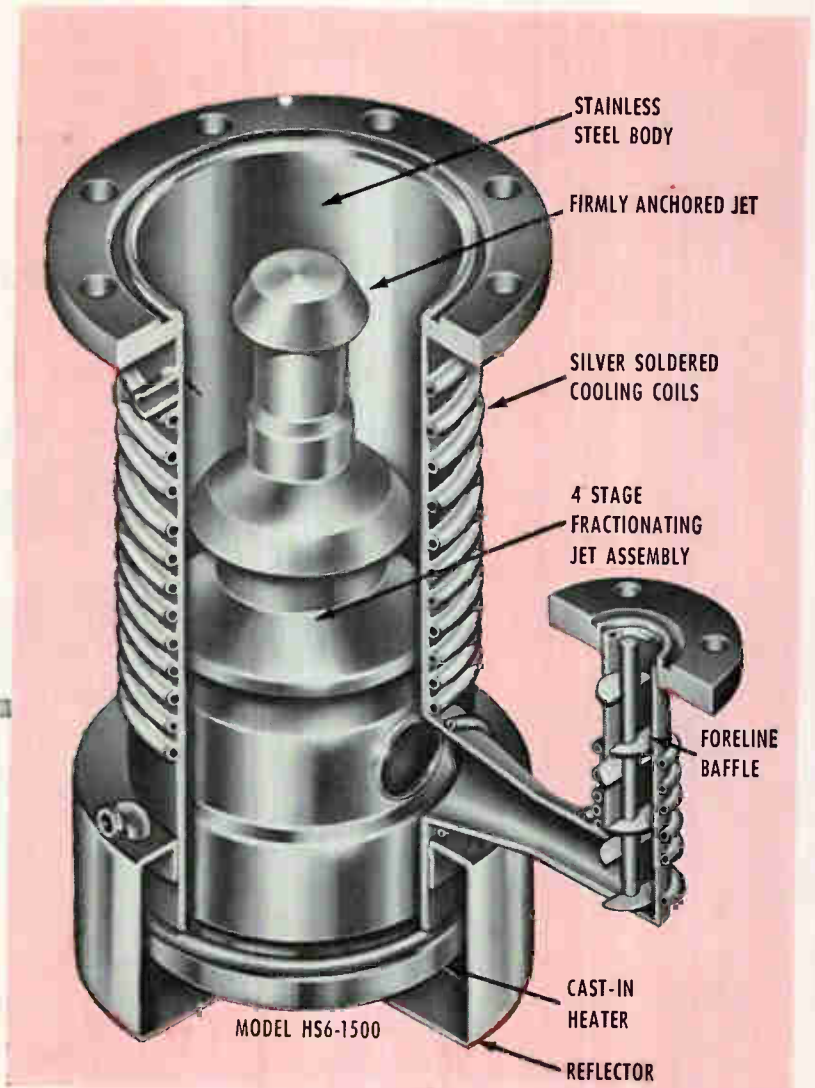
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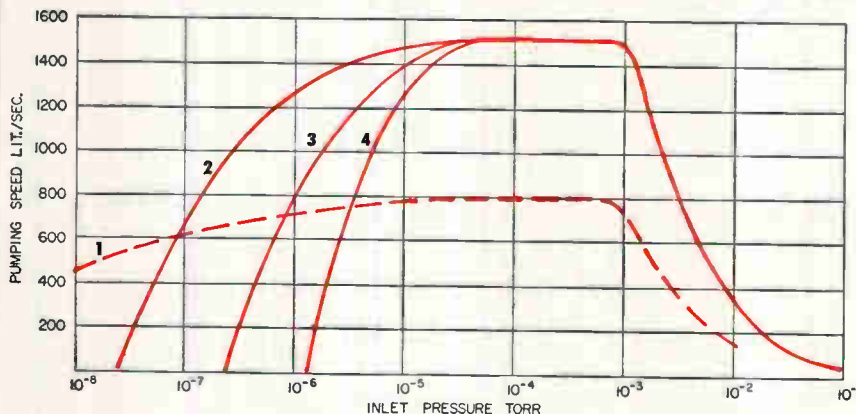
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PROGRAM SCHEDULE

TUESDAY, APRIL 18, 1961

8:30-10:00 A.M.

Registration. Terrace Casino, Morrison Hotel

10:00 A.M.

SESSION I. ANTHRACENE

Session Chairman: James J. Brophy

Invited Paper — **CHARGE CARRIER MOBILITY AND PRODUCTION IN ANTHRACENE CRYSTALS**

R. G. Kepler,
Central Research Department,
E. I. duPont de Nemours and Company,
Wilmington, Delaware

Invited Paper — **ELECTRONIC TRANSPORT IN ANTHRACENE AND OTHER ORGANIC SYSTEMS**

Oliver H. LeBlanc, Jr.,
General Electric Research Laboratory,
Schenectady, New York

12:00

CONFERENCE LUNCHEON

Constitution Room, Morrison Hotel
W. W. MacDonald, Toastmaster

Speaker:

J. F. Bourland, General Manager,
Central Research Laboratory,
American Cyanamid Company,
New York, New York
"A Management Appraisal
of Organic Semiconductors"

2:00 P.M.

SESSION II. POLYMERS

Session Chairman: Donald J. Berets

Invited Paper — **SEMICONDUCTION IN POLYMERS**

Herbert A. Pohl,
Plastics Laboratory,
Princeton University,
Princeton, New Jersey

ELECTRICAL PROPERTIES OF PYROLYTIC GRAPHITES

Claude A. Klein,
Research Division,
Raytheon Company,
Waltham, Massachusetts

ELECTRICAL CONDUCTIVITY IN PYROLIZED POLYACRYLONITRILE

W. D. Brennan and J. J. Brophy,
Physics Division,
Armour Research Foundation,
Chicago, Illinois
and

H. Schonhorn,
Stamford Laboratories,
Central Research Division,
American Cyanamid Company,
Stamford, Connecticut

STUDIES ON SOME SEMICONDUCTING POLYMERS

H. A. Pohl, J. Bornmann, and W. Itch,
Plastics Laboratory,
Princeton University,
Princeton, New Jersey

THERMAL CONDUCTIVITY OF MOLECULAR CRYSTALS

R. W. Keyes,
Research Center,
International Business Machines Corporation,
Poughkeepsie, New York

WEDNESDAY, APRIL 19, 1961

9:00 A.M.

SESSION III. SIMPLE MOLECULES

Session Chairman: William D. Brennan

Invited Paper — **GENERATION OF FREE CARRIERS AND ELECTRODE EFFECTS**

Marvin Silver,
U. S. Army Research Office,
Durham, North Carolina

ELECTRONIC PROPERTIES OF ORGANIC COMPOUNDS. I. HETEROCYCLIC COMPOUNDS

S. Aftergut and G. P. Brown,
General Engineering Laboratory,
General Electric Company,
Schenectady, New York

ELECTRONIC PROPERTIES OF ORGANIC COMPOUNDS. II. THEORETICAL CONSIDERATIONS ON THE EFFECT OF IMPURITIES

G. P. Brown and S. Aftergut,
General Engineering Laboratory,
General Electric Company,
Schenectady, New York

PHOTOCONDUCTIVITY AND INTERMOLECULAR INTERACTION IN NON-IONIC AROMATIC CRYSTALS

M. Y. Kleinerman and S. P. McGlynn,
Coates Chemical Laboratories,
Louisiana State University,
Baton Rouge, Louisiana

AN OPEN SHELL SELF-CONSISTENT FIELD METHOD FOR AROMATIC AND OLEFINIC ORGANIC MOLECULES

O. W. Adams,
Chemistry Division,
Armour Research Foundation,
Chicago, Illinois

12:00

CONFERENCE LUNCHEON

Constitution Room, Morrison Hotel
James J. Brophy, Toastmaster

Speaker:

W. O. Baker, Vice-President—Research,
Bell Telephone Laboratories,
Murray Hill, New Jersey
"Implications of Organic Semiconductors
for Industrial Science"

2:00 P.M.

SESSION IV. CHARGE-TRANSFER COMPLEXES

Session Chairman: John W. Buttrey

Invited Paper — **ELECTRONIC CONDUCTION IN MOLECULAR COMPLEXES**

Jan Kommandeur,
Parma Research Laboratory,
Union Carbide Corporation
Parma, Ohio

ELECTRONIC CONDUCTION AND EXCHANGE INTERACTION IN A NEW CLASS OF CONDUCTIVE ORGANIC SOLIDS

R. G. Kepler, P. E. Bierstedt and R. E. Merrifield,
Central Research Department,
E. I. duPont de Nemours and Company,
Wilmington, Delaware

OBSERVATIONS ON THE PARAMAGNETISM OF SOME ORGANIC SEMICONDUCTORS

Charles M. Huggins,
General Electric Research Laboratory,
Schenectady, New York

A COMPARISON OF MEASUREMENTS PERFORMED ON SINGLE CRYSTAL AND COMPRESSED MICROCRYSTALLINE CHARGE-TRANSFER COMPLEXES

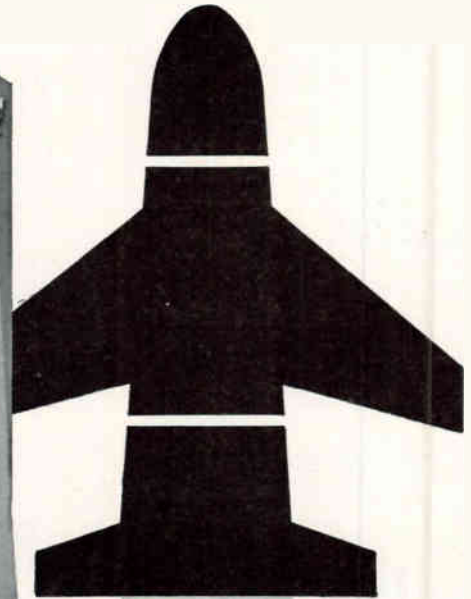
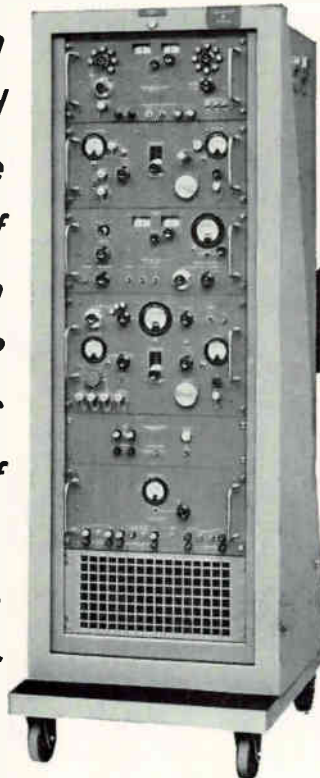
M. Labes, and P. L. Kronick,
Franklin Institute,
Philadelphia, Pennsylvania

Summary Invited Paper — PRESENT STATE OF ORGANIC SEMICONDUCTORS

David Fox,
State University of New York,
Long Island Center,
Oyster Bay, L. I., New York

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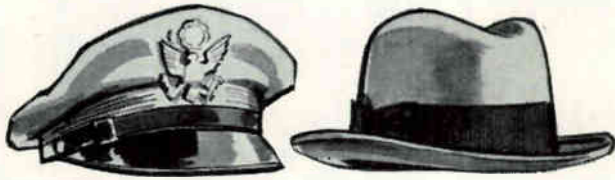
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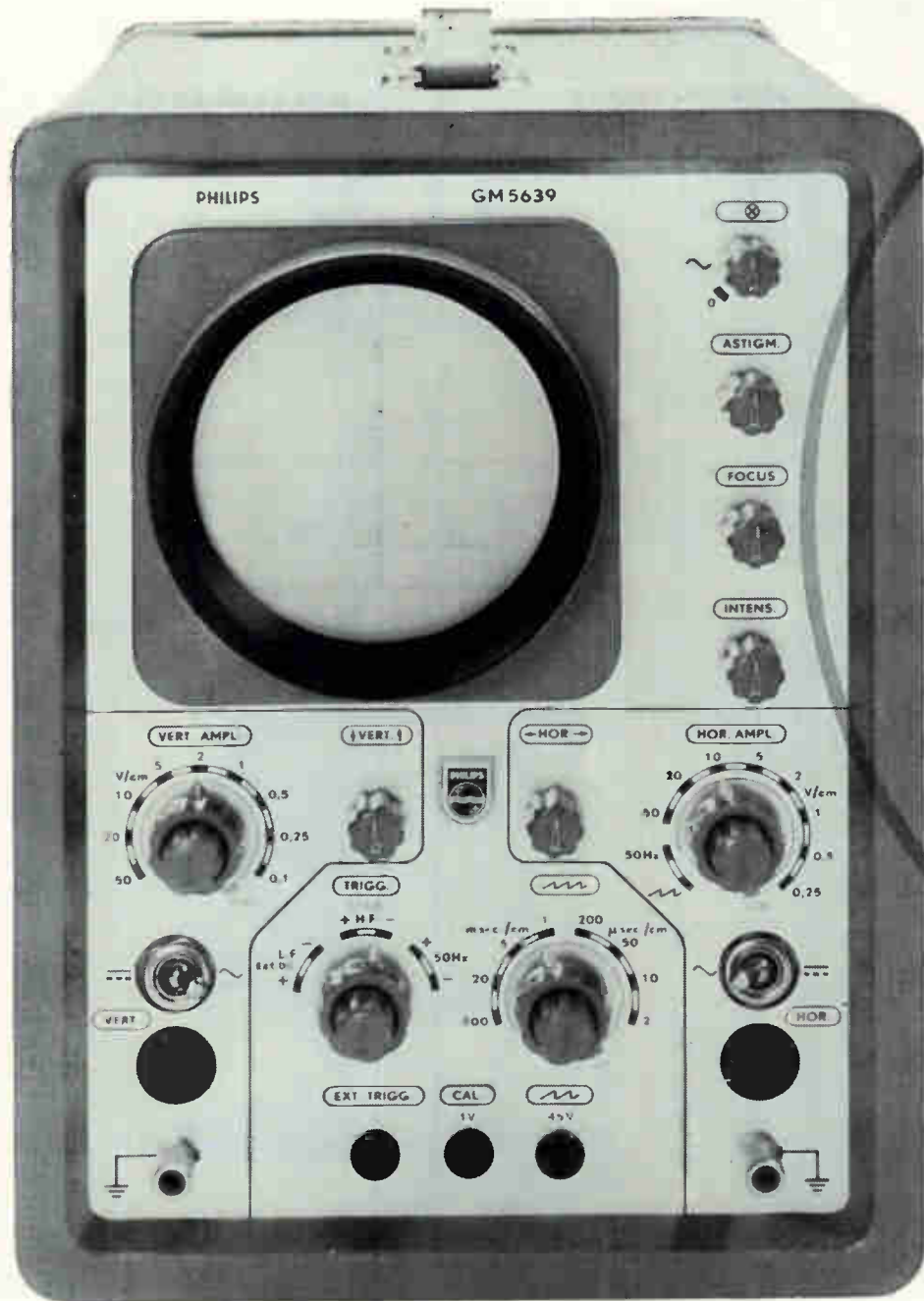
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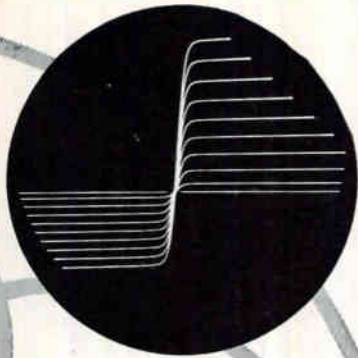
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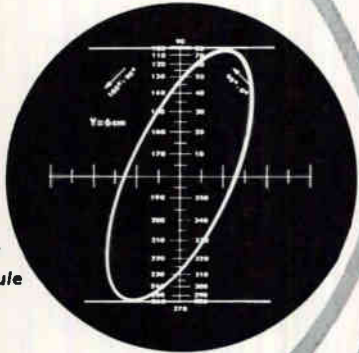
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Bandwidth : 0-1 Mc/s
Sensitivity : Y-amplifier 100 mV/cm, X-amplifier 200 mV/cm
Attenuation : up to 50 V/cm adjustable in 9 calibrated steps (accuracy $\pm 3\%$) and continuous 1:3
Relative phase shift less than 2° for frequencies up to 1 Mc/s.

Time base

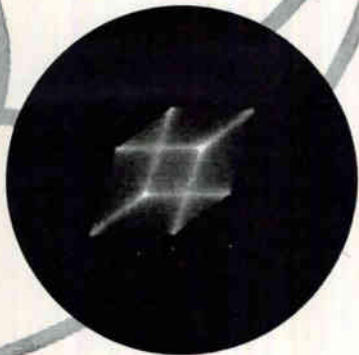
Sweep speeds : $2 \mu\text{s/cm}$ - 100 ms/cm adjustable in 8 calibrated steps (accuracy $\pm 5\%$) or continuously up to 600 ms/cm.
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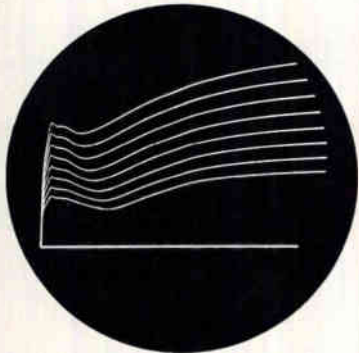
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Different graticules for curve tracing and phase measurements are supplied.

Comparison of
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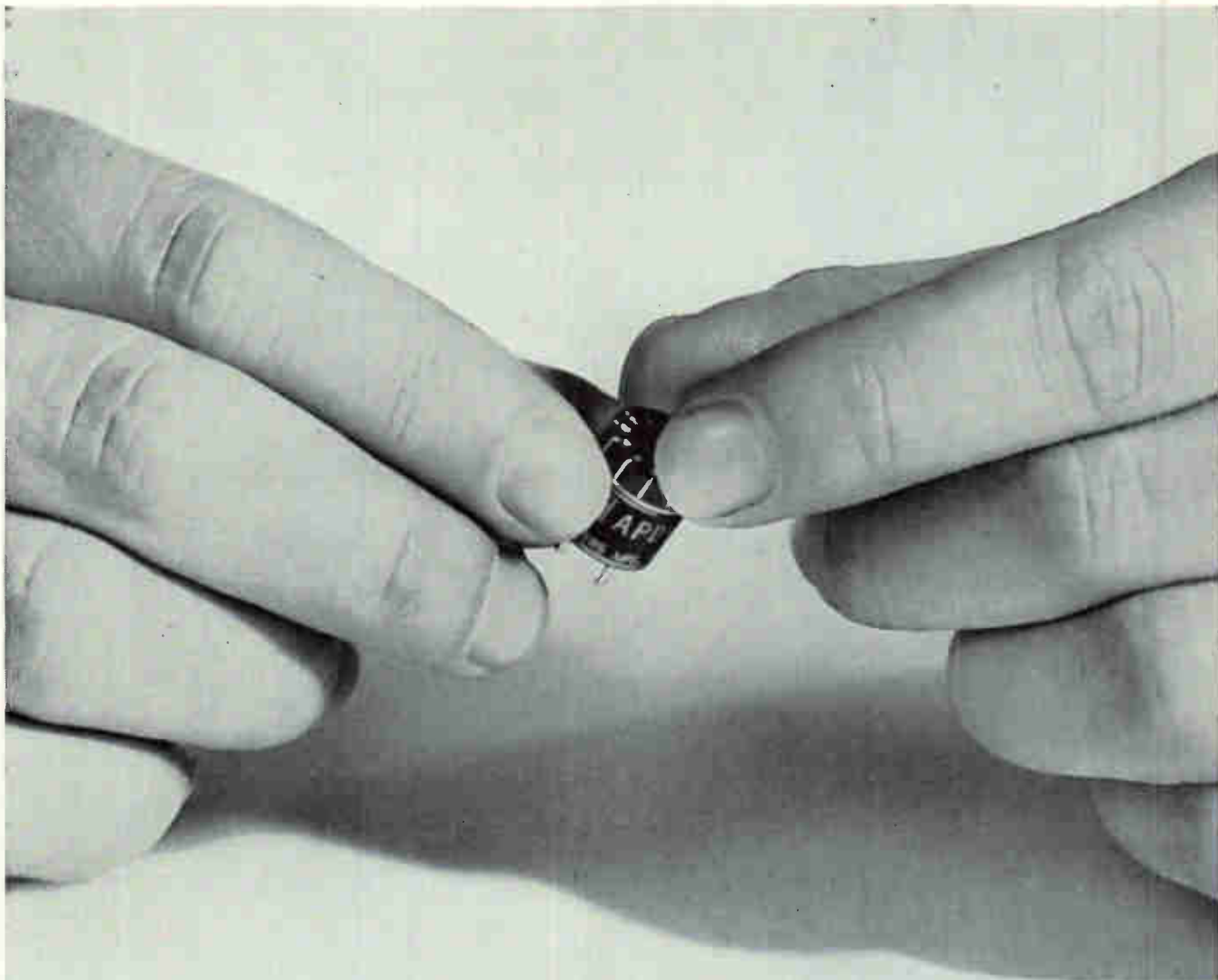


$I_a - V_a$ curves
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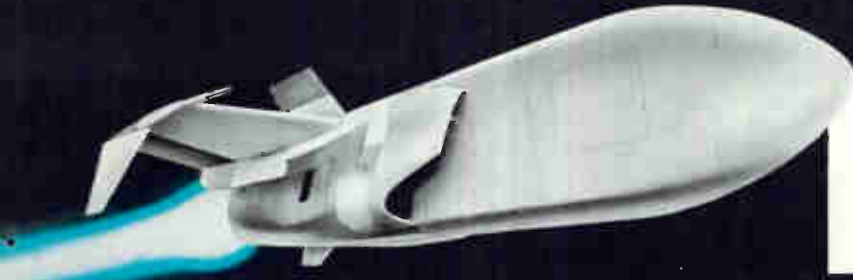
standard. The brush is phased so that the "0" graduation on the dial is in line with the scribe line at 0° functional rotation. Terminals are located on a standard .1 inch grid, as used in printed circuitry. Terminal numbers are clearly marked. Dissipates 1 watt at 40°C. Independent linearity (above 500 ohms.), ±3%. Meets MIL-R-19 and other specifications as applicable. Standard resistances: 50, 100, 500, 1K, 2K, 5K, 10K, 20K. Write for Bulletin APD-261.

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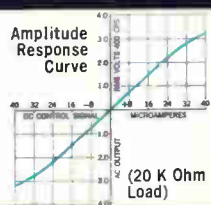
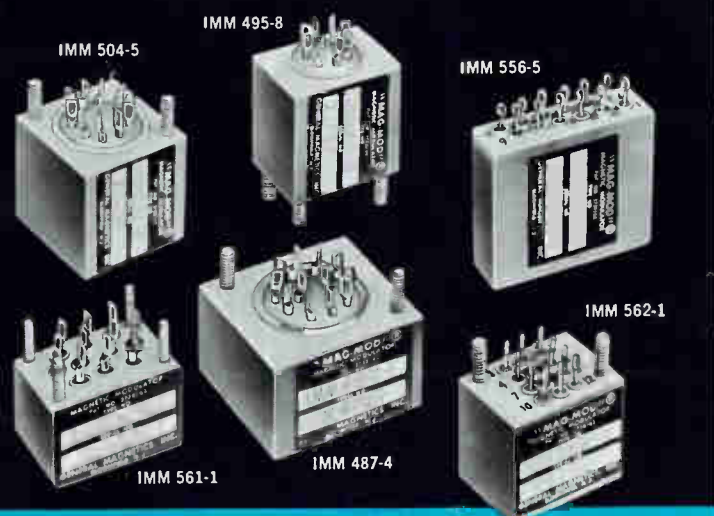


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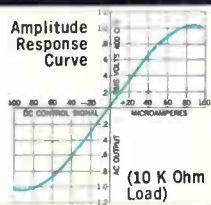
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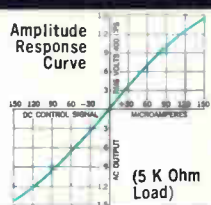
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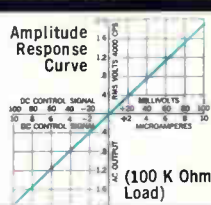
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Type No. IMM 487-4
 Subminiature "MAG MOD"® featuring high input signal sensitivity and high AC output impedance. Male or female mounting.



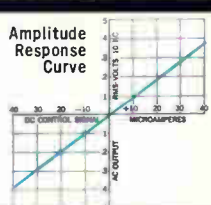
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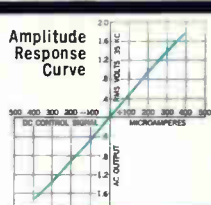
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 Subminiature "MAG MOD"® featuring low input and output impedance, resistance vs. temperature compensated input, extreme zero stability, repeatability and insignificant hysteresis. Supplied with male or female mounting.



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Type No. IMM 562-1
 Subminiature "MAG MOD"® featuring 4 KC carrier operation, wide frequency band width, high output impedance and voltage range. Mounting male or female.



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See reverse side
 for specifications



Specifications for General Magnetics' Sub-Ouncer Line of "MAG MOD" Miniaturized MAGNETIC MODULATORS

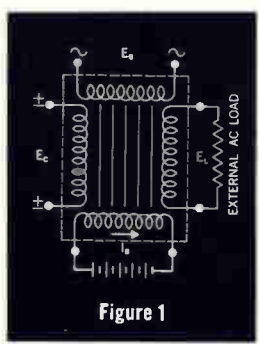
TYPE NUMBER	IMM 487-4	IMM 495-8	IMM 504-5	IMM 562-1	IMM 561-1	IMM 556-5
Excitation Carrier Voltage and Frequency	115 V @ 400 cps	115 V @ 400 cps	115 V @ 400 cps	2.5 V RMS @ 4 KC	1.0 V RMS @ 10 KC	6 to 10 V RMS @ 35 KC
Control Signal Winding DC Resistance	Winding No. 1 6200 ohms Winding No. 2 7400 ohms	Signal Winding No. 1 550 ohms Signal Winding No. 2 600 ohms	1000 ohms	Signal Winding 1300 ohms Feedback Winding 160 ohms	200 ohms	5000 ohms
Input Control Signal Range	0 to $\pm 40 \mu\text{a}$ Each Winding	0 to $\pm 100 \mu\text{a}$ (Both Sig. Windings in Series)	0 to $\pm 100 \mu\text{a}$	0 to $\pm 100 \mu\text{a}$ 0 to $\pm 1 \text{ V}$ Bipolar	0 to $\pm 400 \mu\text{a}$	0 to $\pm 400 \mu\text{a}$
Amplitude Modulated AC Output Range	3 V RMS @ 400 cps Phase Reversing	0 to 1 V RMS @ 400 cps Phase Reversing	0 to 1.5 V RMS @ 400 cps Phase Reversing	0 to 6 V RMS @ 4000 cps Phase Reversing	0 to 3 V RMS @ 4 KC Phase Reversing	0 to 1.8 V RMS @ 35 KC Phase Reversing
Differential Gain RMS mv AC Out/ μa Signal In	100 mv/ μa	15 mv/ μa	10 mv/ μa	200 mv/ μa	10 mv/ μa	4.2 mv/ μa
Null Amplitude (Noise Level) mv RMS	25 mv RMS Maximum	5 mv RMS Maximum	10 mv RMS Maximum	30 mv RMS Maximum	10 mv RMS Maximum	20 mv RMS Maximum
Output Impedance	Approx. 30 K ohms	1600 ohms	1000 ohms	Approx. 70 K ohms	Approx. 40 K ohms	900 ohms Each Output Wind.
External Load (Suggested)	Approx. 20 K ohms	Approx. 10 K ohms	Approx. 5 K ohms	Approx. 100 K ohms	Approx. 100 K ohms	1000 ohms Each Output Wind.
Null Drift (In terms of Input Signal) -65°C to $+135^\circ\text{C}$	Less than $\pm 0.25 \mu\text{a}$ Over Temp. Range	Less than $\pm 0.25 \mu\text{a}$ Over Temp. Range	$\pm 1 \mu\text{a}$ Maximum Over Temp. Range	$\pm 0.5 \mu\text{a}$ Maximum Over Temp. Range	$\pm 1 \mu\text{a}$ Over Temp. Range	$\pm 2 \mu\text{a}$ Over Temp. Range
Hysteresis (% of Input Control Signal)	0.5% Maximum	0.5% Maximum	0.5% Maximum	Approx. 0.5%	0.5% Maximum	0.5% Maximum
% Harmonic Distortion In Output AC Modulated Envelope	Approx. 40% (3rd Harmonic)	Approx. 25% (3rd Harmonic)	Approx. 30% (3rd Harmonic)	Approx. 15% (3rd Harmonic)	Less Than 10% (3rd Harmonic)	Approx. 5% (3rd Harmonic)
Overall Dimensions (In Inches)	$1\frac{1}{4} \times 1\frac{1}{2} \times \frac{3}{4}$	$\frac{3}{4} \times 1 \times 1$	$1 \times 1 \times 1$	$1 \times 1\frac{1}{16} \times \frac{7}{16}$	$1\frac{1}{16} \times 1 \times \frac{7}{16}$	$7/16 \times 1\frac{1}{4} \times 1\frac{1}{4}$
Type of Mounting	4-40 Studs or Inserts	4-40 Studs or Inserts	4-40 Studs or Inserts	4-40 Studs or Inserts	2-56 Studs	4-40 Tapped Holes or Studs
Weight in Ounces	Approx. 1.25	Approx. 1	Approx. 1.1	0.75	0.6	1
Response Time (Band Width cps)	0.01 sec. for 15 K Sig. Source Imp. (12 cps Corner Frequency)	20 cps for 10 K Sig. Source Imp. 25 cps for 20 K Sig. Source Imp. (Both Sig. Windings in Series)	5 cps for 1 K Sig. Source Imp. 10 cps for 5 K Sig. Source Imp. 20 cps for 10 K Sig. Source Imp.	70 cps for 10 K Sig. Source Imp. (Time Constant Approx. 2 Mill-Seconds)	Corner Frequency 2 KC for Sig. Source Imp. of Approx. 6 K ohms	Corner Frequency 200 cps for 600 ohm Signal Source Imp. or 1000 cps for 5 K Source

Magnetic Multiplying Modulator Model MCM 515-1



The MAGNETIC MULTIPLIER is a miniaturized magnetic modulator specifically designed to deliver an analog output voltage which is the continuous product of two variable input voltages. One of these is an excitation voltage which varies over a pre-determined range; in this case, 0 to 1 VRMS 400 cycles per second. The other signal is a DC current which varies between 0 and $\pm 400 \mu\text{a}$. The output voltage is 400 cycles AC, and is always in phase or 180° out of phase with the variable excitation or fixed reference, i.e., in phase when the variable amplitude DC signal is positive, and 180° out of phase when the DC signal is negative. The relationship between variable alternating supply signal voltage E_s , variable direct current control signal E_c , and the alternating load voltage E_L having a sinusoidal wave shape is denoted by the equation—

$E_L = \text{Constant} \times E_s \times E_c$



This expression, which defines the fundamental principle of the four quadrant MAGNETIC MULTIPLYING MODULATOR, can be clearly illustrated by linear transfer response curve families as shown at right, in Figure 2-A and Figure 2-B.

- Illustrating:
- (1) Load voltage E_L as a function of alternating supply signal voltage E_s with control DC signal voltage E_c as a parameter.
 - (2) Load voltage E_L as a function of control DC signal voltage E_c with alternating supply voltage, E_s as a parameter.

With linearity response curves held to within approximately 1 to 2% of theoretical straight lines, the product accuracy of the fundamental equation will be within 2 to 5% of the theoretical product.

SPECIFICATIONS MODEL MCM 515-1	
Variable Excitation Carrier Voltage and Frequency	Variable AC Signal 0 to 1 V RMS 400 cps
Control Signal Winding DC Resistance	DC Signal Winding Resistance 2650 ohms
Input Control Signal Range	Variable DC Signal 0 to $\pm 400 \mu\text{a}$
Amplitude Modulated AC Output Range	0 to 0.9 V RMS @ 400 cps Phase Reversing
Null Amplitude (Noise Level) mv RMS at Max. AC Excitation	5 mv RMS
Output Impedance	Approx. 3500 ohms
External Load (Suggested)	Approx. 25 K ohms
Null Drift (In terms of Input Signal) -65°C to $+135^\circ\text{C}$	$\pm 2 \mu\text{a}$ over Temperature Range
Hysteresis (% of Input Control Signal)	0.5% Maximum
% Harmonic Distortion In Output AC Modulated Envelope	Less than 5%
Overall Dimensions (In Inches)	$27/32 \times 27/32 \times 1 \frac{3}{16}$
Type of Mounting	4-40 Insert or Stud
Weight	Approx. 1 Ounce

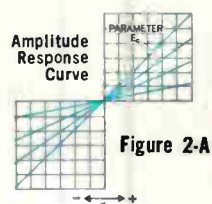


Figure 2-A

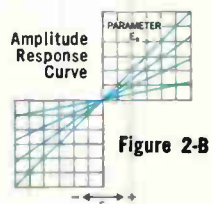


Figure 2-B

Typical "Mag Mod"® Applications—Circuit applications for MAGNETIC MODULATORS include algebraic addition, subtraction, multiplying, raising to a power, controlling amplifier gain, mechanical chopper replacement in DC to fundamental frequency conversion, filtering and low signal level amplification.

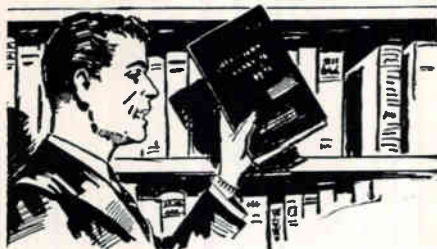
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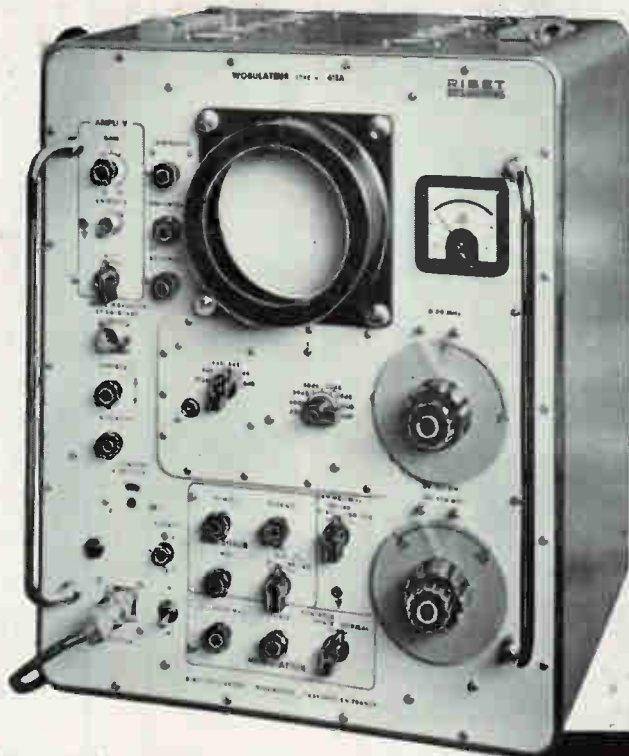
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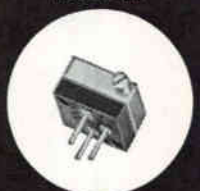
MODEL 60
Teflon insulated leads



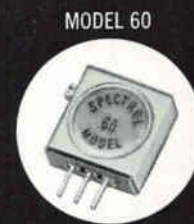
MODEL 80
Transistor size case



MODEL 80
Transistor size case, bushing mount



MODEL 50
Printed circuit pins from base



MODEL 60
Printed circuit pins, side adjust



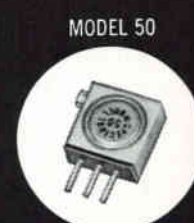
MODEL 50
Bushing panel mount



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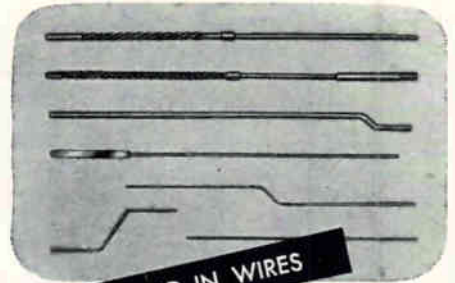
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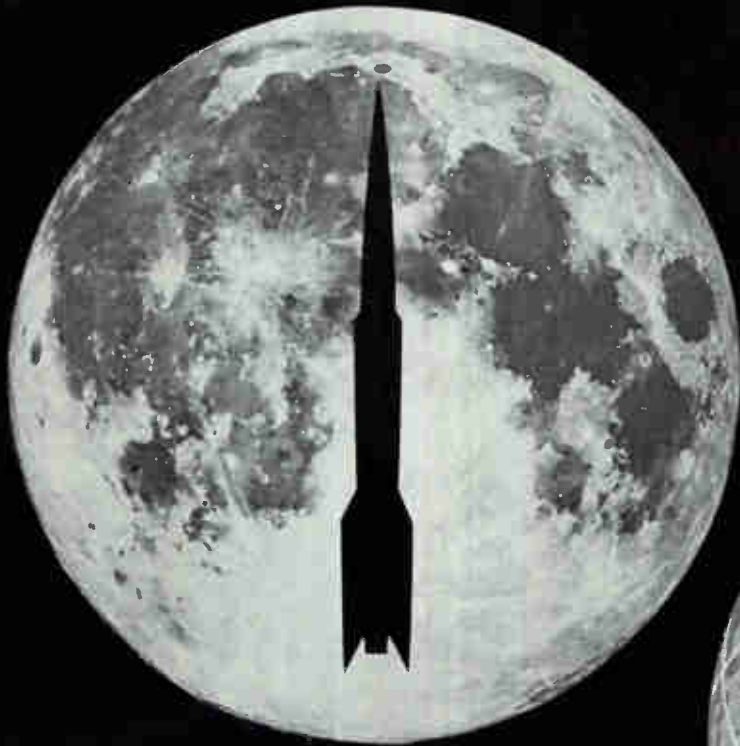


Solve your eyelet machine problems fast — Write today.

EYELET TOOL CO.
INCORPORATED

31 Carleton Street, Cambridge, Mass.

CIRCLE 307 ON READER SERVICE CARD
electronics



SPACECRAFT



AIRCRAFT

NOW UNDER ONE ROOF AT LOCKHEED / BURBANK

Lockheed California Division has expanded its already great resources at Burbank. For it now encompasses, under one roof, the two vast worlds of Spacecraft and Aircraft.

This typifies Lockheed policy to steadily advance the state of the art through basic research in related and scientific fields.

Result? Now—more than ever—Lockheed offers Scientists and Engineers uncommon opportunities; equips them with every modern facility; gives them freedom to explore and express new ideas; makes possible greater individual recognition.

Now being designed and developed in Spacecraft and Aircraft are: Hypersonic interceptors; V/STOL; supersonic interceptors; limocopters; missiles; manned spacecraft; and satellites.

Scientists and Engineers of outstanding talent are now invited to participate in this new, dual enterprise. Immediate

openings are available to: Aerodynamics engineers; thermodynamics engineers; dynamicists; electronic research engineers; servosystem engineers; electronic systems engineers; biophysicists; infrared physicists; hydrodynamicists; ocean systems scientists; physio-psychological research specialists; mammalian culture research specialists; and radiation hazards specialists.

Write today to Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 1503, 2408 N. Hollywood Way, Burbank, California.

LOCKHEED

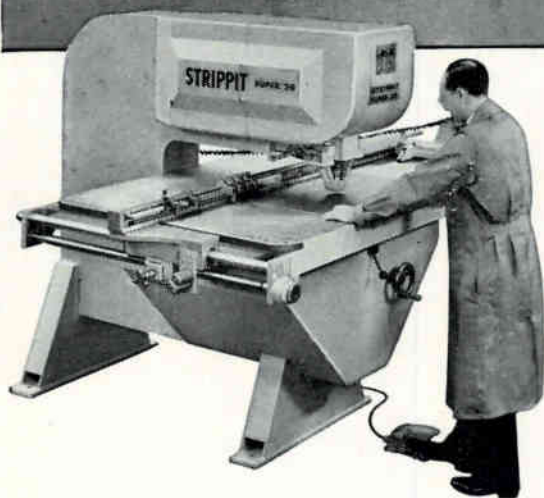
CALIFORNIA DIVISION

PUNCH COMPLICATED PATTERNS FAST

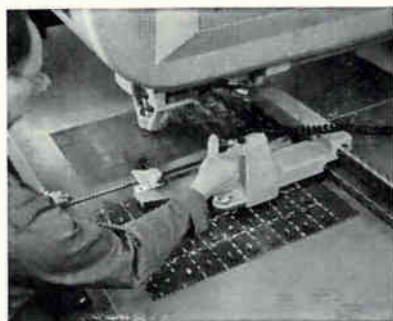


**IN SHEET METAL AND
PRINTED CIRCUIT BOARD**

**IRE
SHOW
booth 4010**



WORKPIECES 60" WIDE by any length are handled with ease by the STRIPPIT Super 30 Fabricator. This amazingly versatile machine will punch close-centered hole clusters in any material up to $\frac{1}{4}$ " thick ... notch and nibble square or contour cutouts in $\frac{1}{8}$ " material ... and, with the universal tool holder, standard and special tools can be interchanged in seconds to eliminate time-out between jobs. Flat punched parts produced require no deburring. See the STRIPPIT Super 30 featuring the new Electro-Hydraulic Head and Micrometric gauging demonstrated at the IRE Show.



FOR PRODUCTION RUNS, the integral STRIPPIT Duplicator functions like a pantograph to reproduce any hole pattern from a drilled or punched template. No custom dies are needed to turn out precision sheet metal parts or cold-punched printed circuit boards. Another accessory is the STRIPPIT Dupl-O-Scope, a precision optical device which can be mounted on the Duplicator. It enables the operator to work directly from a drawing, blueprint, layout or sample. 4-power scope zeroes-in on hole locations with extreme accuracy. See these cost-saving features at the IRE Show.



DRILL, REAM, CENTER PUNCH AND SCRIBE with tool room accuracy ... $\pm .002$ ". This STRIPPIT Flex-O-Drill saves time by eliminating the need for base line drawings and vernier height gauges. Anyone who can read blueprints and knows anything about layout practice can use the STRIPPIT Flex-O-Drill to reduce template making time by 50% or more. The Flex-O-Drill can handle stock up to 24" in width, any length, and $\frac{1}{4}$ " thick. Write STRIPPIT for a free demonstration in your plant. Or stop by Booth 4010 at the IRE Show.

WALES **STRIPPIT** INC.

225 Buell Road • Akron, New York



In Canada: Strippit Tool & Machine Company, Brampton, Ontario
In Continental Europe: Raskin, S.A., Lausanne, Switzerland *In the British Isles: E. H. Jones (Machine Tools) Ltd., Hove, Sussex, England*

now...

a METAL FILM resistor

for commercial as well as

military applications

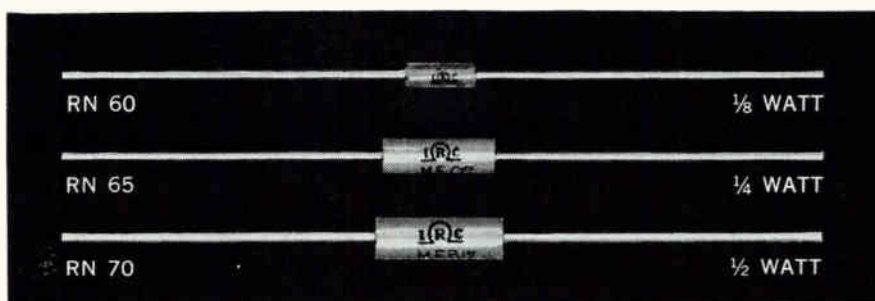
You and others in the industry have made increasing performance demands on deposited carbon and other film resistors because metal film has been too costly for many applications.

To continue our leadership as suppliers of precision film resistors, we set an objective—to produce a metal film resistor at a price comparable to deposited carbon resistor. *We have met our objective!*

IRC has invested nearly \$2,000,000 in plant, automated equipment and engineering to achieve this new dimension in Metal Film Resistors.

A new technical production breakthrough makes it economically feasible to specify premium performance Metal Film Resistors for commercial as well as military applications.

T-O Metal Film Resistors are available . . . now! Write for Bulletin B-3. International Resistance Company, 401 North Broad Street, Philadelphia 8, Pennsylvania.



MIL-R-10509:

CHARACTERISTIC B—exceeds all requirements.

CHARACTERISTIC C—Meets or exceeds all requirements except for ± 50 ppm. T.C.

CHARACTERISTIC D—meets or exceeds all requirements.

CHARACTERISTIC G—meets or exceeds all performance requirements without hermetic sealing.

TEMPERATURE COEFFICIENT: within ± 150 ppm.

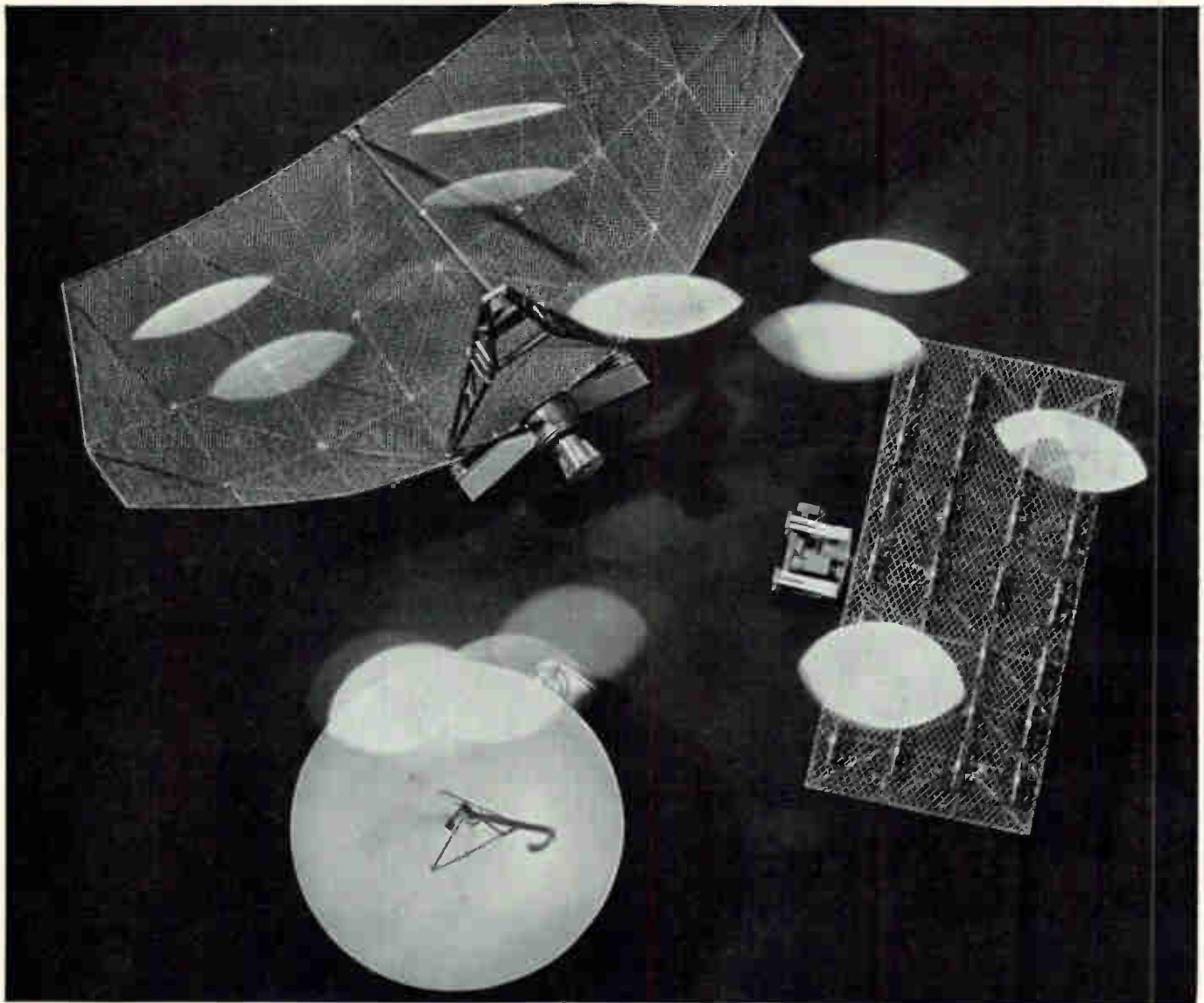
DESIGN TOLERANCE: approximately 5 times tighter than deposited carbon (MIL-R-10509, Characteristic B) resistors and 20 times tighter than carbon composition (MIL-R-11) resistors.

RESISTANCE TOLERANCE: 0.5% and 1%.

COST: Same as molded deposited carbon resistors.



Leading supplier to manufacturers of electronic equipment



I-T-E...single responsibility for antenna systems

The rigid specifications imposed by modern radar antenna systems requirements can be met only by a completely integrated facility. Engineers, precision-fabricating and experienced test personnel must be completely coordinated to translate, produce and test modern antenna systems.

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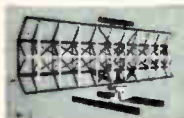
Worldwide, I-T-E antenna systems are on continuous guard. On shipboard and at landlocked airports, special I-T-E precision equipment transmit intelligence to control centers. This formidable history of performance is your assurance that specifications will be met . . . an insurance of a single responsibility from engineering to completed tests and service.

For further information call or write I-T-E Circuit Breaker Company, Special Products Division, Dept. EL, 601 E. Erie Ave., Phila. 34, Pa. GARfield 6-5700.



I-T-E CIRCUIT BREAKER COMPANY

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RESEARCH & DEVELOPMENT



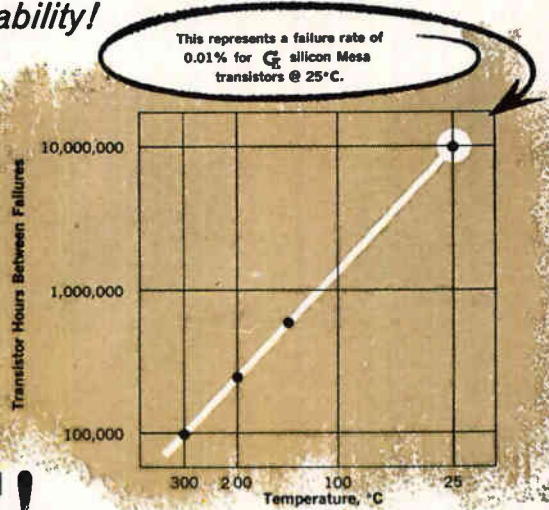
DESIGN & ENGINEERING



PRECISION MANUFACTURING

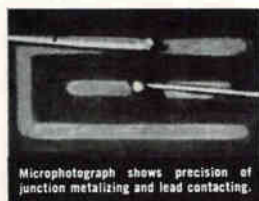
General Instrument Semiconductor... Leader in Reliability!

GI ANNOUNCES INDUSTRY'S MOST RELIABLE SILICON MESA TRANSISTORS!



PROOF! Extended life tests at each of temperatures shown above, demonstrate GI superior mesa performance with 0.01% per 1000-hrs. failure rate at 25°C.

General Instrument Semiconductor has achieved a major breakthrough in transistor manufacture! Through detailed research, careful product development and advanced production techniques we offer the most reliable silicon mesa transistors available today!



Microphotograph shows precision of junction metalizing and lead contacting.

Exclusive combination of reliability benefits offered by GI through long-term R & D:

- Advanced techniques of junction metalizing;
- Superior junction contacting;
- Permanent surface passivation;
- 100% lot stabilization with 96-hour bake at 300°C; and
- Critical analysis with automatic equipment for exhaustive parameter testing.

COMPLETE LINE OF GI SILICON MESAS... FROM STOCK

What are your needs? General Instrument offers a full line of double diffused NPN silicon mesas for your most exacting applications. Abbreviated ratings and characteristics below indicate a wide range of usefulness: Very high speed saturated switching; VHF tuned amplifiers; and units with high beta linearity for magnetic memory drivers

and video amplifiers.

Available in accordance with MIL-S-19500/99A (GI 2N696, 2N697) and MIL-S-19500/120 (GI 2N706). Contact General Instrument today for more information on these realistically-priced units, and the name of your local authorized stocking distributor.

TO-5		GENERAL INSTRUMENT NPN SILICON MESA TRANSISTORS									
Type	Case	RATINGS			Maximum Dissipation (T _{case} = 25°C)	I _{ceo}	CHARACTERISTICS				
		BV _{ceo}	BV _{ebo}				h _{FE} V _{CE} = 10 v I _C = 150 ma pulsed	h _{FE} V _{CE} = 10 v I _C = 50 ma f = 20 Mc	V _{BE} I _B = 15 ma I _C = 150 ma	V _{CE} (SAT.) I _B = 15 ma I _C = 150 ma	C _{ob} @ I _B = 0 V _{CE} = 10 v
2N696	TO-5	60 v	5 v	2 watts	@ V _{CE} = 30 v T = 25°C Ambient: 1 μa max T = 150°C Ambient: 100 μa max	20 min 60 max	2 min	1.3 v max	1.5 v max	35 pf max	
2N697	TO-5	60 v	5 v	2 watts	@ V _{CE} = 30 v T = 25°C Ambient: 1 μa max T = 150°C Ambient: 100 μa max	40 min 120 max	2.5 min	1.3 v max	1.5 v max	35 pf max	
2N699	TO-5	120 v	5 v	2 watts	@ V _{CE} = 60 v T = 25°C Ambient: 2 μa max T = 150°C Ambient: 200 μa max	40 min 120 max	2.5 min	1.3 v max	5.0 v max	20 pf max	
2N706	TO-18	25 v	3 v	1 watt	@ V _{CE} = 15 v T = 25°C Ambient: 0.5 μa max T = 150°C Ambient: 30 μa max	V _{CE} = 1 v I _C = 10 ma 15 min	V _{CE} = 15 v I _C = 10 ma f = 100 Mc 2 min	I _B = 1 ma I _C = 10 ma 0.9 v max	I _B = 1 ma I _C = 10 ma 0.6 v max	6 pf max	
2N1252	TO-5	30 v	5 v	2 watts	@ V _{CE} = 20 v T = 25°C Ambient: 10 μa max T = 150°C Ambient: 600 μa max	15 min 45 max	2 min	1.3 v max	1.5 v max	45 pf max	
2N1253	TO-5	30 v	5 v	2 watts	@ V _{CE} = 20 v T = 25°C Ambient: 10 μa max T = 150°C Ambient: 600 μa max	30 min 90 max	2.5 min	1.3 v max	1.5 v max	45 pf max	
2N1420	TO-5	60 v	5 v	2 watts	@ V _{CE} = 30 v T = 25°C Ambient: 1.0 μa max T = 150°C Ambient: 100 μa max	100 min 300 max	2.5 min	1.3 v max	1.5 v max	35 pf max	

See you at the IRE Show Booths 1101-1106

GENERAL INSTRUMENT
GENERAL TRANSISTOR

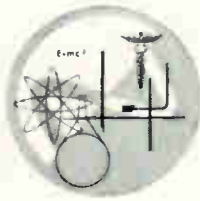


SEMICONDUCTOR
DIVISION OF GENERAL INSTRUMENT CORPORATION

55 Gouverneur Street, Newark 4, New Jersey



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 - Microwave accelerated particles
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 - Velocity and phase by interferometry
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**NEW FERRITE-LOADED
 CRYSTAL MULTIPLIER**



You have long wanted more power at Ultra-microwave® frequencies. These ferrite-loaded harmonic generators deliver 10 db more power at the second harmonic.

Units are available with outputs to 200 KMC sec.

CIRCLE 375 ON READER SERVICE CARD

UNIQUE FERRITE ISOLATORS

We use a special ferromagnetic compound in these units.
 Result: improved unidirectivity.

Typical Specifications

- Frequency range: full waveguide bandwidth
- Insertion loss: 1.0 db max.
- Isolation: 30 db min.
- VSWR: 1.15 max.
- Overall length: 5 7/8"



CIRCLE 374 ON READER SERVICE CARD

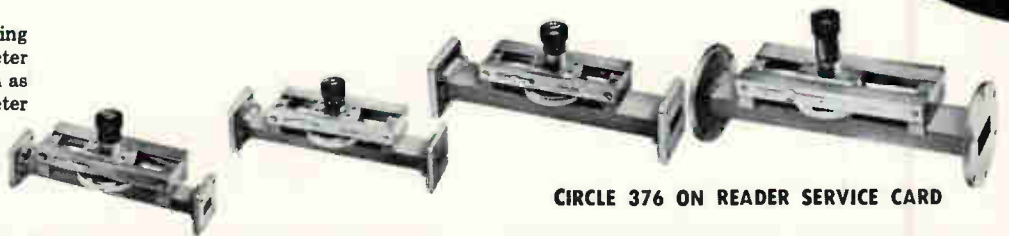
CLICHE' DEPT.

*We not only claim
 "the most complete line"
 —we have it!*

DE MORNAY

STUB TUNERS

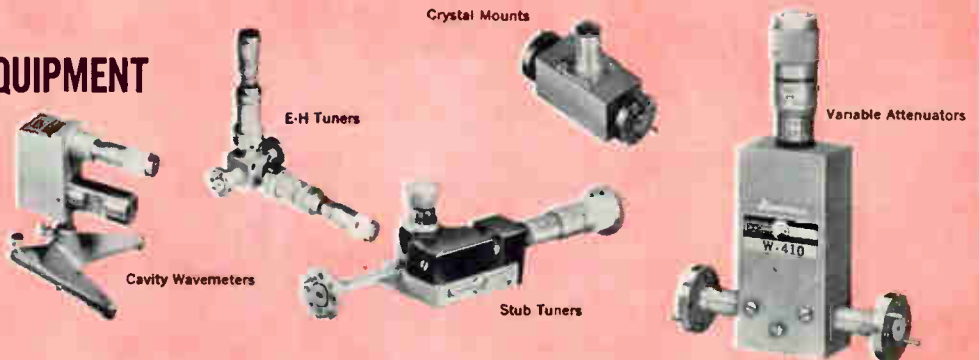
—the finest money can buy, offering precise resettability . . . micrometer depth control . . . VSWR as high as 20/1, as low as 1.02 . . . micrometer readout to .0001".



CIRCLE 376 ON READER SERVICE CARD

ULTRAMICROWAVE® EQUIPMENT

This line—the most widely used in America today—has opened new horizons in microwave applications. If you are interested in higher and higher frequencies, get in touch with us—we're now working with frequencies up to 300 KMC/sec.



CIRCLE 377 ON READER SERVICE CARD

WHAT IS THE FREQUENCY STANDARD FOR THE U.S.A.?

ANSWER: By act of congress, the U.S. Bureau of Standards determines the primary standard, based on the revolution of the earth. Our unique design, methods, and environmentally controlled calibration procedures enable us to deliver production cavity wavemeters calibrated to an accuracy of 1×10^4 . Transfer of frequency calibration from U.S. Bureau of Standards data is accomplished well within the limits defined.

Exclusive features:

- Hermetically sealed
- Temp. comp. 10^{-5} fMc/°C, -30 to +70°C
- Covers full waveguide bandwidth
- High Q values
- .0001 micrometer resolution



CIRCLE 378 ON READER SERVICE CARD

A CHALLENGE TO YOU!

Buy any one of our 1500 stock items. Try it. If it doesn't meet our specifications, the person who verifies this and notifies us will receive a reward of \$50.00.

This offer holds good for orders placed until the end of the month following publication of this issue.

BONARDI

OLD! OLD! OLD!

—yes, we're proud to have the oldest name in the business.

AWARD of MERIT

THIS ANNUAL AWARD IS MADE IN RECOGNITION OF OUTSTANDING ACHIEVEMENT IN INDUSTRIAL DESIGN

TO DeMORNAY-BONARDI
FOR PRECISION STANDING WAVE DETECTOR

Credits to Individuals
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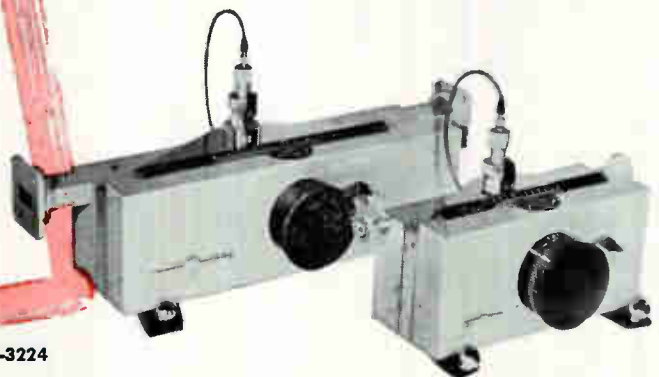
Presented at Los Angeles, August, 1960

See us at The I.R.E. Show — Booths #3222-3224

STANDING WAVE DETECTORS

Exceptionally accurate . . . patented, gearless, infinitely variable speed drive . . . linear displacement readout to .01 mm . . . direct phase readout . . . only 30 seconds to change to any of 10 other waveguide sections, with perfect alignment.

Available from 5.8 KMC to 300 KMC.



CIRCLE 379 ON READER SERVICE CARD

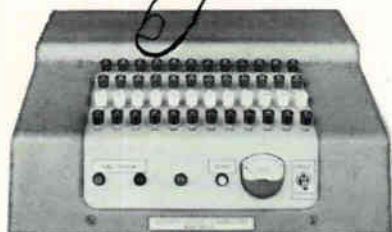
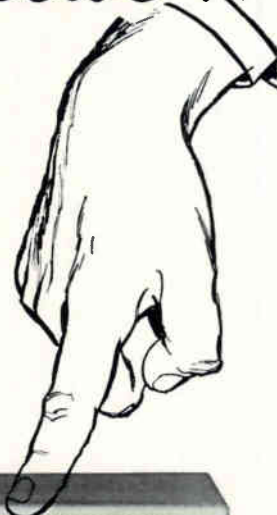
You decide...

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SELECTIVE SIGNALING

Yes, YOU make the decisions, selectively . . . to activate or alert over 11,000 individual groups of decoder equipped units. The 12 tone 4 pulse sequential transmission eliminates the need for continuous receiver monitoring.

Although designed primarily to operate in conjunction with decoders, the versatile encoder is ideally suited for use in almost any encoding system.

The ET12-4 Encoder employs our highly stable "Resonator" Resonant Reed Oscillator controls as frequency determining devices. The infinite life characteristic and low power consumption of Resonators coupled with transistors as active elements, provide years of economical trouble-free service.

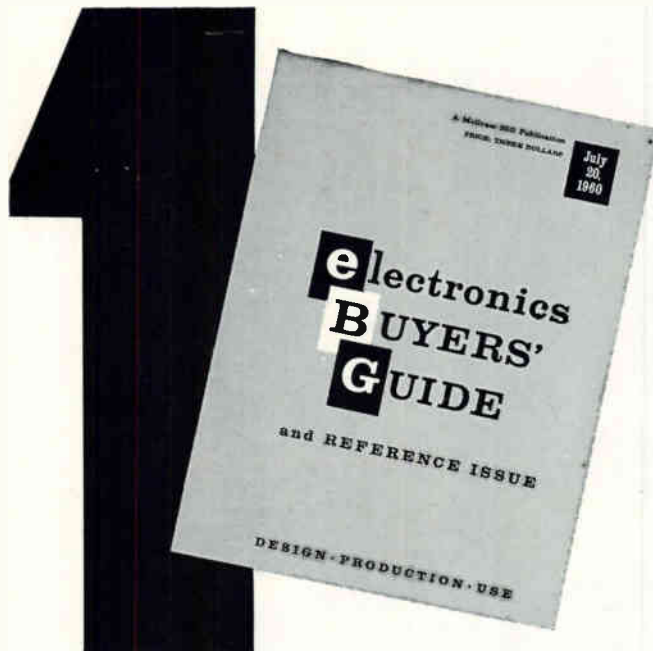


Complete specifications and application data on request.

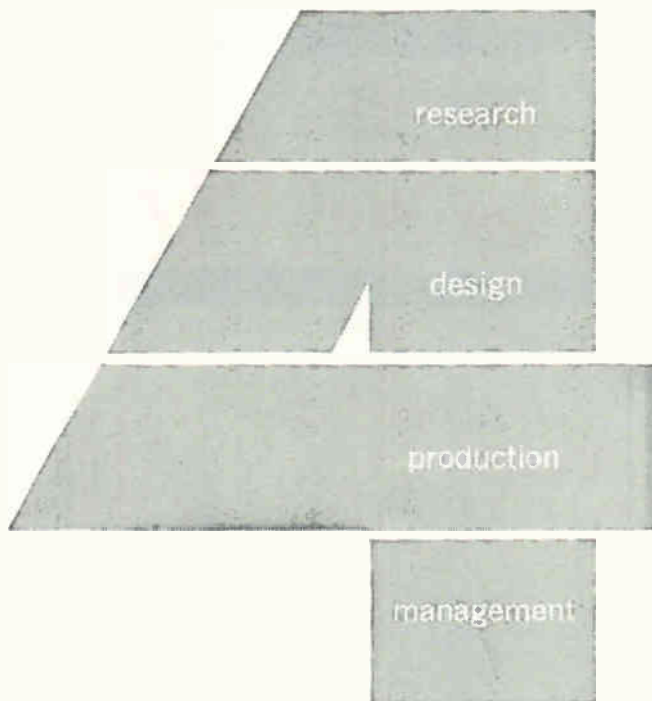


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and REFERENCE ISSUE**

11 REELS IN 1

With the revolutionary new Potter High Density Recording System, each reel of 1-inch tape holds as much data as 11 reels recorded by the most widely used computer tape system.

For highly reliable computer applications, Potter High Density recording can give you data transfer rates of 360,000 alphanumeric characters per second or more, at densities to 1500 bits per inch on 1-inch tape. Sixteen parallel channels can be accommodated on one-inch tape. Because Potter has made the information channels self-clocking, no separate clock channel is needed, and multichannel data can be read out in true parallel form, despite inter-channel time displacement.

WITH POTTER HIGH DENSITY RECORDING

In production units delivered by Potter, this dramatic new technique makes recording so reliable that in 40 hours of continuous operation, less than 2 seconds re-read time are required to recover information lost through transient error. Dropouts are fewer than 1 in 10^7 at densities up to 1500 bits per inch. More than 20,000 passes of the tape can be made without losing information or significantly increasing the dropout rate.

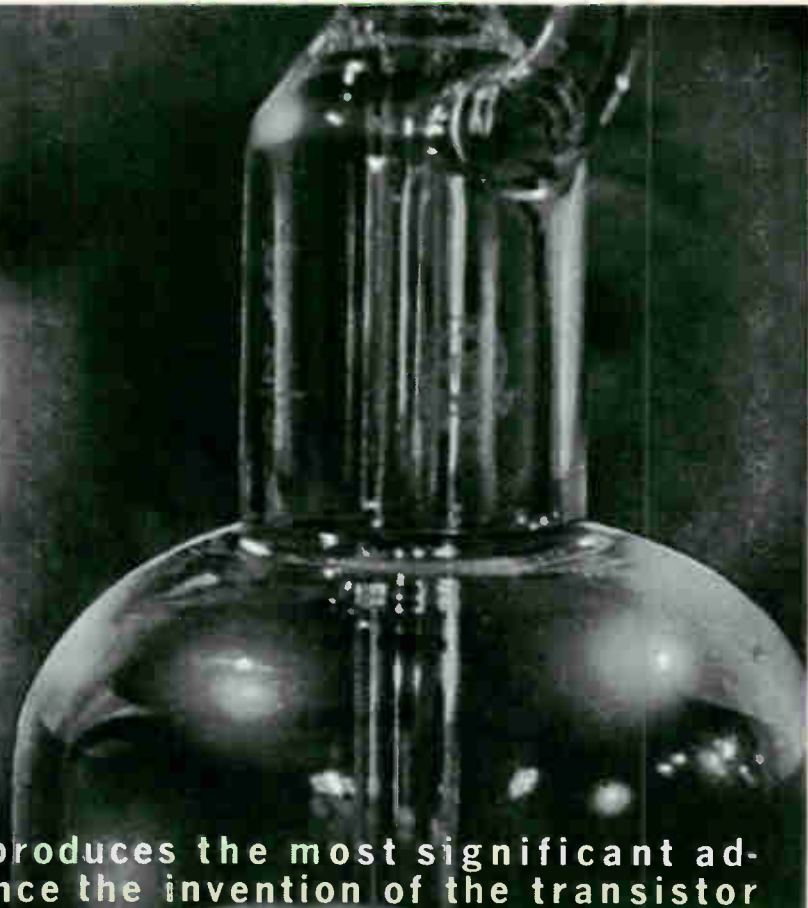
Tested and proven in computer systems, Potter High Density Recording is presently available in the Potter 906II High Speed Digital Magnetic Tape Handler, and will be available in other Potter Tape Systems.

Write today for details on how High Density Recording can be applied to your data handling problem.

See us at the IRE — Booths 3405-3407

POTTER INSTRUMENT COMPANY, INC. • SUNNYSIDE BOULEVARD, PLAINVIEW, NEW YORK

MicroSemiconductor
announces the
industry's smallest, most
reliable diode



an entirely new concept produces the most significant advance in semiconductor devices since the invention of the transistor

MicroSemiconductor Corporation has perfected a revolutionary surface passivation concept making possible unprecedented size reduction resulting in virtually unlimited reliability in semiconductor devices. Success in stabilizing erratic surface properties of semiconductors has enabled MicroSemiconductor to eliminate more than 90% of device failure mechanisms together with elaborate, bulky packaging and failure due to device-package interaction. In MicroSemiconductor products, circuit designers and packaging engineers now have available discrete, active, micro-size components suited to the ever more critical requirements of advanced electronics.

MICRO DIODE PACKAGES . . . SMALLER AND MORE RELIABLE THAN EVER!



To fit your particular component requirements, MicroSemiconductor Corporation offers micro-miniature rectifiers and diodes in smaller-than-ever packages . . . in a variety of configurations. These complete, encapsulated circuits and packaged assemblies combine exceptional reliability . . . compactness . . . extremely rugged construction. Detailed specifications are available to meet individual requirements.



MICROSEMICONDUCTOR CORPORATION

11250 PLAYA COURT, CULVER CITY, CALIFORNIA

Technical Representatives of the Company will be at the Savoy-Hilton during the I.R.E. Show, March 18-24. Inquire at the desk for Suite No.

SPECIFICATIONS

IA. SILICON MICRO MINIATURE RECTIFIERS

MSC TYPE	PEAK INVERSE VOLTAGE (v)	MAX. AVERAGE RECT. MAX. REVERSE CURRENT @ PIV (μA)				MAX. TEST CURRENT (mA)
		@ 25°C	@ 150°C	@ 25°C	@ 150°C	
MC020	200	200	50	.2	15	400
MC040	400	200	50	.2	15	400
MC060	600	200	50	.2	25	400
MC080	800	200	50	.3	30	200
MC100	1000	200	50	.5	50	200

IB. SILICON ULTRA-FAST COMPUTER MICRO DIODES

MSC TYPE	EQUIV.	FORWARD CURRENT @ 1 VDC	BREAKDOWN VOLTAGE	CAPACITY @ 0 VDC	INVERSE CURRENT		REV. RECOV. (NANOSEC)
					25°C	150°C	
MC001	FD100	10	75 @ 5 μA	2	1(-50V)	100(-50V)	2
MC002	FD200	100	200 @ 100 μA	5	1(-150V)	100(-150V)	50

III. PARTIAL LISTING OF MICRO DIODES TO ESTABLISHED SPECIFICATIONS (Types for Fast Recovery)

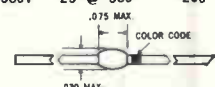
MSC TYPE	MINIMUM SATURATION VOLTAGE @ 100 μA (VOLTS)	MINIMUM FORWARD CURRENT @ +1.0 VOLT (mA)	MAXIMUM REVERSE CURRENT (μA)		REVERSE RECOVERY CHARACTERISTICS	
			25°C	100°C	REVERSE RESISTANCE (OHMS)	MAXIMUM RECOVERY TIME (μs)
MC643 (IN643)	200	10	.025(10V)	5(10V)	200K	0.3
MC658 (IN658)	120	100	.05(50V)	25(50V)*	80K	0.3
MC659 (IN659)	60	6	5(50V)	25(50V)	400K	0.3
MC663 (IN663)	100	100	5(75V)	50(75V)	200K	0.5

* @ 150°C

MSC TYPE	EQUIV.	FORWARD CURRENT @ 1 VDC	BREAKDOWN VOLTAGE @ 100 μA	CAPACITY @ 0 VDC	INVERSE CURRENT @ 25°C	150°C	REV. RECOV. (NANOSEC)
MC914	1N914	10	100	4	.025(-20V) 5.0(-75V)	50(-20V)	4
MC916	1N916	10	100	2	.025(-20V) 5.0(-75V)	50(-20V)	4

IIB. SILICON GENERAL PURPOSE DIODES

MSC TYPE	MINIMUM SATURATION VOLTAGE @ 100 μA VOLTS	MINIMUM FORWARD CURRENT @ +1.0 VDC @ 25°C (mA)	MAX. INVERSE CURRENT AT MAX. DC OPERATING VOLTAGE (μA @ VOLTS)	MAXIMUM AVERAGE RECTIFIED CURRENT (mA)
MC459A (1N459A)	200	100	.025 @ 175	5 @ 175
MC488A (1N488A)	420	100	.100 @ -380V	25 @ 380



PHYSICAL CHARACTERISTICS

- Hermetic Seal - Stable Surface Films integrally Bonded to the Device Crystal
- Terminals .003 x .018 gold plated leads, lead length 1/2" minimum
- Marking-type number designated by color of body and color stripes on pointed (cathode) lead
- Encapsulation - not required
- Operating Temperature Range: -65°C to +200°C
- Storage Temperature: 300°C
- Thermal Shock: -65°C to +200°C (no delay in transfer)
- Power Dissipation: 300 mw @ 25°C

RCA Image Orthicons

TV's

Star Performers



Capable of converting the focused scene into video information having superlative resolution, high signal-to-noise ratio, and remarkable fidelity, RCA Image Orthicons play a major role in extending the techniques of TV broadcasting beyond previous concepts of camera technology.

World-famed designer and manufacturer of Image Orthicons, RCA can provide a type to meet virtually every modern TV-camera need—whether the application involves color or black-and-white, indoor or outdoor operation, low-level or high-level lighting.

Accept this invitation to evaluate RCA Image Orthicons in connection with your specific camera design. Simply contact the RCA Field Office nearest you. For technical information on specific types write: Section A-19-Q-3, Commercial Engineering, RCA Electron Tube Division, Harrison, N. J.

Facts About RCA Image Orthicons

Type	Description
RCA-7295-A	Designed for tape and B&W studio broadcast use. High resolution capability and very high signal-to-noise ratio. Features new Field Mesh.
RCA-7389-A	Superior quality, extremely high signal-to-noise ratio. For tape recordings and exceptionally high-quality B&W pickup. Features new Field Mesh.
RCA-5820	Studio and outdoor pickup in B&W. The "standard" of broadcasting.
RCA-7293-A	Fine performance in B&W studio cameras. Features Field Mesh and anti-ghost, image-section design.
RCA-7513	Precision construction for color and high-quality B&W TV. Features Field Mesh.
RCA-4401	High signal output—for studio or outdoor color or B&W light level situations. Matched sets for max. performance in color cameras.
RCA-4401-VI	High sensitivity and high signal output. For B&W remote pickup at very low light levels.

RCA Electron Tube Division Field Offices

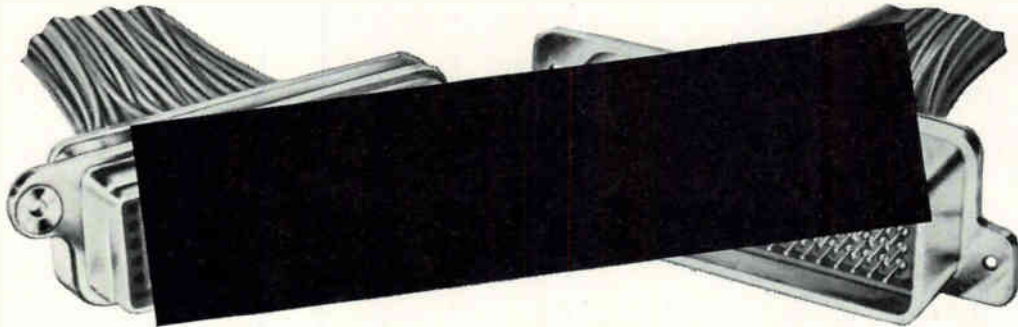
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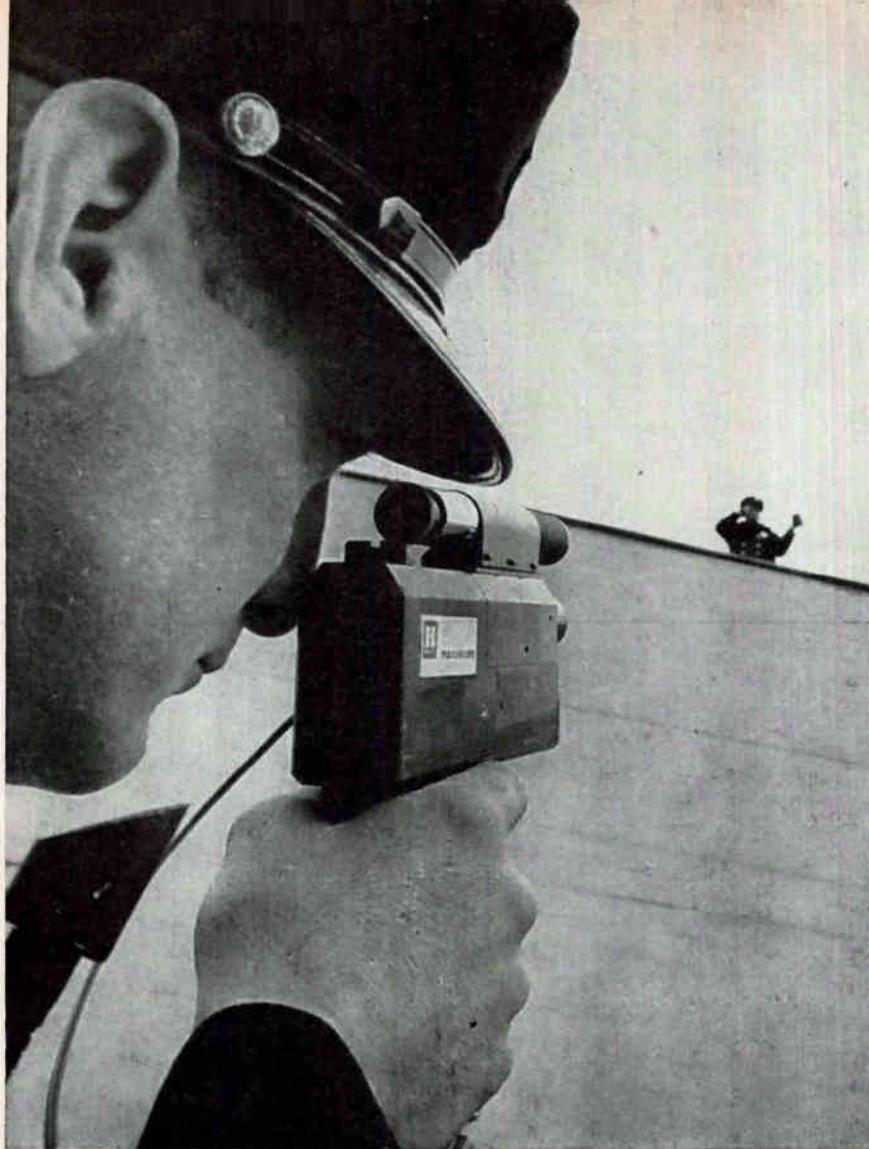
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Heart of the communications system described here is a semiconductor device that modulates infrared radiations. Transceiver combinations form communications links of high security and reliability



Solid-State Modulators for Infrared Communications

By P. W. KRUSE, Staff Scientist, L. D. McGLAUCHLIN, Research Section Head,
Honeywell Research Center, Hopkins, Minn.

THERE ARE a number of situations in which communication by radio has serious drawbacks. Transmission and reception are generally omnidirectional so that power requirements are high and eavesdropping can be prevented only by complex coding or modulation techniques. The Federal Communications Commission restricts communications to assigned frequencies. The relatively long wavelengths employed require large antennas

for reasonable efficiency.

An optical communications system, on the other hand, overcomes some of these disadvantages. It can be made highly directional to conserve power and maintain secrecy. No governmental agency regulates this means of communication. The relatively short wavelengths make it possible to achieve high efficiencies with small reflectors to replace both transmitting and receiving antenna arrays. To save weight in an

optical space-communication system, the sun could be used as the source of radiant energy, which could then be modulated.

There are two different approaches that can be used to get modulated radiant energy. The first uses direct modulation of a source of radiation, as by modulating the electrical power supplied to a gas discharge lamp¹ or an incandescent filament lamp. The gas discharge lamp is the more widely used, hav-

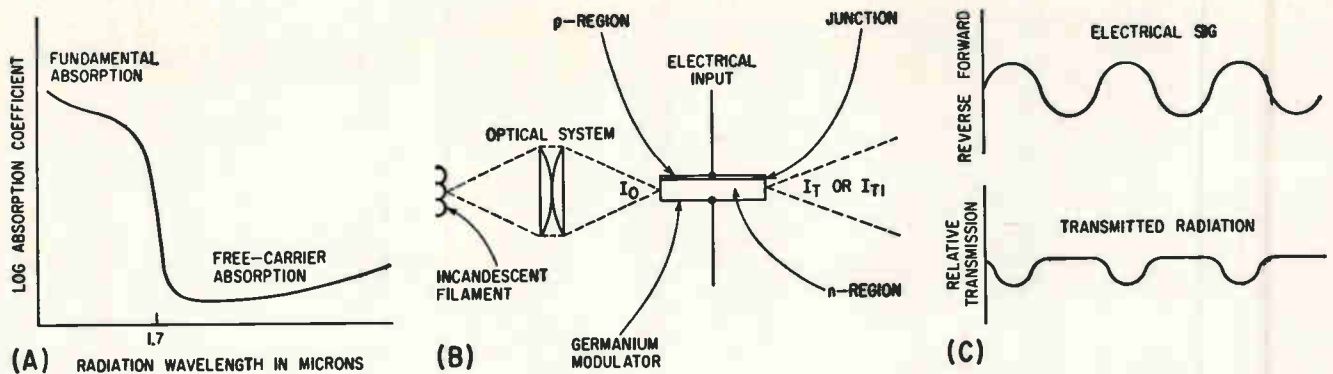


FIG. 1—Absorption characteristics of germanium (A). An electrical input signal to modulator (B) varies the infrared transmitted through the modulator (C)

ing been employed by both sides in World War II. Direct modulation of incandescent filaments has been used to a limited extent in short-range systems requiring low power.

The second method uses an external mechanical or electrical modulator interposed in the path of the radiant energy emanating from a steady source. Examples of mechanical methods are reflection systems based upon galvanometer mirrors, vibrating shutters or rotating blades. Such systems are limited in frequency response by the mechanical inertia of the moving parts. Electrical systems in general are based upon modulation of the optical transmission of materials. Electrooptical phenomena employed include the Kerr and Faraday effects. Although the response time of these effects can be less than a microsecond, the large power dissipation requires pulsed operation with a small duty cycle. Whereas the spectral content of mechanically modulated radiation is usually dictated by the spectral content of the source, that of electrically modulated systems may be limited by the spectral transmission of the modulating element.

A semiconductor phenomenon, known as free-carrier absorption, provides a convenient means of modulating electromagnetic radiation.^{2,3} Free-carrier modulation overcomes some of the frequency response, spectral transmission and power limitations inherent in the other methods.

Consider first the spectral absorption of a specific intrinsic semiconductor, germanium (Fig. 1A). Two mechanisms account for the

absorption in these materials. At wavelengths shorter than the absorption edge, λ_c , which is 1.7 microns for germanium, photons cause electrons to become detached from atoms composing the semiconductor lattice, thus producing free electron-hole pairs. This wavelength region is characterized by strong absorption. At longer wavelengths the energy possessed by a photon is insufficient to cause electron detachment. The free electrons and holes that are produced by thermal excitation will, however, weakly absorb this radiation. Although free-carrier absorption is present also at the shorter wavelengths, it is masked by the much stronger fundamental absorption. Neglecting reflection losses, the transmitted intensity I_T , passing through a path of length x in a medium of absorption coefficient K is given by the Lambert-Beer law

$$I_T = I_0 \exp^{-Kx} \quad (1)$$

where I_0 is the incident radiation intensity.

At wavelengths greater than λ_c , in the infrared region, but shorter than the microwave region, it can be shown theoretically⁴ that

$$K = n \lambda^2 e^2 / 4\pi^2 \mu m \epsilon_0 N c^2 \quad (2)$$

where n is the concentration of free carriers, λ is the wavelength of the radiation, e is the electronic charge, ϵ_0 is the permittivity of free space, μ is the carrier mobility, m is the effective mass of the charge carriers, N is the index of refraction of the medium, c is the velocity of electromagnetic radiation.

Note that K is proportional to the carrier density and the square

of the wavelength. However, the carrier density and the square of theoretical expression does not give the correct order of magnitude of K , although it shows the dependence of K on carrier density. Therefore, it is convenient to use

$$K = \alpha n \quad (3)$$

where α is a lumped factor dependent upon wavelength, which can be determined experimentally. An equation of this type can be written for both electrons and holes. The value of α for holes is experimentally found to be 80 times that for electrons. Equation 3 shows that K is linearly dependent upon carrier density. Therefore, Eq. 1 shows that the absorption of radiation depends exponentially upon the free-carrier concentration.

There are several methods for electrically modulating the concentrations of free electrons and holes in a semiconductor. The most common is carrier injection at a $p-n$ junction. Applying a forward bias, that is, connecting the n region to a negative electrical terminal and the p to a positive terminal, injects minority carriers into each region. Holes enter the n region from the p region. Initial concentration of the minority carriers is low. Injection drastically increases the concentration. Therefore, at infrared wavelengths longer than the absorption edge, electrical means can make the semiconductor less transparent, that is, more opaque, by using a forward bias to increase the hole concentration in the n region. In germanium the holes absorb much more strongly than electrons. Design considerations

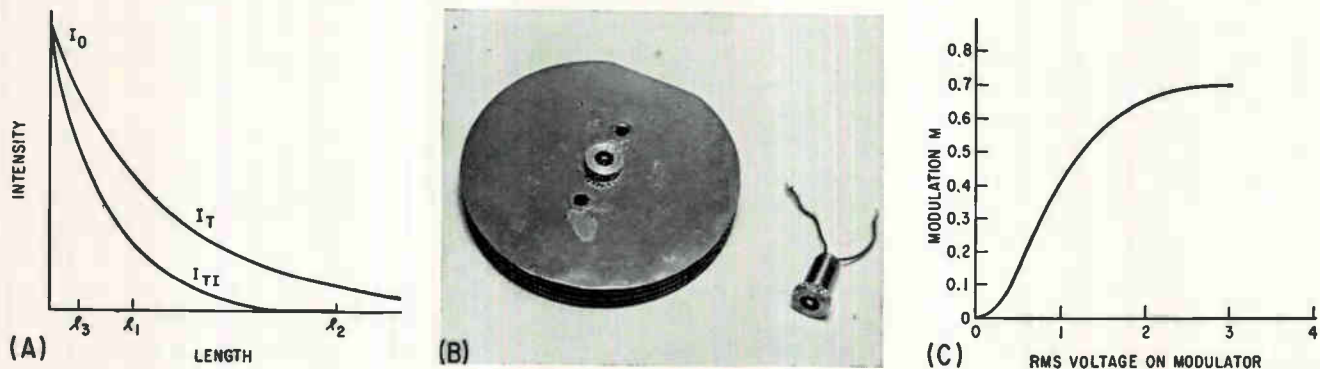


FIG. 2—Variation of transmitted intensities is a function of length of modulator (A), whose assembly appears in (B). The M figure of merit is function of rms volts across modulator (C)

therefore dictate use of n -type germanium. Before applying a bias, the modulating region will be relatively transparent, since the electrons, which are more numerous than the holes, absorb weakly. When holes are injected into the n region, they will greatly change its transmission, since they absorb 80 times more strongly than the electrons and their concentration has been greatly increased.

A free-carrier modulator consists of a slab of n -type germanium having a typical resistivity of 1 ohm-cm and a p - n junction along one face (Fig. 1B). Radiation from an incandescent source is focused upon one end of the modulator. The portion of the radiation that has wavelengths shorter than that of the absorption edge at 1.7 microns is absorbed at the surface within a depth of approximately 1 micron. The longer infrared wavelengths are transmitted through the material but are attenuated somewhat depending upon the concentration of thermally-excited free carriers. Figure 1C shows the result of applying a sinusoidal electrical signal to the p - n junction. As the voltage swings in the forward direction, that is, as the n region is made negative with respect to the thin p -type layer, holes are injected into the n region from the p region. These injected holes cause the longer wavelengths to be more strongly attenuated than they were previously. Therefore the transmitted radiation intensity is reduced. When the signal swings in the reverse direction, holes are not injected and the transmission of the longer wavelengths is the same

as it was previously. Thus application of a sinusoidal electrical signal modulates the amplitude of the transmitted intensity.

There are two figures of merit used in describing the performance of a free-carrier modulator. The modulation M specifies the reduction of the transmitted radiation caused by the electrical signal. Thus $M = 1$ indicates that the transmitted intensity has been reduced to zero by the injection of carriers. The signal S is the ratio of the modulated radiant power to the radiant power incident on the modulator.

These figures of merit are

$$M = (I_T - I_{TI})/I_T \quad (4)$$

$$S = (I_T - I_{TI})/I_0 \quad (5)$$

where I_T is the transmitted intensity in the absence of an electrical signal,

I_{TI} is the transmitted intensity in the presence of an electrical signal, and

I_0 is the intensity incident upon the modulator of wavelengths greater than the absorption edge. Reflection losses have been neglected in all cases.

Applications in which electrical power is limited, for example, portable transceivers, require signal S to be maximized. Gibson has shown that a relationship exists between the germanium resistivity and the modulator length that will maximize S .⁵ If there were no thermally excited carriers present, the signal could be made as large as 1 by making the slab sufficiently long. Because thermally excited carriers are present which attenuate the radiation even when no signal is applied, an optimum modulator length exists for maximizing the signal. Figure 2A shows how radiation is attenuated both with and without carrier injection, as it travels through a sample having some particular value of resistivity. For length l_1 the modulation is 0.5 and the signal 0.25. For length l_2 , although the modulation is nearly 1, the signal has decreased to less than 0.1, indicating less than 1 watt of modulated radiation power for each 10 watts of incident radiation power. For length l_3 both the modulation and the signal are smaller than at l_1 . If the material resistivity is changed, the curves will be

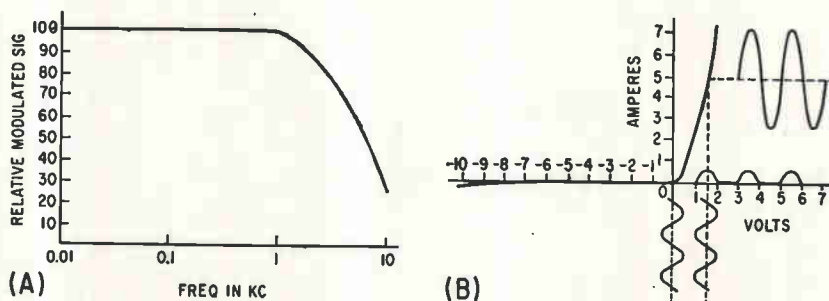


FIG. 3—Modulator response is frequency-independent till about 1 Kc (A). Output waveshapes of (B) correspond to two levels of bias on modulator

shifted and the optimum length will change. Use of material of high resistivity leads to excessive length, whereas low-resistivity material requires larger electrical power input. A convenient choice is a modulator 1.5-cm long made from 1 ohm-cm germanium.

Modulators are constructed using transistor manufacturing techniques to alloy an indium layer along one surface of a germanium slab having the dimensions required. Electrical connection is established by making ohmic contacts to each side of the *p-n* junction. To facilitate handling and dissipate heat, the modulator is embedded in a heat sink using copper-oxide cement. Figure 2B shows the completed modulator.

Although signal *S* is the figure of merit of greater interest, it is more difficult to measure than the modulation (*M*). This is because the measurement of *S* requires knowledge of the absolute values of incident and transmitted radiant power. Since these values depend upon knowledge of radiant-source characteristics, optical configuration and detector efficiency, they are difficult to measure. On the other hand, the modulation can be measured by observing the ratio of the signal obtained by electrically modulating a radiant source to the signal obtained by mechanically modulating this source. Because the modulation requires measurement of a ratio, rather than of absolute values, it is easily obtained.

The modulation depends upon the signal voltage applied to the modulator. Figure 2C shows a typical curve of modulation versus voltage. Modulation rises with voltage until it reaches a saturation value of about 0.7. Typical modulator frequency response is indicated in Fig. 3A. Response is frequency independent to about 1 Kc and slowly falls off at higher frequencies. At 10 Kc the response is still about 27 percent of the value below 1 Kc. If material of lower resistivity is used, the frequency response can be improved at the expense of higher power dissipation.

Current-voltage characteristics of a typical modulator are shown in Fig. 3B. For the zero-bias condition, an electrical sine wave input causes a rectified output and therefore a rectified optical signal. However, by applying a d-c bias to the modulator in the forward direction, an improvement in the signal waveform is achieved. Although intelligible conversations can be transmitted in the absence of electrical bias, some improvement can be obtained with d-c bias.

Figure 4 shows a transceiver that uses an infrared modulator. This transceiver has been used to talk over lengths greater than 1 mile. The transmitting section of each unit has a tungsten filament lamp emitting radiation focussed upon one end of the germanium modulator. The amplified signal from the microphone, impressed upon

the modulator, modulates the transmitted infrared radiation. This modulated radiation is collected by a three-inch diameter *f*/1.5 objective lens and transmitted in a beam of 1 degree angular width.

A push-to-talk arrangement permits the same optics and electronics to be used for transmission and reception. In the transmitting mode a relay is energized, causing a solenoid-actuated mirror to raise, exposing the modulator to the objective lens. Actuation of the relay also lights the lamp, connects the microphone to the audio amplifier, and connects the audio amplifier to the modulator power stage. In the receiving mode the mirror is interposed between the objective lens and the modulator, causing the incident radiation to be reflected to a lead-sulfide infrared detector. The signal from the detector is amplified by a preamplifier, and audio amplifier, and fed through an output stage to either a loudspeaker or headphones. A 750-cps tone aids in aligning the transceivers during field operation. A 750-cps band-pass filter is switched into the receiving circuit to optimize the signal-to-noise ratio.

The modulator power stage contains two power transistors connected as a double emitter follower (Fig. 5). The bias current through the modulator is adjusted by varying *R_b*. The audio amplifier, which increases the microphone and oscillator signals to the level required by the power stage, contains a vol-

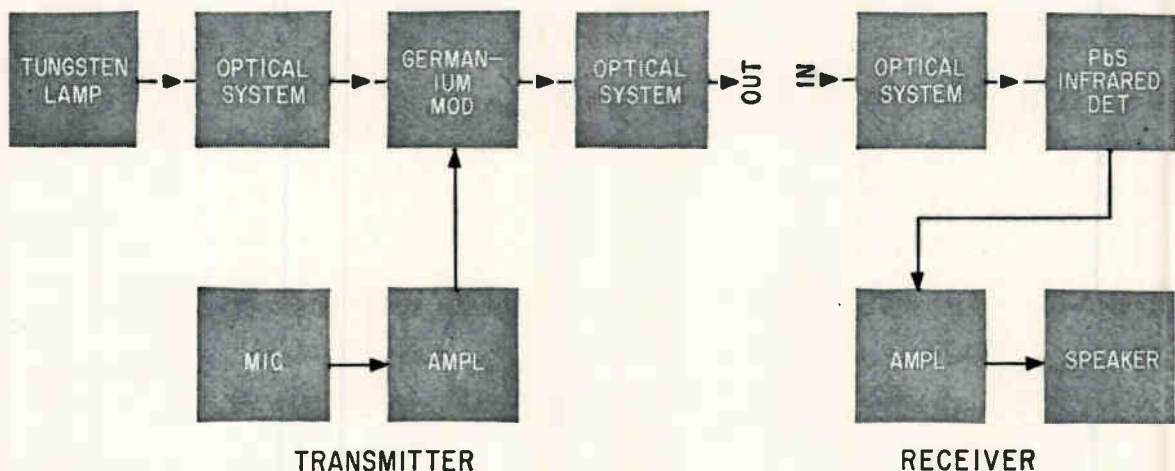


FIG. 4—Transmitter and receiver are combined in a gun-like package. Their common power supply is not shown in block diagram

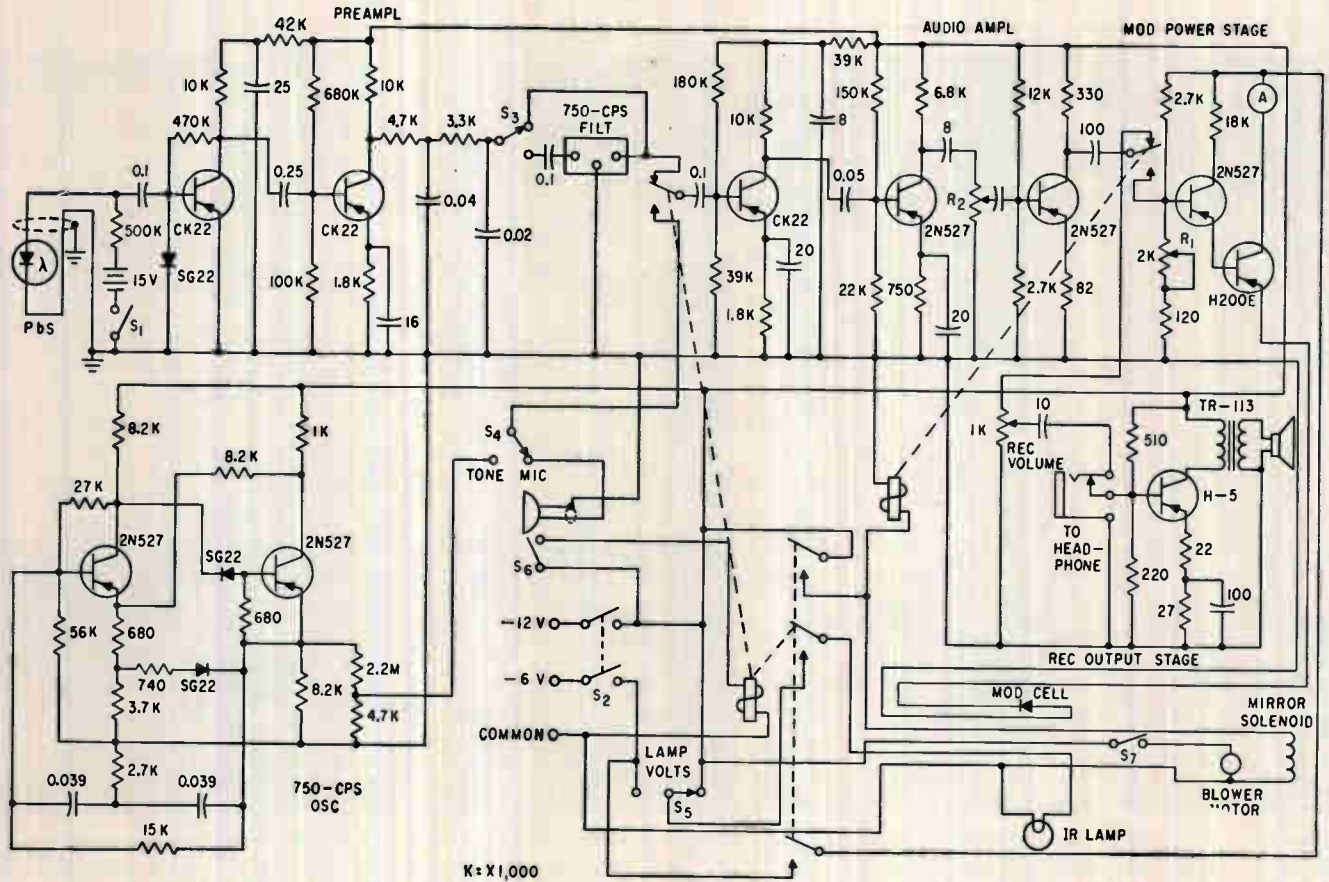


FIG. 5—When closed, switch S_1 swings the transceiver into its transmitting mode of operation

ume control (R_2) to adjust the percentage modulation. Each transceiver is powered by a 12-volt storage battery. Power dissipation in the receiving mode is less than 1 watt. The transmitting mode required 30 watts. Overall weight of each unit, exclusive of battery and tripod, is 15 pounds.

The spectral region utilized is determined by the characteristics of the lamp, modulator, lens, lead-sulfide detector and atmosphere. These factors combine to cause operation only in the 1.7-to-2.5 micron region of the infrared spectrum. Thus the transmitted radiation is not visible.

These transceivers have been field tested and found to have a range of 1.4 miles. The frequency response, determined by the characteristics of the modulator and the electrical filter, is limited to the band from 300 cps to 3 Kc for minimum noise and maximum intelligibility. The 1-degree field of view indicates detection is accomplished only if the receiver is

located within a 92-foot square area at 1 mile. This high directionality makes interception of secret messages extremely difficult.

An advanced version of an infrared transceiving system has been developed. Both riflestock and pistol grip models of this system are available.

In addition to military applications transceivers of the type described are useful wherever line of sight communications are needed, for example, surveying. Modulators have also been used as radiation choppers in infrared systems. A modulator is being incorporated as a radiation chopper in a horizon scanner for a space vehicle. The horizon is indicated by the discontinuity in the infrared radiation between the earth and its space background. Vertical reference signals are derived from measurement of the angle the vehicle axis makes with the horizon.

Among other uses for infrared modulators is wireless control within buildings. Optical links

beaming modulated radiation along ceilings, down corridors, around corners and up elevator shafts can replace wires. Signals from sensors such as thermostats can be directed over infrared beams to individual controls. Timing signals from a master clock can synchronize satellite clocks. Conversations can be transmitted. Even low-level power transmission is possible because of the directionality of the system.

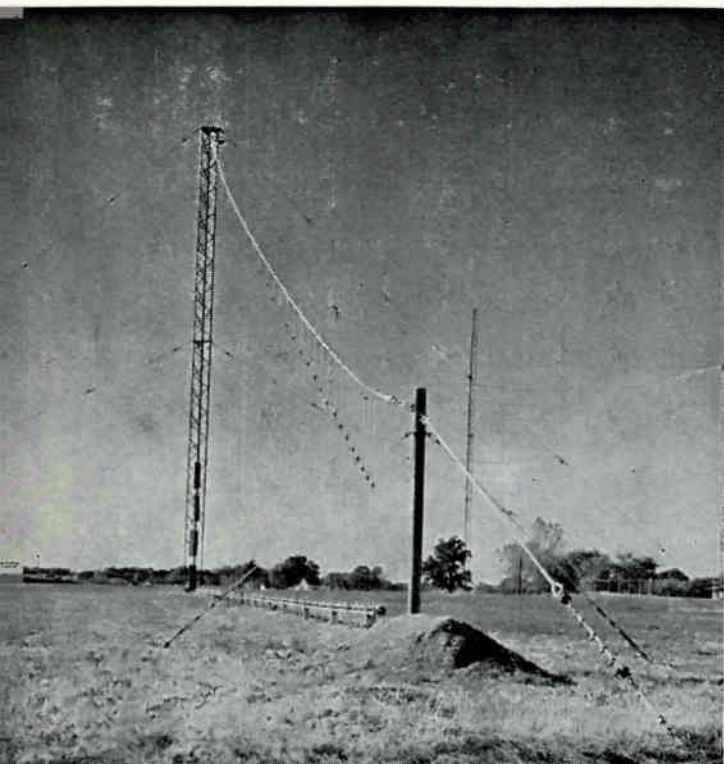
Certainly, in addition to those which have been mentioned, there are many other possible applications of infrared modulation.

We are indebted to W. D. Saur, D. E. Benz and A. E. Johnson for assistance in modulator preparation and circuit design.

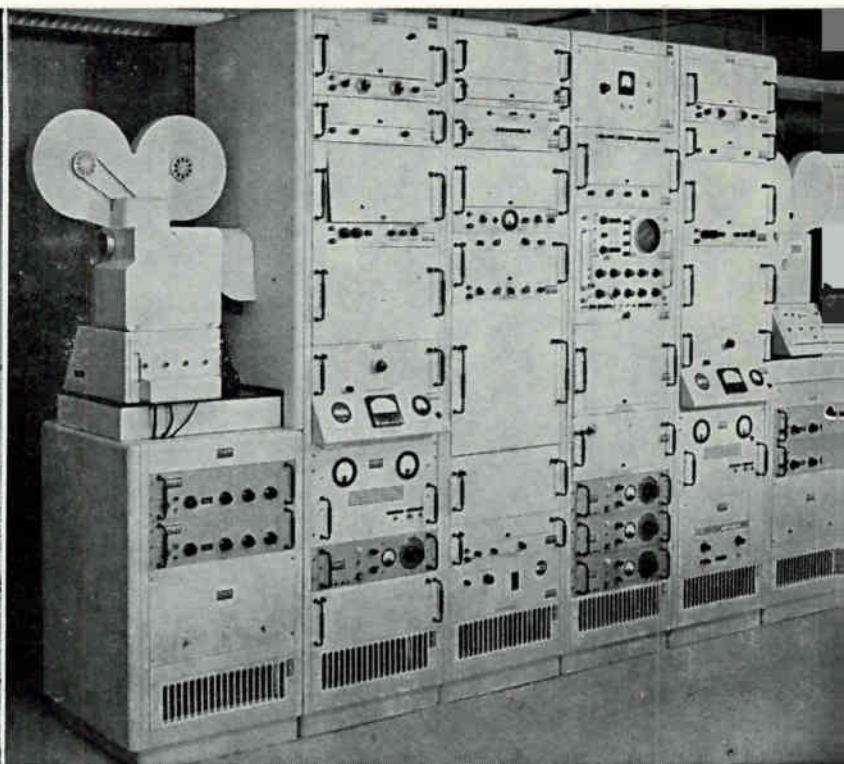
REFERENCES

- 1 W. E. Osborne, *ELECTRONICS*, p. 38 Sept. 18, 1959.
- 2 K. Lehovec, *Proc IRE*, p. 1,407 40, 1952.
- 3 A. F. Gibson, *ELECTRONICS*, p. 155 Oct. 1954.
- 4 J. W. Granville, *RRE Journal* 40, 35, 1957.
- 5 A. F. Gibson, *Proc Phys Soc B* 66, 588, 1953.

Engineering Highlights of the



Log-periodic monopole antenna array uses its image to reduce maximum height to $\frac{1}{2}$ wavelength



Ground readout equipment of Photoscan reconnaissance system duplicates all important functions to improve reliability

UNLESS SOME engineer finds out how to divide himself like an amoeba, nobody will be able to cover the whole of the 1961 IRE International Convention. At last count there will be some 265 papers and speeches presented in 54 sessions. Sometimes as many as eight papers will be presented simultaneously.

As usual, the papers will cover topics ranging in complexity from broad-gage management subjects to highly abstract treatments of circuit and control theory.

This year **ELECTRONICS** home-office and field editors have put together a roundup of what we see as the highlights of the show. These include laser radar, log-periodic antennas, tunable tunnel-diode amplifiers, semiconductor bandpass filters, new solid-state display devices and others.

Laser radar. An optical radar employing the new laser light source will be discussed by D. A. Buddenhagen, B. L. Lengyle, F. J. McClung, Jr., and G. F. Smith of Hughes Research Labs. The ruby laser, recently achieved by T. H.

Maiman, provides intense pulses of monochromatic light in a sharply directional beam. A pulsed output permits ranging. High angular resolution can be obtained with no additional optics. Spectral filtering at the receiving photodetector provides discrimination against unwanted optical signals. The setup is shown in Fig. 1.

A simple experimental radar using a ruby laser transmitter and a receiver consisting of a multiplier phototube, spectral filter and 5-inch telescope will be described. Radar ranging has been achieved at distances of several miles.

Log-periodic monopole array. Engineers D. B. Berry and F. R. Ore of Collins will describe a vertically polarized, undirectional, frequency-independent antenna that uses its image to reduce its maximum height to $\frac{1}{2}$ wavelength at its lowest operating frequency. This contrasts with the $\frac{1}{2}$ -wavelength dimension that has been necessary in other types of log-periodic antennas. The antenna is shown in Fig. 2 and a photograph. The relatively

small dimension of the new antenna makes it desirable for use in the lower portion of the h-f spectrum and other frequency ranges where frequency-independent operation must be coupled with small size.

The frequency-independent properties of the antenna are produced by an arrangement of reactive elements that introduce additional degrees of freedom in the design. Radiation pattern and phase center data will be given as a function of the usual log-periodic parameters. Design data will be given that will permit the designer to control the antenna characteristic impedance and vswr by adjusting the additional parameters. Techniques necessary to insure proper operation will be discussed as well as methods of analysis that were attempted. The measured vswr of an antenna designed to operate from 4 to 20 Mc will be presented.

Tunnel-diode amplifier. A tunable L-band tunnel-diode amplifier will be described by H. M. Wachowski of Kearfott division, General Precision Inc. Since a tunnel diode has

1961 IRE Convention



Some of the developments include: laser radar, log-periodic monopole antennas, tunable tunnel-diode amplifiers, semiconductor filters, solid-state display devices, depletion-layer ultrasonic transducers, thermoelectric spot cooling, photographic-electronic reconnaissance system and gallium-arsenide transistors

a negative dynamic resistance over a certain range of applied bias voltage, a one-port negative-resistance amplifier can be realized by terminating a uniform transmission line by a tunnel diode. The junction capacitance and parasitic series inductance of the diode must be tuned out. The tunable L-band tunnel diode amplifier of this kind provides a gain of 17 db, a bandwidth of 8 Mc and a noise figure of 6 db.

Being a one-port device, the amplifier is used with a circulator, or alternatively, two amplifiers are used with a hybrid in a balanced-bridge arrangement. The amplifier is tunable by unique microwave circuits over the frequency range from 900 to 1,100 Mc. The advantage of this amplifier is its low power requirements. A disadvantage of this amplifier, as well as of all single-stage, high-gain, negative-resistance amplifiers, is its sensitivity to small variations in the electrical parameters of both the diode and its circuit. A theory of operation for the amplifier, together with a description of its actual realization will be presented.

Semiconductor filters. Devices using minority carrier delay and storage effects are under development and will be described by S. N. Levine and J. J. Sein of RCA Surface Communications Systems Labs. The devices include semiconductor electronically variable delay lines, encoders and solid-state band-pass filters. In addition to their intrinsic interest, these devices bear on the problem of microminiaturization, particularly of the molecular electronic variety, where the object is to fabricate an entire circuit from a single semiconductor crystal, possibly supplemented with

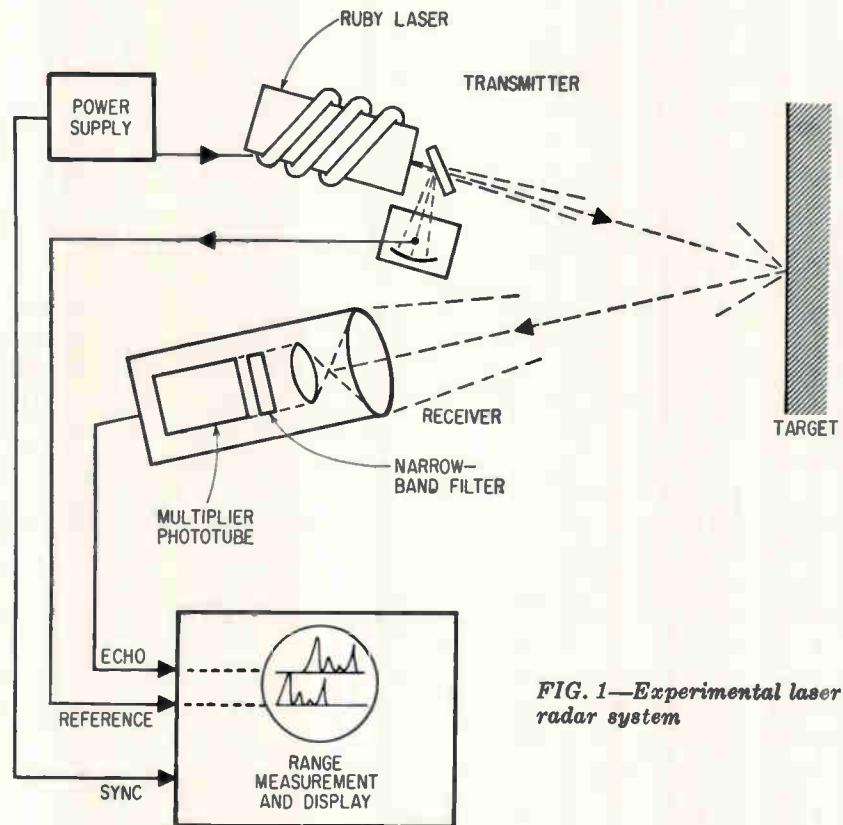


FIG. 1—Experimental laser radar system

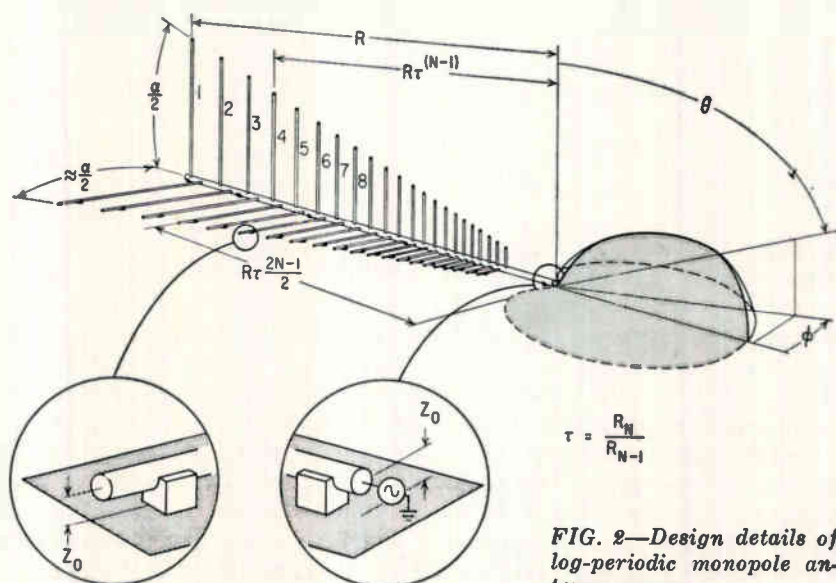


FIG. 2—Design details of log-periodic monopole antenna array

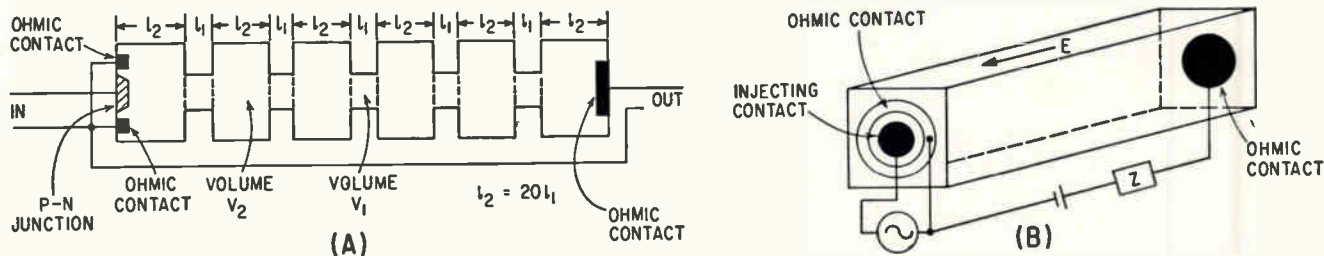


FIG. 3—Top and side views of rectangular semiconductor parallelepiped (A) used as band-pass filter. Delay-line storage unit is shown in (B)

thin adhering metallic film.

One realization of a semiconductor filter is shown in Fig. 3A. Maximal response is obtained when the signal frequencies are such as to lead to coherent addition of the resistivity changes occurring at the smaller volumes V_1 . Typical operating frequencies of a p -type silicon device range from 50 to 500 Kc. The bandwidth is ± 20 percent about the center frequency. By varying the driving field applied to the ohmic overcontacts, the filter can be tuned over a fairly broad range. These filters also permit voltage gain in the order of 100. Typical dimensions are $0.25 \times 0.25 \times 0.5$ inch.

The Q of this class of filters is low. However, by cascading several units, Q 's of 100 can be attained.

Closely related to the filter in certain basic features are delays and dynamic memory units also being fabricated. The delay devices have a bandwidth of approximately 200 Kc and permit electronically variable delays ranging from 100 to $10 \mu\text{sec}$. A typical delay line is shown in Fig. 3B. The injected carriers (in this case electrons) drift across the device, producing a time delay expressed by $t = L/E_s u$, where E_s is the minimum driving field, u is the electron mobility and L the length. Minority carrier storage devices capable of storing up to 4 bits for a 2×10^{-4} seconds are also under study.

A new electroluminescent display panel developed by the General Telephone & Electronics Laboratories and to be described by S. Yando uses piezoelectric voltages to excite a thin electroluminescent panel. Voltage pulses applied to edges of a ceramic plate of piezoelectric material cause acoustic waves to travel across the panel.

The voltages caused by the acoustic wave render the electroluminescent layer visible. By launching several acoustic waves properly directed and phased, high voltages can be selectively positioned to display desired patterns. The intersection of two or more acoustic waves will cause a high voltage node that can be made to cause illumination or increased intensity of illumination. The brightness of the light patterns can be regulated by applying additional voltages across the electroluminescent panel as are used in panelescent lamps.

The scanning of the display panel is determined by the timing of the applied electronic signals. Proper adjustment of the construction details permits the creating of a small spot whose brightness, position and motion are determined by the input electronic signals. The simplest form of the display would be a rectangular area with side electrodes. Such a device would have a raster scan similar to an oscilloscope. Details of construction, electrical characteristics and light levels have not been made available. This fully solid state electronically scanned display panel may have important military and industrial applications.

On the industrial and commercial side, uses will range from multiplexing distributors and picture display panels in communication systems, to access systems in computers.

In the consumer area this development indicates the potential for a tubeless television set whose display component will take the form of an ordinary picture and frame. In addition, its unique characteristics will make it especially interesting for future color television development.

Ultrasonic transducer. Bell Labs' depletion-layer ultrasonic transducer, to be described by D. L. White, is constructed by forming a depletion layer on an extrinsic piezoelectric semiconductor. See Fig. 4. Preliminary models made by vapor-plating such metals as gold and aluminum of gallium arsenide plates approximately $\frac{1}{8} \times \frac{1}{8} \times \frac{1}{8}$ in. have operated between 500 and 1,000 Mc. Bell expects, however, to be able to operate at higher frequencies with efficiencies superior to other techniques now in use.

High efficiency is the result of using the thin (on the order of 3×10^{-4} cm) depletion layer as the piezoelectric active region. The depletion layer is a high-resistance contact and the bulk of the semiconductor is low-resistance. The resulting electric field across the layer generates the ultrasonic waves.

It should be possible to use any extrinsic piezoelectric semiconductor such as gallium phosphide and cadmium sulfide, as well as any type

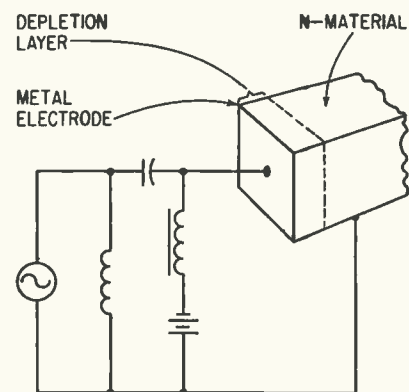


FIG. 4—In depletion-layer transducer, a high-resistance layer is formed by metal-to-semiconductor rectifying contact. A d-c voltage controls depth of depletion layer, a-c voltage generates ultrasonic waves in layer

of rectifying semiconductor contact (such as a *p-n* junction) as long as the contact is flat and has some area.

Models now operating are felt to be at least as efficient as other techniques for the 500 to 1,000-Mc range. These techniques include use of high-overtone crystal plates, or quartz bars in microwave cavities.

Thermoelectric spot cooling. Results of a study in which thermoelectric spot cooling was used to cool critical areas in electronic equipment will be described by W. R. Stubstad of Collins. The evaluation of the specially designed spot cooler, which is no larger than a pack of cigarettes, included both thermal and mechanical tests.

The evaluation checked out with theory and afterwards the spot coolers were analytically applied to cooling equipment designed to be cooled by forced convection and by natural means. Analysis showed that spot cooling can reduce the forced-convection cooling requirements with corresponding reduction in weight, volume and power required for the equipment. Equipment designed to be cooled by natural means could operate in higher-temperature environments when thermoelectric spot cooling was applied to critical elements. Figure 5 illustrates two applications of cooling.

Photoscan reconnaissance system. Conventional fighters, bombers or drones can be converted into strike reconnaissance units by CBS labs' Photoscan reconnaissance system, described by R. H. McMann, Jr. This electronic image processing and transmitting system combines a special cathode-ray tube with aerial photographic techniques to make optimum use of available data within existing time and bandwidth limits.

Reconnaissance systems using conventional television techniques suffer because of the relatively low resolution capabilities of pickup tubes and require real-time transmission to avoid complex and unwieldy airborne video recorders. This system uses the high resolution and inherent storage capabili-

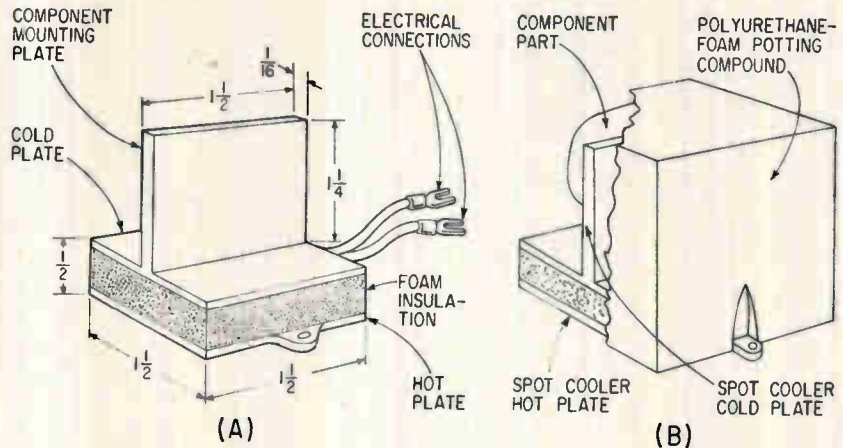


FIG. 5—Two applications of thermoelectric spot-cooling to electronic equipment

ties of photographic film processed in the air in coordination with a flying-spot scanner.

Heart of the scanner is a special cathode-ray tube with a rotating phosphor drum enclosed in the evacuated envelope. This device permits a single line to be displayed without phosphor burn or loss in phosphor efficiency due to overheating. Because the spot is viewed from the bombarded side, halation effects are reduced and extremely small spots can be generated.

The tube is used in both airborne scanner and the ground reproducer (photo)—as a flying-spot scanner in the air and as a reproducing kinescope on the ground.

Gallium-arsenide transistors. An experimental *n-p-n* diffused-base gallium-arsenide transistor will be described by M. E. Jones and E. C. Wurst, Jr. of Texas Instruments Central Research Labs.

Results demonstrate that transistors can be constructed from such compound semiconductors as gallium arsenide and that superior properties of such devices predicted from the physical properties of the material are attainable.

Gallium arsenide has a high energy-band gap; thus gallium-arsenide transistors should be able to operate at 350 to 400 C, considerably higher than silicon. Experimental units have been limited to lower temperatures but diodes have demonstrated the high-temperature capabilities.

High electron mobilities in gallium arsenide should allow tran-

sistors made from the material to operate at frequencies at least as high as germanium units. Experimental transistors, even though made by relatively crude techniques, have alpha cutoff frequencies in excess of 1,000 Mc.

Because high-frequency performance is coupled with low values of carrier lifetime in gallium arsenide, fast switching transistors are possible. Total switching times of 20 nanoseconds have been observed. This is better than with silicon. With optimized device geometry, switching times as low as with germanium should be possible. Thus gallium arsenide transistors potentially may combine the performance of germanium units with the heat resistance of silicon.

Dot-component packaging. A microelectronics packaging scheme that makes possible packing densities of 2,080,000 components a square foot will be described by A. E. Hawley, E. A. Klein, and S. Rubin of Hughes. The design makes available 2,300 transistors, resistors, diode and capacitors interconnected in a self-contained volume $1\frac{1}{4}$ in. on a side.

The tiny cube contains components and connections but also provides for heat transfer and structural rigidity. The system uses dot components with the shape of $\frac{1}{8}$ -in. thick, $\frac{1}{8}$ -in. diameter cylinder. Most immediate application of the packaging system is in computers especially those for space and satellite applications.—LS, MMP, MFW, SF, HCH, CMW, JMC.

Coupling Circuit Extends MAGNETIC RECORDER RESPONSE

Unusual coupling circuit between reproduce head and preamplifier extends frequency response of video tape recorder while changes in the tape drive reduce wow and flutter to below 0.1 percent

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ADVANCES have been made in video recording equipment head and amplifier design that extend the frequency response at low tape speeds and improve the signal-to-noise ratio. Modifications in tape transport mechanical design have been combined with control circuits to improve system quality by assuring accurate tape speed and decreasing the effects of wow and flutter.

Attenuation of signal high-frequency components is due to the increased impedance of inductances at higher frequencies. Therefore, it is imperative that winding inductances be kept low. Low-induction windings generate low-level voltages and therefore require high-gain, low-noise preamplifiers. Such amplifiers may present intricate circuit design problems.

Increasing head-to-tape speed is

limited by mechanical complexities when driving the tape faster than 120 ips. Extremely high tape speed can also reduce running time to the point where playing time for a 14-in. reel may be reduced to two or three minutes.

Three tubes and three transistors are used in the preamplifier shown in Fig. 1. The specific advantage of this circuit is the technique used in coupling the circuit to the reproduce heads. Each reproduce head has two windings, one winding (L_1) is connected in series between V_1 and V_2 , while the other winding (L_2) is connected to the input of Q_1 .

Inductor L_2 is a high impedance to high frequencies but permits the low frequencies to pass through capacitor C_1 to transistor Q_1 . The amplified signal is fed through capacitor C_2 to the low side of the

second half of the reproduce head. Transistor Q_1 amplifies only the low frequencies due to the effects of roll-off capacitor C_2 . This circuit extends the frequency response down to frequencies far too low to be efficiently amplified by the first tube alone.

When the transistor amplifier becomes inefficient at the higher frequencies, the second half of the reproduce head (L_1) comes into operation to extend the frequency response to 1 Mc. At these higher frequencies, the amplitude of the signal from the head is sufficient to drive the tube directly with an adequate signal-to-noise ratio. The combined signal appears at the grid of V_1 .

From this point, the circuit is conventional and consists of cascode amplifier V_1 and V_2 , wide-band

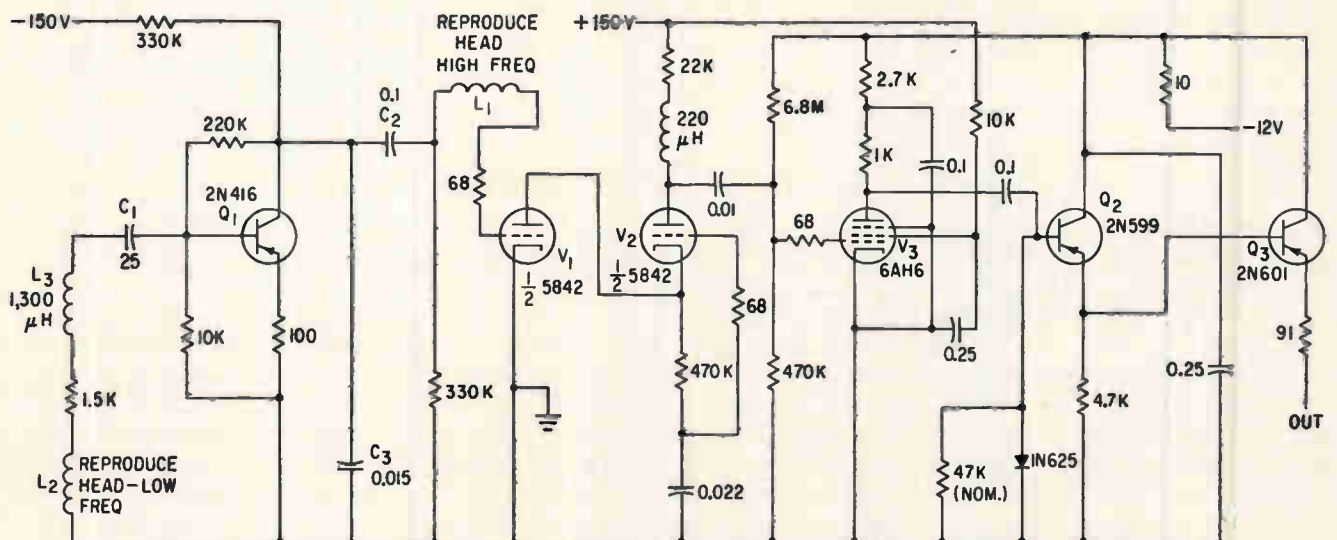


FIG. 1—Low frequency signal is combined with high frequency signal from second half of head and composite broad-band signal is then amplified. Termination resistor for emitter follower is at far end of output cable

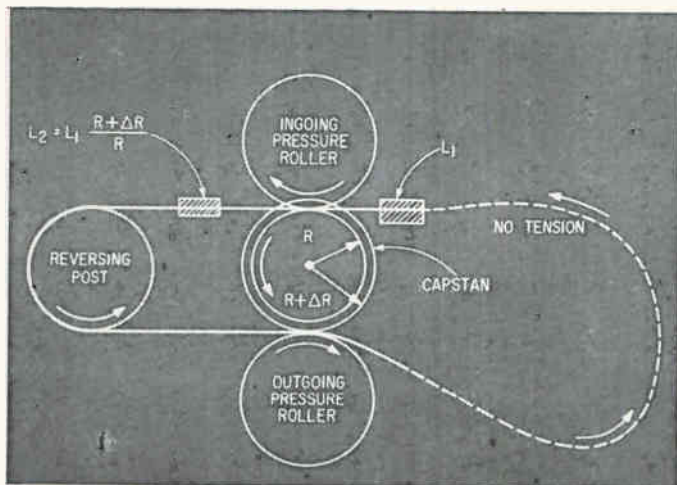


FIG. 2—Principle of the isolated loop tape drive

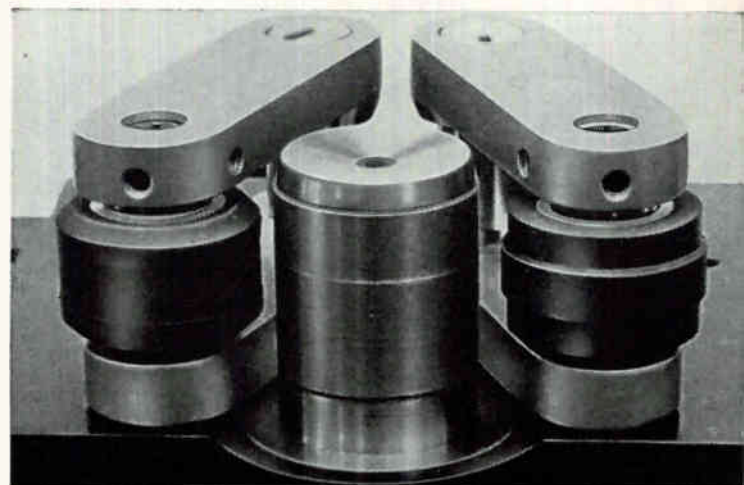


FIG. 3—Isolated loop capstan and pressure rollers

amplifier V_2 and the two-transistor emitter follower Q_3 and Q_4 .

The preamplifier provides an output to a 91-ohm line at an average level of 1.5 v peak to peak with a response of 100 cps to 1 Mc ± 0.5 db.

Accurate tape speed control is essential in a magnetic tape recorder designed to record and reproduce concise information. In this system a d-c shunt-type motor powers the capstan that drives the tape past the magnetic heads. A small tachometer is used with the capstan motor. This is a small a-c generator consisting of a precision gear mounted on the capstan motor shaft and a small permanent magnet wound with a coil and mounted adjacent to the gear. As the gear turns, a-c voltages are induced in the coil and the frequency of this generated signal is directly proportional to the speed of the gear and also to the speed of the capstan motor.

A resonant circuit, tuned to a frequency representing that generated by the tachometer when the motor is operating, locks the drive motor at the resonant frequency. The motor current is controlled by this system so that the speed is maintained within $\pm \frac{1}{4}$ percent over a power-line voltage range of 105 to 135 v and an ambient temperature of 40 to 120 F. It is necessary only to change the capacitor of the resonant circuit to cause the machine to run at other speeds. A single inductance is used, but a push-button operated stepping switch sequentially selects predetermined capacitors to cause the motor to drive the tape at any normally pro-

vided speed. Special speeds may be obtained by inclusion of specially selected capacitors.

During the recording process, a 60-cps control signal from a crystal reference is included in one of the tracks. This signal is detected and compared in phase with a similar signal derived from the crystal used during recordings. Any phase shift between these signals results in an error signal that modifies the output of the speed control unit to keep the reference and tape signal locked together. The reproduction speed is therefore identical to that of recording within the accuracy of the crystal. The latter is oven-controlled and stays within ± 0.005 percent.

The tape drive design differs from conventional hold-back tension techniques. In this design, a differential drive capstan is used to drive the tape past the record and reproduce heads. An isolated loop is formed to decouple the head area from tape speed variations. As shown in Fig. 2, the unit length of tape L_1 is fed into the capstan assembly under zero tension. In the time required to feed L_1 into the loop on the left side, the capstan must remove from the loop a length of tape L_1 simply related to L_1 as a function of the two radii R and $R + \Delta R$.

A slightly elevated ridge is machined in the center of the capstan surface to give the capstan a few thousands of an inch greater diameter at its center than at its edges. Figure 3 shows the capstan and pressure roller surfaces viewed from the head area. The capstan rotates counterclockwise and the tape is fed from the rear under

pressure of the left-hand roller. This roller is grooved at its center so that it exerts pressure at the edges of the tape.

The tape then passes under the record heads, around the reversing post, past the reproduce heads and out of the loop along the right-hand side of the capstan. The rubber idler which presses the tape to the capstan at this point is ridged along its center. This idler presses the tape to the center of the capstan, which is also ridged. Because the drive capstan has a greater diameter at its center than at its edges, the speed of the tape as it leaves the loop is slightly greater than when it enters the loop. Tape tension sufficient to provide good contact pressure of the tape against the heads is created by this tape drive construction. This tape elongation is well within normal tape elasticity and causes no detrimental effects.

The great advantage of this tape drive is the isolating effect it achieves. Since it creates tension to establish tape pressure against the heads, no tension is required outside the loop. Thus, sources of wow and flutter from guiding and spooling can theoretically be reduced to zero. The only sources of flutter are those arising within the loop. In practice, some low value of tension must be provided externally to assure that the tape is adequately guided and wound onto the take-up reel.

Although the practical results of this tape drive system do not totally remove wow and flutter effects, these detrimental variations are reduced below 0.1 percent peak.

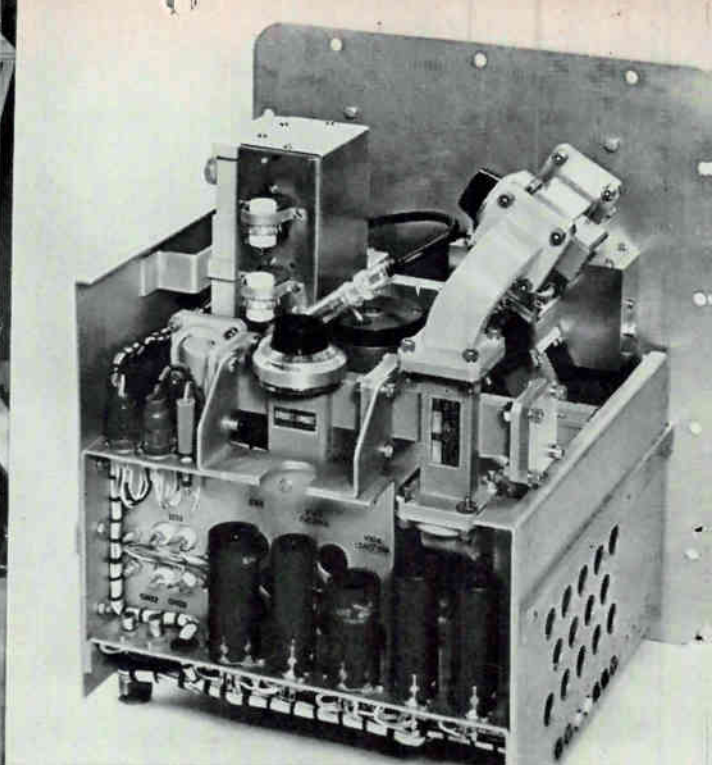
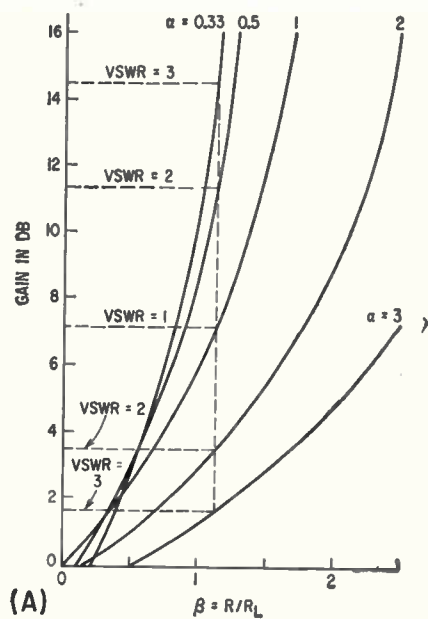
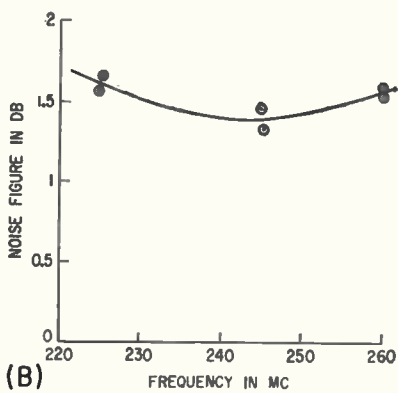


Photo at left shows author adjusting parametric preamplifier. The rear of the preamplifier unit is seen at right

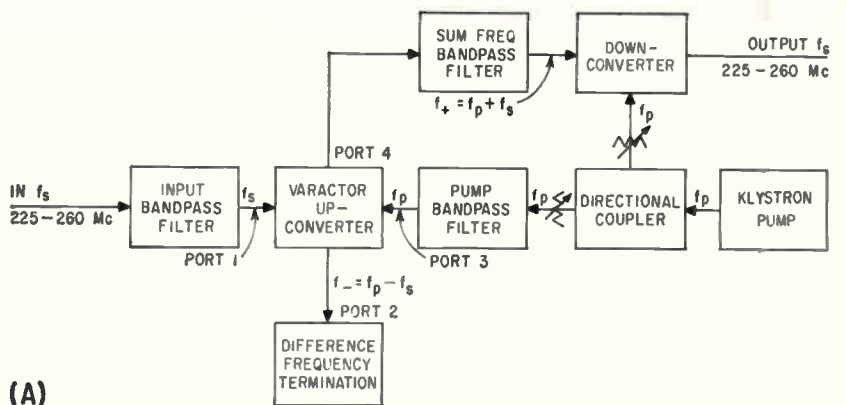


(A)

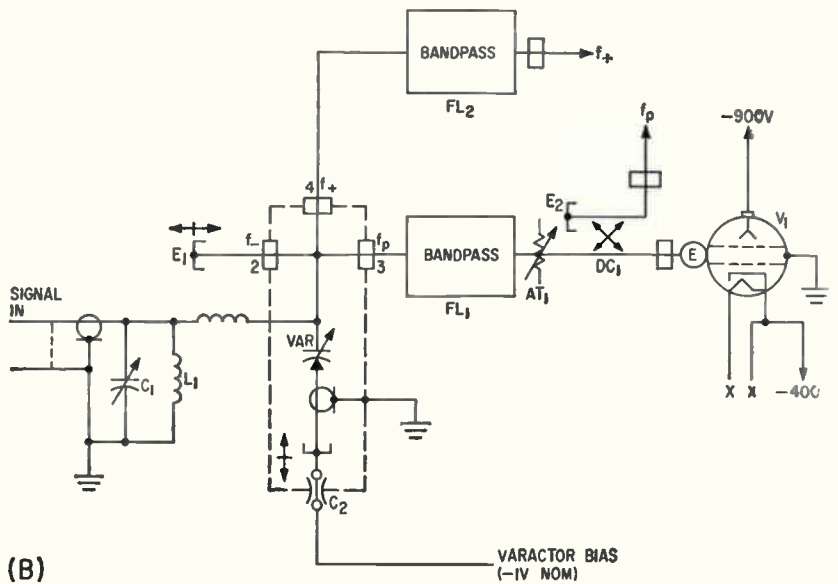


(B)

FIG. 1—Gain against negative resistance for negative-resistance amplifier (A); noise performance for parametric amplifier (B)



(A)



(B)

FIG. 2—System block diagram in (A) shows routing of signal; simplified schematic diagram of up-converter is shown in (B)

Frequency Conversion Technique improves Telemetry System

Noise figure below 2 db is achieved by parametric preamplifier

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LOW-POWER TRANSMISSIONS from satellites and missiles must be reliably received and recorded by tracking telemetry systems. To accomplish this, low-noise preamplifiers are mounted on the directional tracking antennas, thus establishing high gain and sensitivity before the inevitable loss takes place in the cable runs between antenna site and equipment room. Vacuum-tube preamplifiers limit the effective system noise figure to 4 or 5 db. The described telemetry preamplifier was developed to overcome this limitation.

The objective was a rugged, weatherproof unit with a noise figure below 2 db in the 225 to 260 Mc band, and enough gain (25 db) to offset transmission cable loss and excess receiver noise. It was decided to use the best available vacuum-tube preamplifier, preceded by a parametric amplifier stage. The required gain is obtained from the noise figure equation for two cascaded networks, $F_{12} = F_1 + (F_2 - 1)/G_1$, where F_{12} is the overall noise figure, F_1 the first stage noise figure, F_2 the second stage noise figure, and G_1 the first stage gain; F_2 is typically 2.5, and allowing for production alignment and field deterioration, the required noise figure is 1.5 db ($F_{12} = 1.41$).

Assuming the first stage has no excess noise ($F_1 = 1 = 0$ db), the required gain is 3.64, or 5.6 db. In practice there will be excess noise in the parametric amplifier due to input circuit loss, and noise in the varactor diode series resistance. Allowing 0.5 db for these contributions, the required gain is 7.1 db.

The negative-resistance type amplifier was considered first.^{1, 2} Equation 16 of reference 1, neglecting circuit loss, may be rewritten at resonance as

$$G = \frac{4R_g R_L}{(R_g + R_L - R)^2} = \frac{4\alpha}{(\alpha + 1 - \beta)^2}$$

where G is the gain, R_g resistance of generator, R_L load resistance, R the negative resistance generated by parametric amplifier, $\alpha = R_g/R_L$, and $\beta = R/R_L$.

When this equation is plotted in Fig. 1A, the gain in the useful range of values is seen to be a critical function of generator impedance. Assuming $\alpha = 1$ when the antenna (generator) is matched to its line, α may vary over the range of vswr to 1/vswr depending on line length. Thus, the gain may vary from 1.6 db to 14.4 db for a vswr of 3 to 1. Since this is not an uncommon vswr value in directional antennas in this frequency range, and since isolators are not commercially available, the negative-resistance amplifier was rejected.

The logical choice became the parametric up-converter whose the-

oretical gain, without regeneration, equals the ratio of output to input frequency, as shown by the Manley-Rowe equations.³ Since the model RA-1 must operate as a straight-through amplifier, it is necessary to convert down to the input frequency. The conversion loss and excess noise in the crystal mixer limits the second-stage down-converter noise figure to 10 db.

Assuming that F_1 is 0.5 db, for a noise figure of 1.5 db the required gain is 15 db. This gain requires conversion up to X-band and is marginally close to the theoretical gain given by Manley-Rowe. Calculations based on Leenov⁴ show that gain degradations of 1 to 3 db may be expected from commercially available varactors with cut-off frequencies between 40 and 100 Gc. A small amount of regenerative gain is needed to achieve the required noise figure; therefore the three-frequency up-converter⁵ was chosen. Figure 1A shows that for 3 db of regenerative gain, the gain will stay between +1 and -3 db for a vswr of 3 to 1. This results in stable gain and noise figure performance in the field.

The amplifier with power supply (see photo) is enclosed in a weatherproof case for mounting on the antenna structure. Included is a control panel for remote operation of the preamplifier at distances up to 300 feet. The table shows the specifications of the amplifier; a typical noise figure performance curve taken with a hot-cold noise source is shown in Fig. 1B.

As seen in the block diagram, Fig. 2A, the system consists of an up-converter that modulates the incoming signal f , on a microwave carrier f_c generated within the

SPECIFICATIONS

Passband	225 to 260 Mc
Gain	25 db \pm 3 db
Noise Figure	1.5 db typical, 2 db max.
Input Impedance	50 ohms nominal
Output Impedance	50 ohms, vswr 1.5 max.
Operating Temperature	20 F to 130 F
Power Requirements	1 ampere max. at 117 \pm 10v 60 \pm 5 cps
Dimensions	11 1/2 W \times 14 3/4 H \times 12 D
Weight	46 pounds

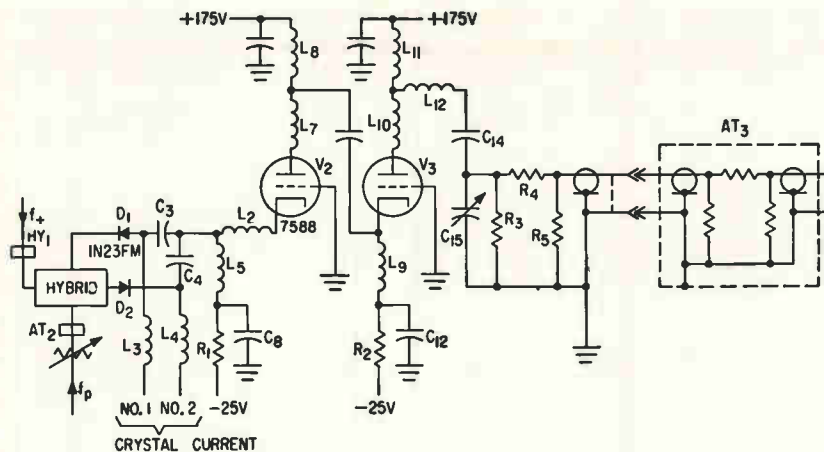


FIG. 3—Simplified schematic diagram of down-converter

unit, followed by a bandpass filter that conducts only the upper sideband $f+$, generated by the modulation, to a down-converter where the signal is demodulated to provide an output at the original frequency f .

The input signal f , enters port 1 of the up-converter from the input bandpass filter and is applied across the varactor. A microwave carrier, called the pump f_p , is generated by the klystron and enters port 3 through a directional coupler, a level set attenuator and the pump bandpass filter, and is also impressed across the varactor. Input signal f , modulates the pump f_p , generating a sum frequency $f+$ and a difference frequency $f-$. The sum frequency passes through port 4 through the sum frequency bandpass filter to the down-converter, and there is demodulated to input frequency f . Local oscillator signal for the down-converter is derived from the pump f_p through the directional coupler and level set attenuator, so that any klystron frequency drift is cancelled; this ensures that the output is exactly the same as input frequency f .

A schematic of the up-converter is shown in Fig. 2B. Varactor VAR (Microwave Associates 450 ER) is mounted across a four-port junction. Pump power, developed by klystron V_1 , is applied to port 3 through level set attenuator AT_1 and bandpass filter FL_1 , thus varying the varactor capacitance at pump frequency f_p . Signal f , is transformed by network C_1, L_1 from 50 ohms to an optimum source impedance, and then applied to the varactor through port 1.

The varactor mixes signal and pump frequencies to produce the sum frequency $f+$, which leaves through port 4, and the difference frequency $f-$, which leaves through port 2. The amplified signal $f+$ is transmitted through bandpass filter FL_2 to the down-converter.

A movable coaxial short, incorporated into the varactor mount, matches the varactor to the waveguide, and provides the microwave return for the varactor. Return for the signal frequency is provided by C_2 , and d-c return for the varactor bias by L_1 . Fixed bias stabilizes the varactor operating point.

Local oscillator power for the down-converter is derived by sampling the klystron output by directional coupler DC_1 . Fixed short E_1 reflects the energy from the normally coupled output port to the decoupled port used to supply local oscillation to the down-converter. This indirect means provides a microwave monitor port for alignment purposes.

The down-converter is an X-band short-slot hybrid mixer feeding a wide-band i-f amplifier, with range from 225 to 260 Mc. The i-f amplifier is mounted to the mixer, forming a replaceable assembly. A simplified schematic of the down-converter is shown in Fig. 3.

The sum-frequency signal $f+$ is delivered to the signal port of hybrid mixer HY_1 . Local oscillator signal f_p passes through level set attenuator AT_2 to the L.O. port of the hybrid mixer, where the two signals are mixed in reversed crystals D_1 and D_2 to produce an amplified input signal f . The mixer output is applied to the first

grounded-grid stage V_2 through coupling capacitors C_3 and C_4 and matching coil L_2 . This coil, with the capacitance of the crystal mount and the input capacitance of V_2 , forms a π network that transforms the i-f impedance of the parallel crystals, approximately 150 ohms, to the optimum source impedance for the input tube V_2 . Decoupling chokes L_7 and L_8 provide d-c return for the mixer crystals, and L_9 is for d-c return of V_2 cathode.

Interstage coupling is provided by a tapped tuned circuit consisting of L_7, L_8 , output capacitance of V_2 and input capacitance of V_3 ; coil L_9 effectively varies the Q of the circuit and L_7 , the resonant frequency. The output of the second grounded-grid stage, V_3 , is matched to the 50-ohm output by a double tuned output circuit consisting of L_{10} resonating with the output capacitance of V_3 , and L_{11} resonating with C_{11} in series with C_{15} and mutual inductance L_{11} . The secondary Q is adjusted by C_{15} and the coupling by L_{11} , so that the overcoupled circuit compensates for the drop-off of the interstage single tuned circuit, giving a relatively flat response from 225 to 260 Mc with sharp drop-off outside the passband.

A 6-db, 50-ohm matching pad consisting of R_3, R_4 and R_5 is built into the down-converter. A 6-db pad AT_3 is mounted externally.

Each stage is stabilized by d-c degeneration produced by returning the cathode through 1,000-ohm cathode resistors R_1 and R_2 to a -25 v supply. Bypass capacitors C_6 and C_{12} prevent r-f degeneration.

The author wishes to acknowledge the contributions of George Flanagan, who achieved the compact packaging of the unit, Jack Vigiano, who designed the down-converter, and Charles Bosomworth, who designed the power supply and control circuits.

REFERENCES

- (1) S. Bloom and K. K. N. Chang, Theory of Parametric Amplification Using Nonlinear Reactances, *RCA Review*, p 578, Dec 1957.
- (2) E. D. Reed, The Variable-Capacitance Parametric Amplifier, *IRE Trans of Electron Devices*, April 1959.
- (3) J. M. Manley and H. E. Rowe, Some General Properties of Nonlinear Elements Part I. General Energy Relations, *Proc IRE*, 44, p 904, July 1956.
- (4) D. Leenov, Gain and Noise Figure of a Variable-Capacitance Up-Converter, *The Bell Syst Tech Jour*, p 989, July 1958.
- (5) E. M. T. Jones and J. S. Honda, A Low-Noise Up-Converter Parametric Amplifier, 1959 *IRE Wescon Convention Record*, Part I, p 99.

Using Time-Compression Techniques In Digital Correlation

By MAX ROSENBLOOM, Project Engr.,
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Digital circuits take samples of incoming and reference signals, speed them up, and compare them in a correlator.

Techniques given here can be used in many types of signal processing

USE OF THE delay-line-time-compression technique in signal-correlation equipment permits a marked reduction in the complexity and size of the equipment.¹ A Deltic (delay line time compression) circuit loop compresses input signals in time and provides these for use in real-time operations at the compressed rate. The magnetostrictive loop holds input signals in active storage, greatly compressing them in time. Other time-compression methods store data at a specific rate, playing back the data later at a much faster rate. Storage on a tape or drum having fast playback is typical of this technique. The major shortcomings of this method are the amount and size of the equipment, and the inability or difficulty to achieve real-time operations. A drum can be used to achieve a Deltic loop with real-time access. However, it lacks the advantages of small size, high-speed operations and lower cost of a magnetostrictive Deltic loop. The Deltic technique permits faster correlation than the tape or drum technique, hence either more correlations in a given time, or the same number of correlations with a minimum of equipment.

Time compression multiplies the frequency spectrum, and consequently decreases the output filter size for the same equivalent integration. No information is lost in

this process. In fact, where post-detection averaging is feasible, the signal-to-noise ratio is vastly improved. No loss of incoming information occurs because no gaps exist between the sampled segments.

The loop (Fig. 1A) stores and compresses the signals as they arrive and has available the compressed form at an output at any time during the operation. The loop (Fig. 1B) contains an input section that consists of controlling AND gates and a delay section that consists of a magnetostrictive delay line. Although the signal input may be a continuous signal, it can pass AND gate 1 only when a sample pulse coincides. The complement of the AND 1 sampling pulse controls the gating action of AND gate 2 at its *inhibit* input. This is a recirculation gate which, with the 1-Mc clock pulse, allows the content of the delay line to recirculate continuously between sample pulses. When the next sample pulse arrives to enter a new signal bit, the inverted replica of the sample pulse is a proper signal at the inhibit input to the recirculating gate to inhibit the gate for the duration of the sample pulse. This action allows a new data bit to enter the delay line while the oldest data bit in the line is erased simultaneously at the recirculating gate.

Correlation implies the compari-

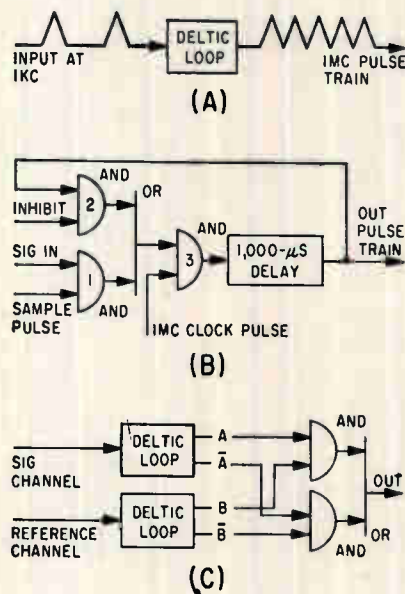


FIG. 1—Signals are compressed in loop (A), shown in more detail in (B). Use of loops in signal correlation (C)

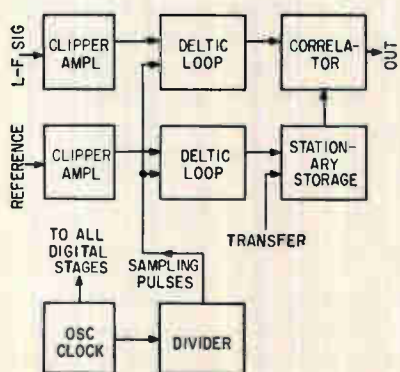


FIG. 2—Processing signals through the correlator

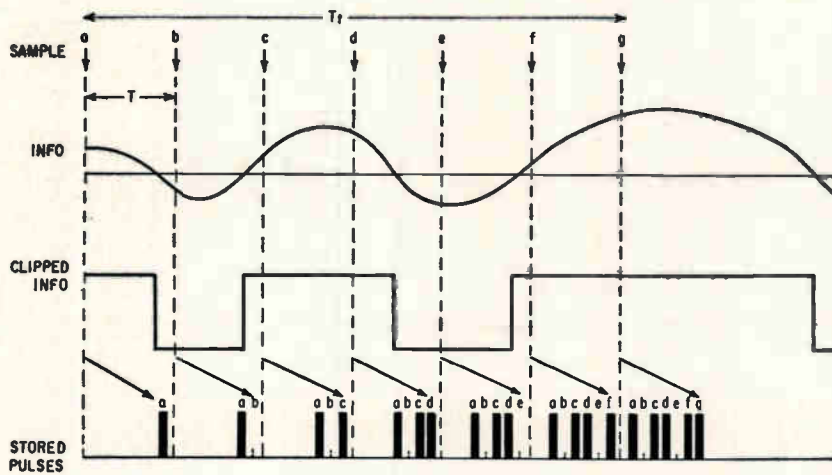


FIG. 3—Bit *b* closely follows bit *a* into the 1,000- μ sec delay line because the interval between sampling-pulse bits is slightly greater than the time it takes bit *a* to travel through the delay line

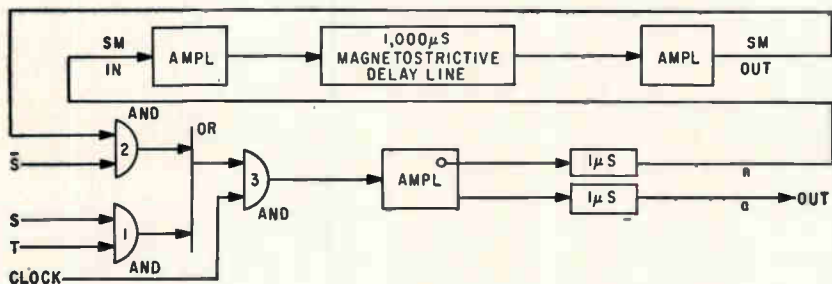


FIG. 4—This circuit is a complete loop

son of a signal and a reference to disclose coincidence of like signals. A Deltic correlator time compresses the signals used in a correlation process. In Fig. 1C, signals *A* and *B* can be considered as ONE outputs of the loops and \bar{A} and \bar{B} ZERO's. The correlating gates produce an output only when like signals appear at the gate inputs. The outputs of the gates are combined in an OR configuration so that the output consists of the signals from either gate. Since the signals of the gates are mutually exclusive, only one gate can produce an output at a specific time. An output from either gate produces a ONE. When neither gate produces an output, a ZERO bit appears at the output.

Hence, while the loop of the correlator continuously samples and compresses input signals into a small fraction of their original duration, the correlator section outputs represent the coincidence or anti-coincidence of the input signals. These outputs, available at

the compressed signal rate, thereby permit simultaneous display with variations of the input signal. The correlator system can consist of a simple two-channel arrangement, or of multiplexed inputs for more sophisticated correlation functions.

Figure 2 shows a simplified correlator. In this application, a clipper amplifier receives a 1-f signal and provides a clipped version of this signal. The clipping of amplitude variations causes no serious loss of information, which is maintained as polarity-in-time. Polarity crossover fidelity is required over a wide input voltage range (10 mv to 3 v) and frequency range (1 cps to 10 Kc) and operating temperature range (0C to +60C). Negative feedback supplies the required stabilization. When the clipped signal is sampled in the loop, one polarity is represented by a pulse and the other polarity by the absence of a pulse.

Time relationship of waves and pulses of Fig. 2 are shown in Fig. 3. A portion (T_s) of the 1-f sig-

nal is sampled at T intervals. The loop (Fig. 1B) accomplishes compression by the following sequence: The delay line receives sample *a*, a ONE, which undergoes a complete circulation of the loop. One microsecond after recirculation, sample *b* (a ZERO) is inserted alongside sample *a*. Both samples circle the loop. One microsecond later, sample *c* is inserted alongside sample *b*. This process continues filling the line with pulses (ONES) or non-pulses (ZEROS) that represent the polarity of the signal at the time of sampling. This action compresses T , the interval between pulses, to the clock interval; for example, 1,000 μ sec becomes 1 μ sec. In other words, *g* samples are compressed into time T . After the storage line is filled, the oldest sample is continuously replaced by a new sample. Thus, the stored information is constantly up to date.

The storage line, which forms the loop shown in Fig. 4 and Fig. 5, contains serial-memory and logic sections. The serial-memory section contains a driver, a magnetostrictive delay line and an output amplifier. A single memory package typically will delay a signal for 1,000 μ sec, thus storing 1,000 samples. Greater delays are obtainable by cascading any number of packages. The logic section is a dynamic decision element that performs logical functions dictated by terminal connections. Information, which is represented by the presence or absence of pulses, flows at a 1-Mc repetition rate. In the logical section, the two input AND gates produce data signals that mix in an OR circuit. The clock pulse reshapes the data signals, which are amplified and made available at the output one microsecond after the input pulses have occurred.

The output appears on two separate lines as ONE pulses from a quiescent ZERO condition at the assertion (*A*) output and as ZERO pulses from a quiescent ONE condition at the negation (*N*) output. The *N* output goes to the input of the serial memory section, and the output of the serial-memory section goes to one gate of the logical section. The serial-memory output is gated by the negation (\bar{S}) of the sample pulse. In the AND 1 gate,

the information (T) is gated by the assertion sample pulse (S). In the quiescent condition the S signal is a ONE, therefore causing continuous recirculation of the content of the DELTIC loop and the S signal is ZERO, therefore inhibiting any input of T . When the sample pulse occurs, \bar{S} becomes a ZERO, inhibiting old information from the serial memory section, and S becomes a ONE, permitting a sample of T to enter the gate. If T is positive, that is ZERO, at gate sensing time, a ZERO enters the logical section; if T is negative, ONE enters.

The input gate signals, after buffering, are gated with the clock pulse for re-timing. Information is amplified and appears one microsecond after sampling at the N and A terminals. The N output feeds through the serial memory and back into the recirculation gate.

The length of the loop is equal to the length of the magnetostrictive line plus one microsecond. Since this total time is one microsecond less than the time between sample pulses, sampling advances information by one digit with each complete circulation. In this way, samples that are separated by time T are stored one digit apart (Fig. 3) resulting in T_s/T compression.

The h-f replica appears at the output g times during storage of the sampled data. In a multiplexed

system, several integral rotations may occur between sampling, or sequential sampling of several channels may occur during one rotation, thus allowing a minimum of equipment or an expansion of system capacity.

The reference signal shown in Fig. 2 and the input signal are compared to establish the presence of mutual relationships. Compression of the reference signal occurs in the same manner as compression of the input signal. After this, the reference signal is stored in a non-processing, or stationary, storage loop which has the same construction as the loop and a logical connection that produces a length of delay equal to the sampling interval. However, no sampling occurs at the input gates of the stationary-storage-loop.

The correlator systems can incorporate various degrees of flexibility. Commands can switch storage loops from a Deltic mode to a STORE mode, or can serially transfer information from a storage loop to a stationary loop where the data circulates until a new command calls for data replacement. Meanwhile, the information in the stationary storage, while recirculating, is compared in the correlator with the constantly renewing information from the signal channel.

The correlator is a polarity-coincidence detector. When the inputs

are both ONES or both ZEROS, the correlator produces a ONE output. When the inputs are opposite, the correlator produces a ZERO output. The product occurs g times in time T_s , where g is typically 1,000. A standard logic circuit, similar to the logic section of Fig. 4, performs the correlation function. The outputs of the correlators may go directly to filters, or pass through demultiplexers or phase mixers before going to filters.

The oscillator clock circuit provides a common source of timed pulses to synchronize and reshape the information in all digital circuits. The master oscillator is crystal-controlled at a frequency of 1 Mc. This circuit can drive several slave clock circuits to time a large system. The divider (Fig. 4) generates sample pulses which are sub-multiples of the basic clock frequency. When signals are sampled by the sample pulses from the divider, no appreciable loss of information occurs if the sampling rate is at least three times the highest signal frequency.

The correlation technique of using delay line time compression is most useful in such fields as sonar, radar, telemetry, loran, and audio spectrum analysis.

REFERENCE

- (1) Victor C. Anderson, Technical Memorandum No. 37 (NR-014-903), Harvard U. Acoustics Research Laboratory, Jan. 5, 1956.

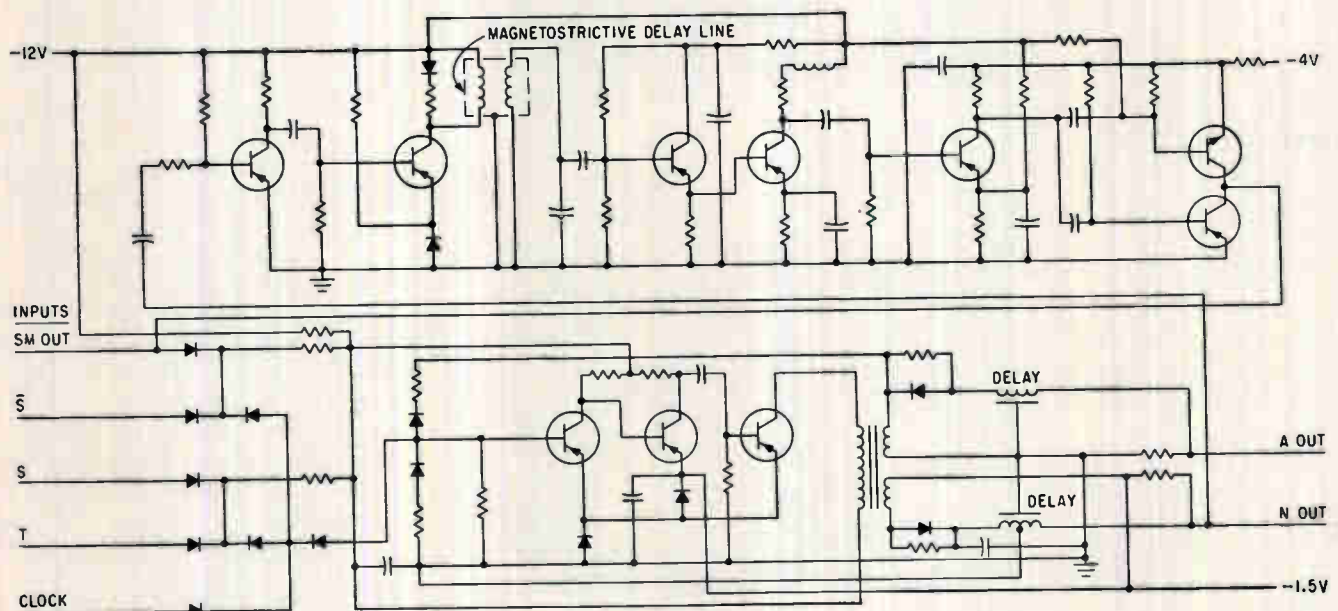


FIG. 5—This is the schematic of the loop shown in Fig. 4

Ultrahigh Frequency Doubler Circuit

Combination of input cathode coaxial quarter-wave cavity and output plate rectangular cavity improves stability and bandwidth

By A. KIRILOFF, Research Engineer
Electronics Research Laboratories,
Columbia University, New York

FREQUENCY MULTIPLIERS for inputs around 650 Mc usually have coaxial $\lambda/4$ input and output cavities. The movable plungers create poor con-

tacts and result in contact losses and multiplier instability. This article describes a microwave doubler for 650 Mc ± 10 percent that uses an input cathode coaxial $\lambda/4$ cavity and an output plate rectangular cavity.

Design of the output rectangular

cavity gives a stable system, flexibility in utilizing the optimum mode, broad bandwidth and a low level of spurious interference between input and output cavities. The number of movable plungers is reduced.

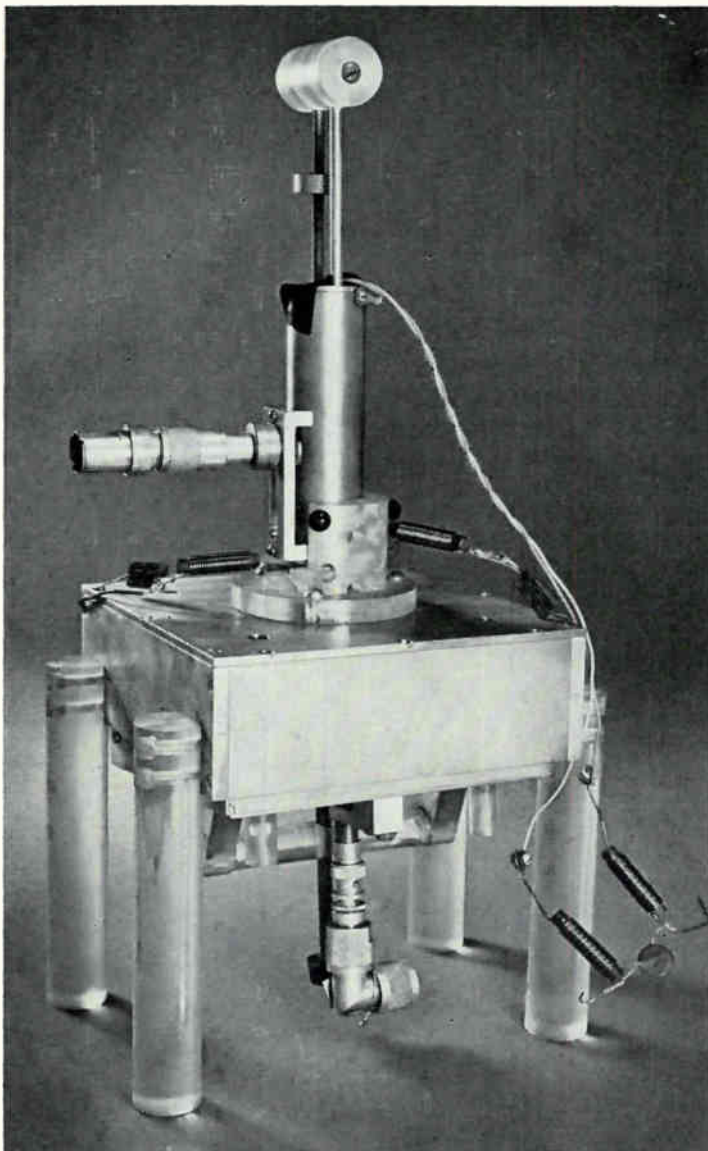
General diagram of doubler construction is given in Fig. 1. The input cathode cavity has been designed for TEM modes and can be tuned to 650 Mc by a movable grid-cathode plunger.

The output rectangular plate cavity is designed to resonate at the second harmonic (H_{011} mode). From the fundamental mode equation $(l/a)^2 + (m/b)^2 + (n/c)^2 = (2/\lambda)^2$, the H_{011} mode for a rectangular cavity requires: $l = 0$, $b = c$, $m = n = 1$, $\lambda = 2^2 b$ (or c), where l , m , n = order of modes, a = height of cavity, b and c = width and length of cavity, respectively. Minimum values are $b = c = 6.2$ inches and $a = 2$ inches.

When the output cavity has been tuned on or near the fundamental, the following modes may be presented in the output rectangular cavity: the fundamental mode of input frequency, the H_{011} mode (when the height of the rectangular cavity is small in comparison with b and c), the H_{101} mode (when the height of the cavity is large in comparison with b and c), the E_{111} mode (when the height of the cavity is equal to b and c).

Analysis of these modes in the output rectangular cavity is given in Fig. 2A. The vertical axis represents the output voltage; the horizontal axis represents the displacement (in $\lambda/2$) of the plunger of a double stub tuner in the output measurement equipment.

The distribution of the E and H fields of the H_{011} mode is given in Fig. 2B. In the vertical plane of the cavity, the maximum electric field



Microwave doubler has cathode coaxial cavity and plate rectangular cavity

Has Broad Bandwidth

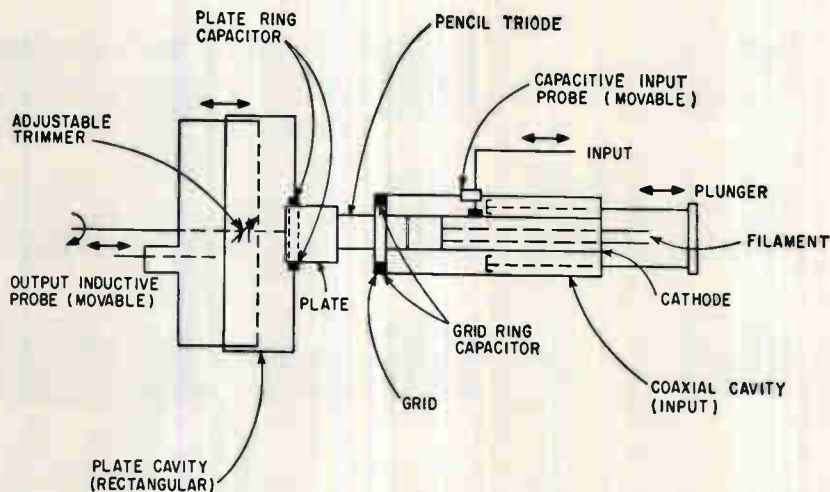


FIG. 1—General diagram shows construction of doubler for 650-Mc inputs

is at the center. In the horizontal plane, the maximum magnetic field is near the walls of the cavity.

Because the height of the cavity is small in comparison with the width and length, the effect of the height on the electric and magnetic distribution and on the frequency is negligible.

The method of output tuning at the fundamental by a precision adjustable capacitor in the output rectangular cavity is more stable, flexible and reliable than direct tuning of the output cavity on sec-

ond harmonics. Indirect tuning gives a broader output bandwidth by using the output inductive probe of different configuration. This probe is shown in Fig. 2C. By rotating the configured probe about its main axis, the output bandwidth can be increased four or five times in comparison with the straight line probe.

Separation of the second harmonic (H_{011} mode) in the output cavity from the fundamental and other spurious modes can be realized by using the double stub or

slug tuners in the output measurement equipment. This type of doubler is shown in the photograph. The cathode coaxial cavity with the movable plunger and capacitive input probe is shown at the top while the plate rectangular cavity with output movable probe and adjustable trimmer is at the lower end. The connections to plate, grid and filament of the tube are supplied through filters to prevent self-oscillation.

Results of tests with a GL-6771 pencil triode are: Input: 2 volts, input resistive load = 50 ohms, power output $E^2/R = 0.08$ watt, frequency $\cong 650$ Mc; Output: up to 1 volt, output resistive load = 50 ohms, power output $\cong 0.02$ watt, frequency $\cong 1,300$ Mc separated in the output from the fundamental mode by using the double-stub tuner in the output measuring equipment.

With a straight line output probe, bandwidth $\cong 25$ Mc (1.9 percent); with an output configured probe the bandwidth is up to 100 Mc (8-10 percent).

The writer thanks C. Walsh of Columbia University for permission to publish this article.

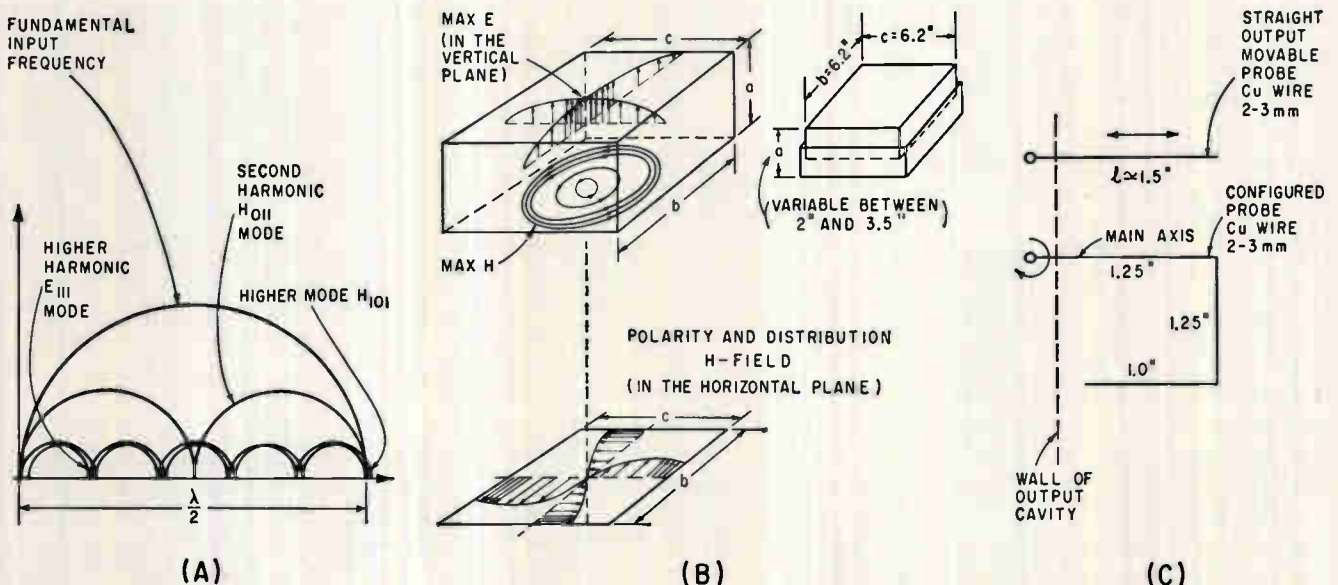


FIG. 2—Analysis of modes in output rectangular cavity (A), distribution of E and H fields for H_{011} mode (B), and output probes (C)

Measuring Human Work Performance

Ultrasonic device used in time-and-motion studies, fatigue analysis, medical studies and job design for the physically handicapped records three dimensional information about every motion of the body member being studied

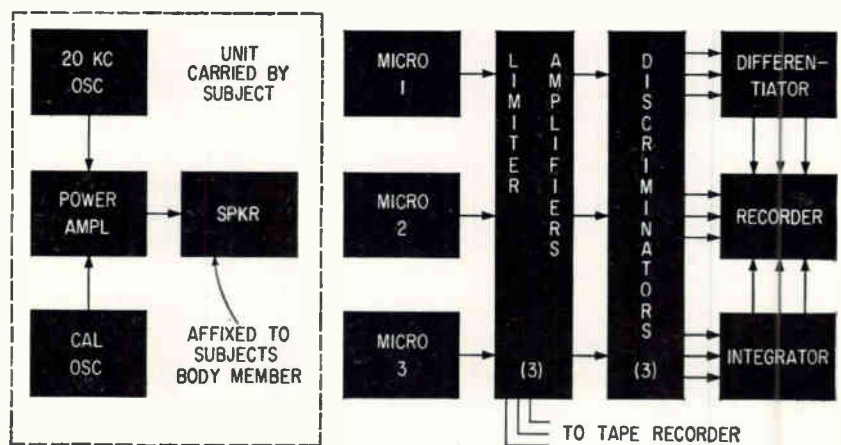


FIG. 1—Transmitter (left) is carried by subject with loudspeaker mounted to body member being studied. Three microphones are on mutually perpendicular axes around work area

By JAY GOLDMAN, Assistant Professor of Industrial Engineering, Washington University, St. Louis, Missouri

D. K. ROSS, Donald Ross and Associates, St. Louis, Missouri

THE CONCEPT of human work performance is fundamental to many scientific disciplines. One important and basic attribute of work performance is the output function. This output function can be realistically depicted by measures of physical motion. Such measures require determination of acceleration, velocity and displacement of each body member contributing to the work performed.

The requirements for maintaining a normal work environment exclude a number of existing means of making measurements. It was decided that the Doppler effect with sound presented the fewest obstacles for development of a work measuring device.

The system was developed at the Department of Industrial Engineering of Washington University and has been called the Universal Operator Performance Analyzer and Recorder (UNOPAR)¹. Figure 1 is a block diagram of the circuit. The system consists of a physically small transducer attached to the subject's body member and radiating acoustic energy at 20 Kc.

The radiated energy is received by three microphones along mutually perpendicular axes around the work area (see Fig. 2). With the microphones each located about 10 feet from the subject, motions within a one yard cube maintain the geometric accuracy of the coordinate system to within ± 1 percent. (The Doppler difference between a motion normal to an axis, and one in an arc about the axis is essentially the same within this work space.)

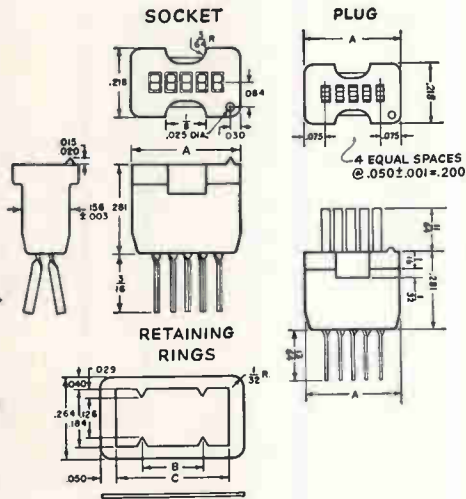
The signal to each of the three microphones is shifted in frequency by an amount proportional to the velocity along the respective axis of each microphone by the amount: $f_d = [V/(V - v)] f_s$, where f_d is Doppler frequency, V is velocity of sound, f_s is transmitter frequency and v is velocity of source.

The construction of the microphone and preamplifier unit was designed to minimize acoustic reflections from the preamplifier back to the microphone. The preamplifier has a gain of about 3,000 that produces an output signal at the 1 volt level. The microphone is an electro-

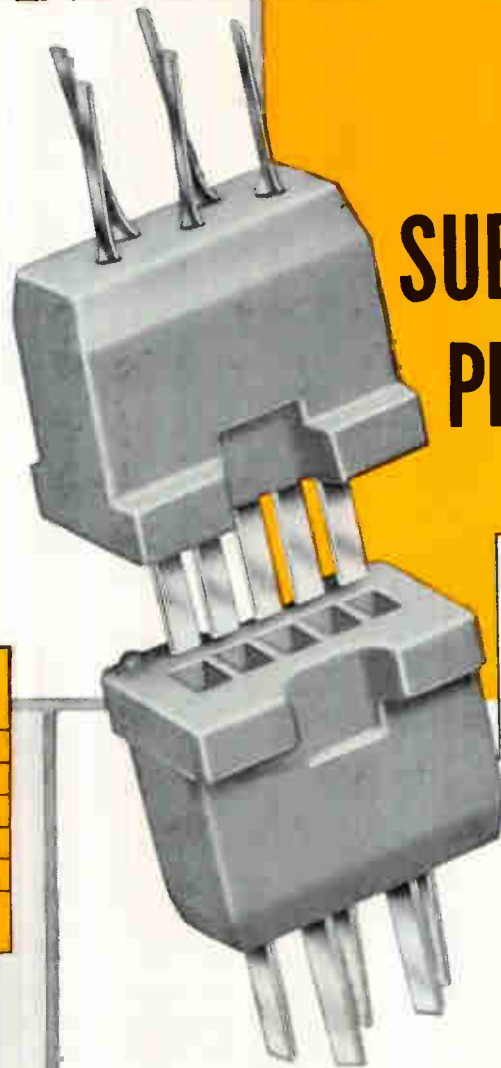
static transducer operating with 300 volts bias and manufactured to resonate at 20 Kc with a Q of about 5.

These signals are fed to limiter amplifiers and discriminators in the main console. The limiter-amplifier consists of a stage of amplification and three stages of Zener-diode clipper circuits. The output of the limiter circuit remains constant at 32 v rms as the nominal 20 Kc signal varies in level from 50 mv to 3 v, or a dynamic range of about 35 db. Since the signal-to-noise ratio is usually poorer than 35 db, further improvement in dynamic range is of no benefit. The signal then passes to a tuned LC discriminator that has a linear bandwidth for plus and minus 300 cps. The output of the discriminator is a bipolar d-c voltage proportional to the Doppler frequency shift, which is in turn proportional to the body member velocity. The signals are recorded on a direct-writing oscillographic recorder. The output is also integrated and differentiated and these signals, proportional to body member displacement and ac-

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4	.350 ± .003	.194	.360
5	.350 ± .003	.194	.360
6	.400 ± .003	.244	.410
7	.450 ± .003	.294	.460

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4 contacts 204-92-04-048	131-14-12-096	441-00-11-082(105)
5 contacts 204-92-05-049	131-15-12-097	441-00-11-082(105)
6 contacts 204-92-06-050	131-16-12-098	441-00-11-083(105)
7 contacts 204-92-07-046	131-17-12-099	441-00-11-084(105)

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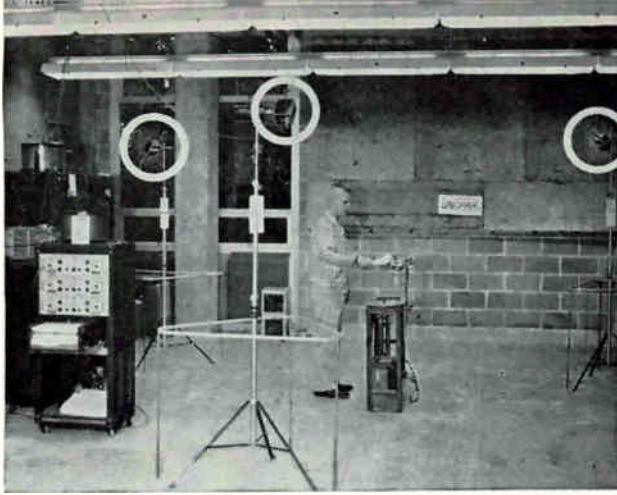


FIG. 2—Physical location of the three microphones located around a typical test area

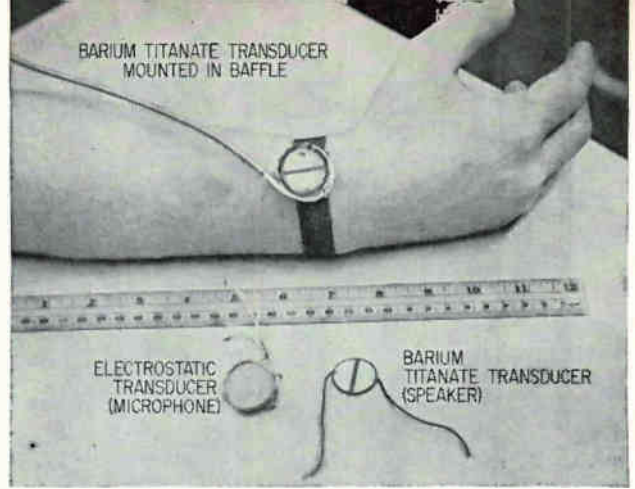


FIG. 3—Method of attaching barium titanate transducer to subject's limb (in this case the wrist)

celeration, are also recorded. Output signals from the three limiter-amplifiers are also directly recorded on magnetic tape for record storage and further processing with computers. Calibration of the system can be made by transmission through the transducer of crystal-controlled frequencies corresponding to peak Doppler variations expected.

Figure 3 shows two body-member transducers. The electrostatic capacitor unit was first used. However, it has only a 30-degree transmission beamwidth. In addition, the 300-volt polarizing potential for this unit presented a hazard to the subject. This transducer was replaced by a prepolarized barium titanate compound cemented to an aluminum disk, with electrodes silvered to the top in the form of two D's. Since barium titanate is a volume expanding substance, the unit alternately cups and relaxes the aluminum in response to the excitation. The coupling to air is good and the unit operates efficiently compared with other transducers that have been tested.

The radiated pattern from the titanate transducer is similar to a flattened dipole pattern. To reduce the back lobe the unit is mounted on foam rubber over an acoustical absorber. This achieves the desirable hemispherical radiation coverage.

The velocities of interest are from $\frac{1}{2}$ -in. per sec to 10 ft per sec, with acceleration up to roughly 10 g or 300 ft per sec. These velocities correspond to Doppler shifts from $\frac{1}{2}$ cps to 180 cps at the 20 Kc frequency or approximately 17 cps per ft per sec². It is difficult to determine analytically what limitations

are presented by the system's electrical bandwidth to the measure of acceleration.

The Doppler equation can be differentiated with respect to velocity and then time; then for velocities small compared with the velocity of sound; $[d(f_d)/dv] [d(v)/dt] = [Vf_0/(V - v)^2] [dr/dt]$. Using this expression, the bandwidth required for a 1 g acceleration and a velocity of 1 ft per sec can be calculated as approximately 600 cps.

The 1 g limitation permits most of the experiments to be conducted. Ease of design made this the final consideration, and a system bandwidth of 600 cps was selected.

Reflections of the transmitted signal from the operator's body and from the work surface have been shown to cause noise in the output. The path-length between direct and reflected signals at the operating frequencies is sufficiently small to cause cancellations and effective phase shift of the received signal. Equally troublesome has been the effect of phase shift caused by the pattern of the wrist transducer when moved and accelerated. The new transducer with its simple lobe pattern has alleviated but not eliminated this problem.

To minimize the effects of these disturbances, sets of low-pass filters following the discriminators have been used with cutoff extended to pass only the maximum frequency signals that are believed to be present for a given type of operation.

To check the accuracy of the system, an experiment was designed in which the transducer was driven by a linkage in simple harmonic motion. The maximum velocity corresponding to the peak deviation

frequency was 6 ft per sec causing a Doppler shift of about 102 cps. The modulating rate, frequency of the simple harmonic motion, was 3 cps. Since the motions are all sinusoidal, conventional f-m analysis of the signal indicates that a deviation ratio of $102/3 = 34$ is present. With a deviation ratio of this type, energy components will all be near 20 Kc, with energy components every three cps out to about plus or minus 125 cps. Therefore all signals are well within the system pass band.

The linkage driving the transducer is also connected to a magnetic plunger in a long coil. The voltage from this coil is proportional to the velocity of the transducer.

The resultant velocity from the three channels compared to that of the coil agrees to within an accuracy of 2-percent with a standard deviation of 0.6-percent.

The UNOPAR can help solve many problems in motion study or work simplification, work measurement and time study, fatigue analysis, selection of people for jobs, training operators for jobs, materials handling, physical education, medical studies (such as the effect of mental illness on performance of jobs), job design for the physically handicapped and many military applications. It obtains exact three-dimensional information about each and every motion for every cycle for the body member being studied.

REFERENCE

- (1) J. Goldman Development and Testing of Electronic Method for Determining Acceleration, Constant Velocity, and Deceleration of Body Motions. Doctor of Science Dissertation, Washington University, St. Louis, Mo. (1955).

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Submillimeter Wave Generation to be Reviewed

OPTICAL PRINCIPLES combined with traveling-wave tube techniques may provide the first submillimeter waves at useable power levels. That is the opinion of Prof. Paul D. Coleman of the Ultramicrowave Group at the University of Illinois. He will discuss the reasons for this conclusion as well as some more radical approaches at the forthcoming International IRE Convention.

Prof. Coleman admits that no one knows whether an electron device can produce useable power at 300 to 3,000 Gc. However he will report progress in several directions made at the university under contracts to Wright Air Development Depot, the Atomic Energy Commission and the Air Force Office of Scientific Research. Interesting possibilities from the more than sixty organizations active in this effort will also be reviewed.

Almost every branch of physics is involved in efforts to produce submillimeter waves, according to Coleman. The classical method for producing electromagnetic energy is to retard electrons with electromagnetic fields to convert their kinetic energy to electromagnetic energy. In the quantum method, a system is permitted to interact with an electromagnetic field so that it undergoes a transition from a higher to a lower energy state. Internal energy is thus converted into electromagnetic energy. Realization of either basic method may take a variety of forms but the problems of coherence, field containment and energy conversion always seem to arise.

In a classical scheme, coherence implies bunching, while in a quantum mechanical scheme it implies stimulated emission. Because both require an electromagnetic field, containment of the field is a requirement for both methods. In electron-beam devices for submillimeter waves, containment is a major problem. Conversion of readily available energy to coherent energy

of the desired frequency is required of any oscillator. The conversion problem also involves getting energy into and out of the device.

The relationship of these three problems to the devices to be discussed at the conference will be indicated as well as the attempts being made to solve them.

In electron beam devices, an electron can interact with electromagnetic fields of other electrons or those established by its own motion. These devices can be categorized as standing-wave or resonator devices, slow-wave devices, fast-wave devices and acceleration radiation devices.

Standing-wave or resonator devices (magnetrons, klystrons) have limited usefulness at wavelengths shorter than 2 mm because of the small dimensions and increased losses. However, with a higher order mode and megavolt bunched beam, an unloaded microwave cavity resonator can operate down to about 0.8 mm.

At shorter wavelengths in an ultramicrowave form of an optical interferometer, interaction between an obliquely incident plane electromagnetic wave and a bunched electron beam can be obtained in a dielectric medium. By maintaining synchronism between wave and beam, a relationship exists that is identical to the Cerenkov radiation condition. This approach is being investigated by M. D. Sirkis and R. Strain at the U. of Illinois.

J. Stafford is working with another resonator at the university that consists of a plasma column between two metal plates and uses a strong magnetic field. Resonant frequency is determined by dimensions and plasma characteristics.

An electron beam can interact with a traveling wave field in several ways. Based on known accomplishments in this area, Prof. Coleman believes that refinements of conventional slow-wave structure techniques will enable them to pro-

duce submillimeter waves long before newer methods are developed. A twt constructed from round waveguide could achieve coherent radiation by prebunching the beam and keeping it bunched during transit. Analysis of the bunched beam case is the same as that used in twt's, so Cerenkov and twt interaction must be the same. The bunched beam would have to contain harmonics of a lower frequency, so the Cerenkov scheme reduces to frequency multiplication. Physical optics are used to couple out the Cerenkov radiation.

Acceleration radiation devices are based on the fact that accelerated charges radiate energy. Recent progress in producing pulsed magnetic fields exceeding 100 kilogauss have renewed interest in these devices.

Several experiments are also in progress at the U. of Illinois in which attempts are being made to shift to higher frequencies using a moving-mirror doppler effect.

Spectrometer Aids Tube And Semiconductor Study

OMEGATRON mass spectrometer permits detection and measurement of gaseous components in high vacuum. It serves as an inexpensive automatic scanning analyzer and was developed during investigation of oxygen interaction with atomically clean germanium and silicon.

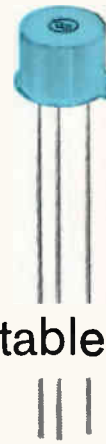
The system developed by Raytheon has other applications to electronics, particularly in relation to vacuum tubes. It can be used to examine residual gases in vacuum tubes and gases evaporated from hot cathodes, that penetrate glass and ceramics, and that are absorbed and released by metal surfaces. The instrument can also be used to detect leaks, examine residual gases in diffusion pumps and for the study of aging effects in vacuum tubes. Further study may lead to noise reduction in klystrons,

SLASH COMPONENT REQUIREMENTS

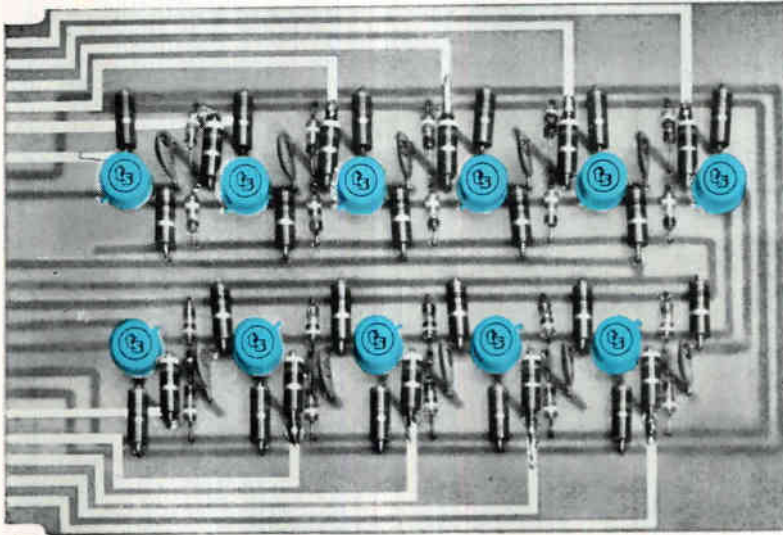
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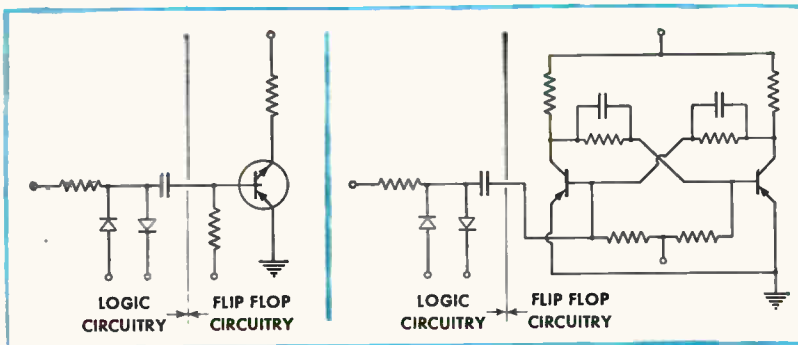


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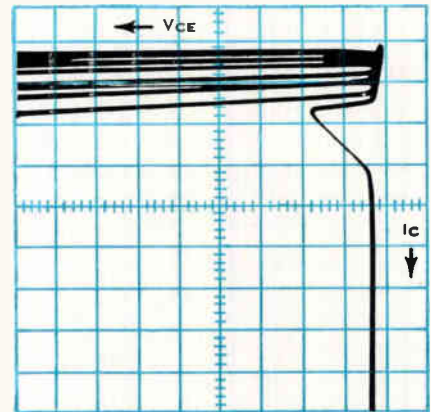


Here is a shift register panel which demonstrates the enormous component savings and the substantial reduction in backboard wiring and circuit complexity that can be achieved through the use of Tung-Sol Dynaquad transistors. This component advantage is typical of the assembly economy (especially with printed circuitry) that can be realized in many other applications, including: computer memory and readout; core drivers; relay activators; sweep generators; and high energy switching. For full technical details write: Tung Sol Electric Inc., Newark 4, New Jersey.

1 printed circuit board assembly performs the job of 3. 10-bit shift register designed with Tung-Sol Dynaquad transistors. Just one assembly is required where 3 are necessary when designed with conventional components.



7 components replace 14. Comparison of a single stage of the 10-bit shift register designed with Dynaquad transistors (left) and conventional components (right) shows the circuit simplicity and component reduction obtained with Tung-Sol's new germanium multilayer alloyed junction transistor.



Dynaquad is a three-terminal device featuring regenerative switching characteristics. One terminal—the base—serves as the control gate for initiation of the regenerative action. It permits turn-on and turn-off by bursts of drive power. In this way, a small signal controls large amounts of energy in a ratio not approached by conventional 3-layer junction transistors. Trace shows Dynaquad collector characteristics with base current turn-on.

2N1966	2N1967	2N1968
Typical electrical characteristics and ratings.		
Pc	collector dissipation at 25°C	120 MW.
BVCES	collector breakdown voltage	— 50 volts
Ics	sustaining current	15 Ma
ib (on)	base turn-on current	0.1 Ma

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see Tung-Sol Dynaquad Transistors
at the IRE show booth Nos. 2334-2336, 2427-2429



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In fact, any of North Atlantic's field engineering representatives can quickly demonstrate how the Models RB-503 and -504 Ratio Boxes will meet all your requirements for high accuracy at lowest cost.

Designed for either bench or rack mounting, both models provide rated accuracy over their full ratio range, with six-digit, in-line window readout for best readability. Both incorporate heavy duty switches with transient suppression, fold-away legs, easily removeable end plates and voltage dividing transformers to MIL-T-27A. Abridged specifications are given below:

	RB-503	RB-504
Ratio Range	0.000000 to 1.111110	-0.111110 to +1.111110
Accuracy Of Ratio For All Ratios (at 400 cps)	$\pm \left[0.001 + \frac{0.0001}{(\text{Ratio})} \right] \%$	$\pm \left[0.0001 + \frac{0.000025}{(\text{Ratio})} \right] \%$
Frequency Range (Useful)	50 to 10,000 cps	50 to 10,000 cps
Nominal Input Impedance (at 400 cps)	50K-60K	> 250K
Max. Input Voltage	0.5f, Volts, (f in cps) (not to exceed 350 V.)	1.0f, Volts, (f in cps) (not to exceed 350 V.)
Max. Effective Series Resistance	3.5 ohms	8 ohms
Resolution	5 decades plus 1 turn potentiometer	5 decades plus 1 turn potentiometer
Size	3½" h. x 19" w. x 8" d.	3½" h. x 19" w. x 8" d.
Price	\$295.00	\$450.00

Also from North Atlantic: Model RB-510 for high precision at 10 kc and RB-520 for MIL Spec applications.

If you're up against critical jobs of ac ratio measurement — in the laboratory, on the production line, or in the field — it will pay you to talk to the North Atlantic man in your area. For his name, call or write today. Or request Bulletin RB 503-504 for complete data.



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advances in vacuum technology and improvement of getters.

The apparatus used in the semiconductor program includes the omegatron—a small-volume r-f spectrometer operating on the cyclotron-resonance principle. It is used with a highly sensitive quartz microbalance that can detect weight changes of 10^{-7} grams, a modified Wagener setup to study getter action and associated vacuum systems using oil, mercury, ion or cryogenic pumping. Pressures as low as 10^{-10} mm Hg were obtained.

Combining the vacuum microbalance and omegatron spectrometer in a single apparatus provides a useful tool to study outgassing, sputtering, dissociation, adsorption and oxidation phenomena. Data are provided over a wide range of pressures and temperatures with simultaneous identification of the products evolved from experimental procedures. These investigations provide information necessary to understand the complex processes occurring in the electron tube.

A complete investigation of residual gases in an electron tube requires knowledge of the origin of contaminants, partial pressure of each gas, its physical state (atomic, molecular, ionic) and its interaction with other materials. Where there are hot filaments, varying potentials and components made from a variety of materials, all must be taken into account to understand the effects of residual gases on tube parameters and tube life.

An off-shoot of the project was development of an oscillator with a simpler drive system. The oscillator covers a range of two decades for one revolution of the tuning control, which was obtained by using a variable capacitor having a range of 10:1. With the oscillator incorporated, the omegatron spectrometer can be swept from mass number 2 to mass number 200 with one revolution of the tuning control.

In operation, ions formed in the omegatron are separated according to mass. Ion currents indicate concentrations present in the analyzing chamber. Recorded current and frequency can be interpreted in terms of concentration of a particular gas identified by its mass number. Mass numbers of low-molecular-weight gaseous components can be successively monitored and relative con-

centrations estimated by sweeping over the available frequencies.

The omegatron mass spectrometer can determine gas composition in the pressure range from 10^{-6} to 10^{-5} mm Hg. In this high vacuum region, partial pressure of a gaseous component can be determined, not just total gas pressure. This capability results because the device has reasonable resolution at high sensitivity and is constructed of materials that can be baked out to achieve low residual pressures.

One-Man Control System For Nuclear Power Plant

CONTROL SYSTEM for a nuclear power plant will perform a variety of functions automatically, including that of shutting down the system if dangerous conditions develop. During normal operation, only one man at a control console will be required to operate and monitor the 1,500-Kw power generating system. The instrumentation and control system has been designed for the PM-3A nuclear power reactor that will be installed at McMurdo Sound in Antarctica.

The system, including all instruments and controls for the nuclear reactor and steam generator, was designed and built by General Dynamics/Electronics. The air-transportable nuclear power plant is being built by The Martin Company.

Logic networks will monitor both the reactor and feed-water systems to differentiate between secondary component failures and dangerous operating conditions. Using this information, these circuits will make decisions whether to continue operation or shut down the system.

Nuclear instrumentation comprises a 7-channel system for measuring and controlling neutron flux in the reactor from cold start-up through 150 percent of rated power output. Automatic self-checking circuits used in the control loops will immediately indicate malfunctions in the instrumentation system and pinpoint location of the fault.

Automatic analyzing equipment will constantly monitor and control chemical composition of water used in the boiler. Computer techniques in the boiler feed-water control loops will anticipate deviations from normal operating conditions.

March 10, 1961

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CIRCLE 179 ON READER SERVICE CARD

203

Speaking of New Components . . .

DEVICE AND MATERIALS men who have not organized a systematic, planned coverage of both exhibitors (over 850) and technical papers (over 265) will find themselves hard pressed to cover all they would like to see and do at this year's International IRE Convention.

With this thought in mind, we pinpoint some specific papers that interest this column and should interest components men. Use this as a check list in your own behalf. We also suggest that readers carefully comb through the special feature that highlights the show (p 182), the special products and designs story on p 36, and other sections including new products on p 212 to ferret out exactly what they want when they are in New York. It will be wise to contact specific people before the show to make sure that they can talk to you. Use your time to advantage, and don't forget to take this issue of *ELECTRONICS* along.

A number of wafer and pellet-shaped microcomponents, including tantalum and ceramic capacitors; carbon and metal oxide film resistors; and silicon rectifiers will be analyzed in a paper that will examine these units from a production mechanization point of view¹. A dot components packaging system² and a survey of high-density computer module construction techniques will be taken up at this same session³.

One paper that should interest electron-device men discusses a solid-state display device that works on a new principle⁴. This is a thin, flat panel of piezoelectric material, one surface of which supports an electroluminescent layer. Voltage pulses, applied to several electrodes suitably positioned on the periphery of the panel, introduce traveling acoustical waves into the piezoelectric material. Electrical fields accompany the waves so produced and interact with the electroluminescent layer to produce a localized

spot of illumination. The position of the spot is controlled by varying the relative timing of the pulses to produce either a raster or an oscilloscope pattern. Means for continuously modulating the light intensity of the spot will be discussed.

Broadcast engineers will take in recent advances in vidicons⁵. This is a report on new and improved vidicons by American and foreign manufacturers. Tubes will be reviewed on the basis of improvement or novelty of the characteristics of sensitivity, spectral response, lag and gamma. Because of current standardization activity, particular emphasis will be given to a review of gamma, the transfer characteristic, with regard to methods of test, and variation with tube parameters.

Space electronics and materials men should cover the talk on the effects of Van Allen Belt Radiation⁶. An estimate of radiation effects on various materials and components is included as an extrapolation of data secured from nuclear fission fragment bombardment and gamma irradiation. Specific components and materials will be discussed, and recommendations will be made for an additional testing and evaluation program.

The present state of new semiconductor and ferrite devices for microwave signals will be covered by a paper⁷ that will emphasize the applications of low-loss ferrites and Varactor, pin and tunnel diodes. Applications will include parametric amplification harmonic generation, r-f power control, signal limiting, crystal protection, oscillation, mixing, negative resistance amplification and tunable filtering. The authors will point out the advantages of the new devices, such as improved sensitivity, lower power supply requirements, reduced size and weight and increased ruggedness and reliability.

Six papers will be presented in the session on Advances in Compo-

nent Designs: resonators⁸, micro-module inductors⁹; micromodule reliability report¹⁰; solid tantalum capacitors¹¹; bowl-shaped permanent magnets¹², and silver-cadmium batteries¹³.

This column was first to report the reliability data on the RCA micromodules program (*ELECTRONICS*, Nov. 25, p. 138) and a complete rundown, now discussed in the Levy paper¹⁰ should be of considerable interest. The practical applications of the RCA micromodule in avionics will be discussed at the Military Electronics Sessions the following day¹⁴. Micromodules can be integrated with standard components in existing equipment requiring a change of scope without a change in configuration.

Several possible transducer applications are presented in a discussion of the piezomagnetic effect in certain ferrites¹⁵. The results of this investigation have been used in the development of a ferrite

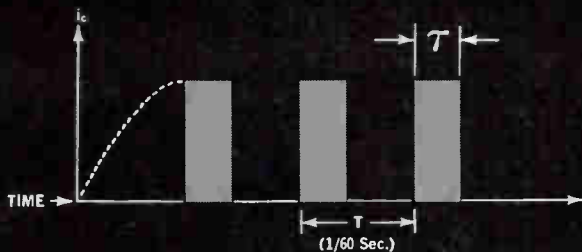
Bonding Semiconductors



Permanent metallurgical bond is assured between solder and base metal. Even when liquid, continuous conductive coating of tin-gallium clings to base metal in smooth uniform layer. Chief use: for stamping base tabs to support the silicon or germanium wafer in transistors. Developed by Alpha Metals, Jersey City, N. J.

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up to 50 amps
at peak power levels!



Only the Baird-Atomic NC-1 offers you the advantages of a direct reading, variable duty cycle test set for non-destructive measurement of medium and high-power transistors.

Check these important features:

- Minimizes heat sink requirements
- Under optimum conditions, requires only 6/10ths of 1% of the input power used in conventional DC current tests
- Permits 750 watts max. power with max. current of 50A or max. voltage of 250V
- Provides DC meter readings of V_{BE} , I_B , V_{CE} and I_C — common emitter configuration under pulse conditions
- Measures leakage currents, I_{CO} and I_{EO} , by standard techniques
- Allows breakdown measurements to be performed under variable bias conditions
- Evaluates switching capabilities of device under dynamic conditions

The Baird-Atomic Model NC-1 applies suitable pulse drive signals to the transistor under test and then peak detects the resulting current pulses at the same measuring value as steady state DC. Because the average pulse signal power is considerably lower than that of steady state DC, less stress is put on the transistor. This permits power tests to be made at a level many times that of rated device dissipation.

Write today for additional information and name of your nearby Baird-Atomic representative.

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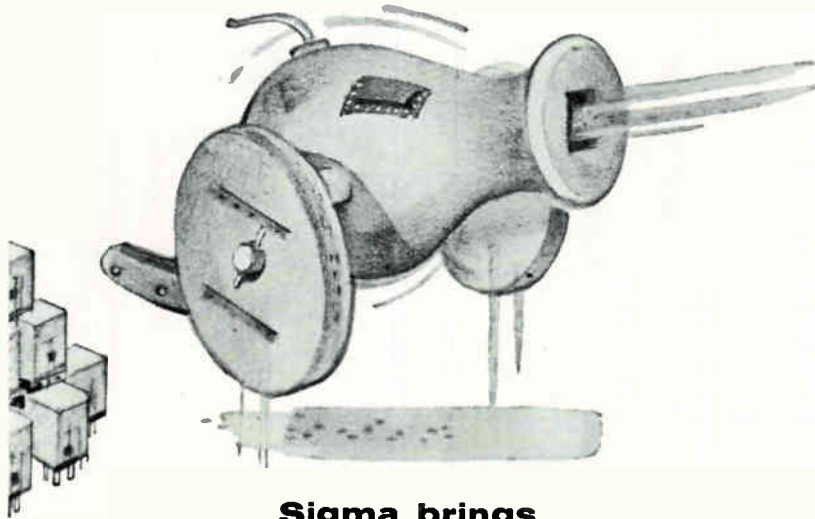


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CIRCLE 380 ON READER SERVICE CARD



**Sigma brings
big gun to bear on
commercial relay field**

There's a new Sigma relay just coming into the picture that's so disarmingly simple in design, construction and operation that Believers in Complexity will probably get mad when they see it. (After all, if you give someone a simple answer to anything nowadays they think that you couldn't possibly have understood the problem.) But the reaction around here is that the designer's really got something, and there was even talk about erecting a small monument to him in the parking lot.*

We were going to call this new general purpose AC-DC relay the "Series 90" until there was some rumbling in the number department, so now it has the much more economical, sensibly conservative number of 46. It's an honest-to-goodness good heavy duty commercial relay, that will switch up to 10 amp, 120-volt resistive loads on as little as 200 mw. DC or 0.5 v-a AC. What the big simplicity pitch Means To You is that there are so few parts it's almost impossible for anything to get out of whack; the few parts it does

have aren't hard to make or assemble (translated, \$3 or \$4 per relay in quantity); a big motor and fat DPDT contacts efficiently use every bit of the volume and give a long mechanical life — from 500,000 operations on 10 amp loads to 10 million operations at no load. Since we hope the "46" will find its way into such things as machine tool controls, timers and laundry equipment (and even smarter Electronic Devices as well), the octal plug-in base has the same pin connections as the relays already sitting in this type of equipment. If you want to call this a retrofit, go right ahead. That's it there in the picture, in a revealing $1\frac{5}{16}'' \times 1\frac{5}{16}'' \times 2\frac{1}{16}''$ plastic enclosure.

The first few thousand are now beginning to roll, and while we're not quite ready to talk delivery by the carload, anyone interested in trying out 46's in sample quantities will get to sit in the sales manager's padded office for $8\frac{1}{2}$ glorious minutes.



Series 46 Relays and other selected Sigma products and personnel on display at booths 2628-2630, New York Coliseum, March 20 to 23. Come energize them.

*We decided not to overdo it and gave him a Rolls-Royce instead.

SIGMA

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62 Pearl Street, So. Braintree 85, Mass.

piezomagnetic stress transducer. The device produces a d-c output voltage proportional to the stress in a ferrite sensor. The relationship between output voltage and stress can be made either linear or logarithmic to fit the best requirements of a particular instrumentation problem. The transducer is smaller and more sensitive than similar devices utilizing semiconductor strain gages by at least an order of magnitude.

The session on Application of Solid-State Devices as Components includes talks on semiconductor band-pass filters¹⁶; microsystem circuits consisting of resistive and capacitive layers¹⁷; a new silicon oxide capacitor¹⁸; new concepts in thermoelectric device design¹⁹; a tape for metal-ceramic sealing²⁰; and a unique component for use in i-f circuitry²¹. M.F.T.

REFERENCES

- (1) S. M. Stuhlberg and L. P. Sweaney, Microminiature Components and Packaging, P. R. Mallory & Co., Inc., Indianapolis; presented at the Product Engineering Session, Mon., Mar 20, 2:30-5 PM, Coliseum, Faraday Hall.
- (2) A. E. Hawley, E. A. Klein and S. Rubin, A Dot Component Packaging System, Hughes Aircraft Co., Culver City, Calif., same session as above.
- (3) N. Schuster and W. Reimann, New Developments in Multilayered Etched Circuitry, Litton Systems Inc., Woodland Hills, Calif.; same session as above.
- (4) S. Yando, Solid-State Display Device, General Telephone and Electronics Labs, Bayside, N. Y.; Electron Devices Session, Mon., Mar 20, 2:30-5 PM, Coliseum, Morse Hall.
- (5) M. Rome, Advances in Vidicons, Machlett Labs, Inc., Springdale, Conn.; Broadcast Session, Tues., Mar 21, 10 AM-12:30 PM, Waldorf Astoria, Jade Room.
- (6) R. S. Shane, Effects of Van Allen Belt Radiation on Material, Light Military Electronics Dept., G E Co., Utica, New York; Space Electronics Session, Wed., Mar 22, 10 AM-12:30 PM, Waldorf Astoria, Sert Room.
- (7) M. E. Himes, A. Uhler and R. Damon, Advances in Solid-State Microwave Devices, Microwave Associates, Inc., Burlington, Mass.; Microwave Solid State Session, Wed., Mar 22, 10 AM-12:30 PM at the Coliseum, Morse Hall.
- (8) J. L. Ekstrom, General Theory of a Class of UHF Resonators, Westinghouse, Baltimore; Advances in Components Design Session, Wed., Mar. 22, 2:30-5 PM, Waldorf Astoria, Jade Room.
- (9) G. G. Hauser, Materials and Form Factors for Micromodule Inductors, Semiconductor Materials Div., RCA, Somerville, N. J.; same session as above.
- (10) D. T. Levy, Micromodule Reliability Status Report, RCA, Somerville, N. J.; same session as above.
- (11) R. Rhodes, Solid Tantalum Capacitors, IBM Corp, Kingston, N. Y.; same session as above.
- (12) J. C. Wurr, Design of Bowl Magnets Using the Electrolytic Tank, Litton Industries, San Carlos, Calif.; same session as above.
- (13) P. L. Howard, Sealed Silver-Cadmium Battery, Yardney Electric Corp., New York, N. Y.; same session as above.
- (14) G. Sievers, Micromodules in Avionics, RCA, Burlington, Mass., Mar 23, 2:30-5 PM, Waldorf Astoria, Sert Room.
- (15) C. E. Land, A Ferrite Piezomagnetic Stress Transducer, Sandia Base, Albuquerque, N. M.; Mar 23, 2:30-5 PM, Coliseum, Morse Hall.
- (16) S. N. Levine and J. J. Stein, Semiconductor Band-Pass Filters, RCA Surf-Com Div., New York, N. Y.; Wed., Mar. 22, 10 AM-12:30 PM, Waldorf Astoria, Jade Room.

(17) W. W. Happ and G. C. Riddle, Film-Type Microsystem Circuits, Lockheed, Palo Alto, Calif.; same session as above.

(18) O. B. Cecil, Silicon Oxide Capacitor, Texas Instruments Inc., Dallas; same session as above.

(19) W. H. Clingman, Thermoelectric Device Design, Texas Instruments, Dallas; same session as above.

(20) H. D. Doolittle, K. Ettore, R. F. Spurr and P. F. Varadi, Ceramic Metallizing-Tape; Machlett Labs, Springfield, Conn.; same session as above.

(21) A. Lungo and F. Sauerland, Ceramic Bandpass Transformer and Filter Element, Clevite Electronic Components, Cleveland; same session as above.

Adhesives for High Temperature Uses

THREE NEW adhesives having increases in high-temperature capabilities, have been announced by Radiation Applications, Inc., Long Island City.

The first, RAISEAL 100, is an elastomeric adhesive, rated capable of withstanding in excess of 300 pounds per square inch in shear at 700 F for one hour. Because it is based on silicone elastomers, it is expected to have the excellent environmental resistance of silicones.

This product is useful as a high temperature sealant or potting compound, and is especially useful in encapsulation of electrical or electronic components. This flexible material would be good for aviation, missiles and electronics applications.

The second RAISEAL 200, a one-component system, is a pasty adhesive or sealant, especially useful for sealing and encapsulation. It has good resistance to various environments such as acids, alkalis, fuels and oxidizers. Tests under tension show it may be used at 50 psi at 800 F for 90 minutes.

The third, RAISEAL 300, a rigid structural adhesive, is claimed to have more impact resistance and more flexibility than a straight phenolic or epoxy adhesive. It does not have the brittleness of a ceramic adhesive. This product can be used best at temperatures between 600 and 1,000 F. For example, a constant tensile load of 20 psi was maintained for 45 minutes at 1,000 F. It is useful for metal-to-metal bonds and putting honeycombs together.

All three new products are cured at far lower temperatures than those at which they will be used. At present the products are available in developmental quantities.

March 10, 1961

NEW!
1/4% ACCURACY

TRUE RMS Voltmeter
with

ACCURACY

measures

wide range of **Waveforms** 

BALLANTINE model 350

features:

- High accuracy achieved on waveforms in which peak voltage may be as much as twice the RMS. Not limited to sinusoidal signals.
- Left-to-right DIGITAL READ-OUT. Fast, simple nulling operation consists of selection of decade range by push-button, and adjustment of four knobs for minimum meter indication. These operations attenuate the input signal to a predetermined value, causing a bridge circuit to be balanced by changing the current through a barretter.
- Temperature-controlled oven contains the barretter and an ambient temperature compensating resistor. Effect of ambient temperature changes is less than 0.005% / ° C from 20° C.
- Proper NIXIE digit is lighted automatically while bridge is being balanced. No jitter.
- Rugged, accurate. Doesn't require the extreme care of many laboratory standard instruments. No meter scales to read. Useful for laboratory, production line, and in the field.



specifications:

VOLTAGE RANGE: 0.1 to 1199.9 v

FREQUENCY RANGE: 50 cps to 20 kc

ACCURACY: 1/4% 0.1 to 300 v, 100 cps to 10 kc;
1/2% 0.1 v to 1199.9 v, 50 cps to 20 kc

INPUT IMPEDANCE: 2 megohms in parallel with 15 pF to 45 pF

POWER: 60 watts, 115/230 v, 50 to 400 cps

WEIGHT: 19 lbs. for portable or rack model

Available in Cabinet or Rack Models

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CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES. ASK ABOUT OUR LABORATORY VOLTAGE STANDARDS TO 1,000 MC.

CIRCLE 181 ON READER SERVICE CARD 207

PRODUCT ENGINEERING AND PRODUCTION REPORTS

Stress Board and Component Miniaturization

FURTHER DETAILS on Litton Systems' methods of designing and using multilayer etched circuit board^{1, 2} will be given in an IRE Convention session on Product Engineering and production. Other papers will discuss microminiature packaging^{3, 4}, thermoelectric spot cooling⁵, and improvement in picture tube manufacturing methods.⁶

Litton has developed three variations of the multilayer board. The basic method (Fig. 1) utilizes clearance holes on all layers above solder connection points. Holes are not plated. Direct access to the connection points allows connections to be soldered and unsoldered many times. The pads, or lands, are held in place by the plastic above and below. Layers of the laminate are bonded with thermosetting material, in a hydraulic press.

This type of laminate is in production for several computers. Modular cards are soldered directly to the laminates. To save space and weight, connectors are not used. Connectors and their associated wiring would almost double the height of the cards, which are about one to 1.5 inches high. Use of the laminate alone concentrates all interconnecting wiring within a height of one-sixteenth inch.

The second approach (Fig. 2) uses clearance holes from one side to the connection point, but has plated-through holes from the connection point to the back side. When

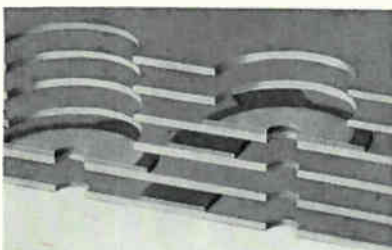
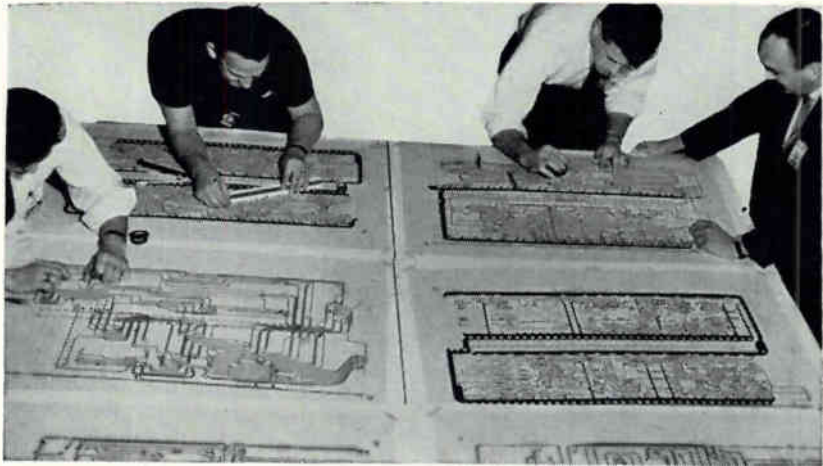


FIG. 1—Exploded view of basic laminated multilayer board



Artwork is prepared for each layer of laminated board

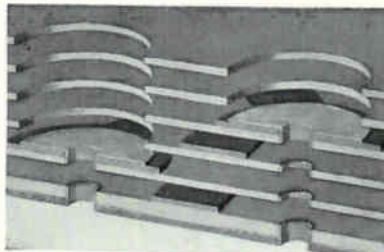


FIG. 2—Board modified for layer connections by bottom wiring

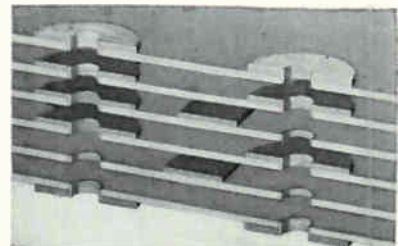


FIG. 3—Plated through holes connect layers directly

circuit paths are provided on the back side, this design permits connections between layers.

A third design (Fig. 3) has no clearance holes. Pads are provided on the top and bottom layers and a hole is plated all the way through. The plating provides layer-to-layer connections. By eliminating the large clearance holes, the circuit capacities of the layers are increased. The small holes and high interconnection densities are suited to microcircuit applications. Litton expects to use this kind of laminate in an aircraft computer where connectors are specified. Cards will plug into connectors soldered into the laminate.

The paper will survey high-density computer module construction techniques and compare volumes,

weights and maintainability.

Component densities of two million per cubic feet, including all thermal, interconnection and structural provisions, can be achieved with a dot component packaging system, Hughes Aircraft Company will report⁷. Multilayer deposition is used to connect components and pressure techniques are used for connections to modules. Speakers from P. R. Mallory will present a microcomponents market analysis and discuss a number of wafer and pellet-shaped microcomponents⁴. Methods of producing prototypes and packaging techniques suited to production mechanization will be described.

Forced convection cooling requirements can be reduced by thermoelectric spot cooling, according

TUNG-SOL HIGH PERFORMANCE

**GENERAL PURPOSE
MINIATURE COMPUTER TRIODE**

7719

Directly replaces parallel-connected 5965 and 7062 twin-triodes while providing these added advantages for designers of computer circuits:

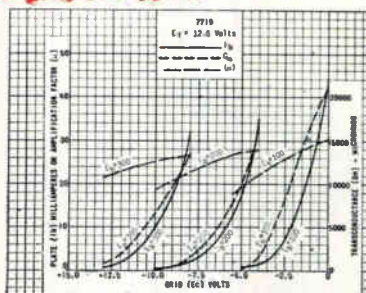
- Higher transconductance
- Much higher plate dissipation
- Very high perveance
- Very sharp cut-off
- Linear transfer characteristics
- Improved reliability

The Tung-Sol 9-pin miniature 7719 general purpose triode is the latest addition to the Tung-Sol family of top-rated, high-reliability tubes for computer service. Rated at 6 watts plate dissipation, the 7719 incorporates many design and construction features which assure computer users the maximum number of hours of trouble-free peak performance.

CHECK THESE ADDITIONAL BENEFITS:

- Freedom from cathode interface and reduced electrical leakage . . . Achieved through use of a passive cathode alloy and lower heater power per unit area.
- Minimization of grid emission . . . The 7719 is designed with heavy grid support wire and a double connection to the grid for cooler operation allowing use of 1 megohm grid circuit resistance.
- High stability . . . Use of heavier stock plate material assures more even distribution of heat and lower plate temperature. Cool operation further guaranteed by cool cathode and low bulb temperature (175°C at 6 watt dissipation).
- Very little "island" formation . . . Optimized geometry minimizes island formation thereby providing sharp cut-off, linearity and high perveance.

Typical applications of the 7719 are found in totem pole amplifiers to drive function-generating potentiometers, cathode followers, and multivibrators. Full technical details on the 7719 are available immediately on request.



RATINGS

Heater Voltage (Series)	12.6 ± 0.6	Volts
Heater Voltage (Parallel)	6.3 ± 0.3	Volts
Maximum Plate Voltage	380	Volts
Maximum Plate Dissipation	6.0	Watts
Maximum DC Cathode Current	40	ma.
Maximum Heater-Cathode Voltage:		
Heater Negative With Respect to Cathode		
Total DC and Peak	300	Volts
Heater Positive With Respect to Cathode		
DC	100	Volts
Total DC and Peak	200	Volts
Maximum Bulb Temperature	175	°C

TUNG-SOL

Technical assistance is available through: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. In CANADA: Abbey Electronics, Toronto, Ont.



Model 100A



Model 106S



Model 181S

**WIRE
WOUND
INFINITE
RESOLUTION**

POTENTIOMETERS

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Outstanding Features

- Infinite Resolution
- .01% Linearity
- Low Noise
- Long Life
- Low Torque
- Low Inductance and capacitance

	Model 100A & 106S	Model 181S
Maximum Resistance	6,000 Ω	30,000 Ω
Resolution	Infinite	Infinite
Linearity (independent)	.01%	.01%
Number of Turns	1 to 20	1 to 40
Power rating maximum	1.5 watts	8 watts

DESCRIPTION

The Vico infinite resolution wirewound potentiometers utilize a unique design in which a precious metal brush of extremely light contact pressure, slides across a single helically wound length of resistance wire. The precious metal brush follows the exact helical path of the resistance wire, thus no sliding or helical error occurs between the contact and wire, insuring extremely long wire life, a true stepless output, high accuracy, and low electrical noise.

The use of a non-metallic wire form of exceptional dimensional stability and low thermal coefficient of linear expansion, results in extremely high insulation resistance and low inductance and capacitance for use in A.C. circuitry.

APPLICATIONS

The Vico potentiometer's stepless output is ideally suited for use in high resolution servo systems and indicating systems where standard wirewound potentiometers cannot eliminate the "Hunting Problems" common to these systems.

CUSTOM MODIFICATIONS

Vico Potentiometers can be modified to specific customer requirements. Some of the available modifications include various shaft lengths, or shafts supplied with hobbled pinion ends, or pinned gears of aluminum, bronze or stainless steel to Agra Precision class 1, 2 or 3.

Shaft Rotations can be supplied in other than 360° increments.

ORDERING INFORMATION

Specifications listed are subject to change. When ordering, please refer to this data sheet number and specify model number, total resistance, and number of turns. Delivery — from stock to 2 weeks.

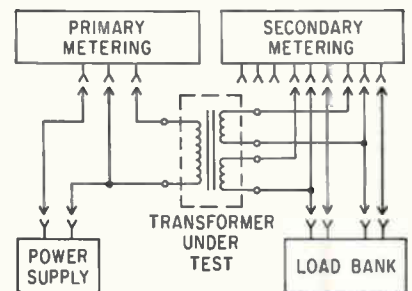
Write for full descriptive literature

to a study⁵ by Collins Radio Company. Combining both methods allows equipment to operate in higher temperature environments. RCA's Electron Tube Division has found that the characteristics of picture tubes can be increased significantly by improvements in manufacturing methods⁶. Ultrasonic cleaning of electron gun parts, clean room assembly, a precision method of controlling cathode to grid spacing and other techniques will be detailed.

REFERENCES

- (1) N. Schuster and W. Reimann, Multilayer Etched Laminates in High Density Electronic Equipment, Electronic Circuit Packaging Symposium, University of Colorado, Boulder, Aug. 18, 1960.
- (2) The following papers are all scheduled for presentation at Session 6, Product Engineering and Production, Monday, March 20, at 2:30 p.m. in Paraday Hall, the Coliseum, during the IRE Convention.
- (3) N. Schuster and W. Reimann, New Developments in Multilayer Etched Circuitry.
- (4) A. E. Hawley, E. A. Klein and S. Rubin, A Dot Component Packaging System for Electronics.
- (5) S. M. Stuhlberg and L. P. Sweaney, Microminiature Components and Packaging Techniques.
- (6) W. Stubstad, The Application of Thermo electric Spot Cooling to Electronic Equipment.
- (7) J. C. Halbrook, Picture Tube Improvement Through Controlled Environment and Ultrasonic Techniques.

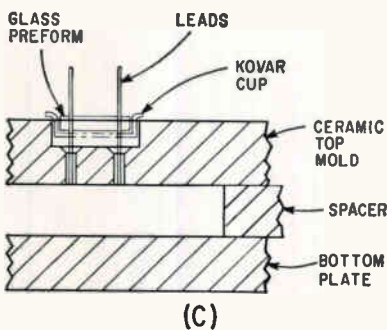
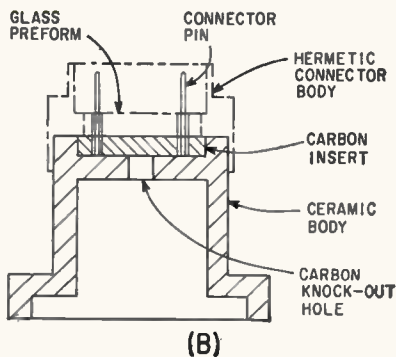
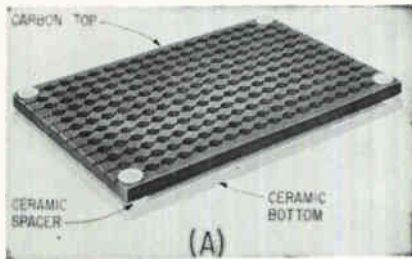
Transformer Tester



Block diagram of console

POWER SUPPLY, loads and meters required to test a wide variety of transformers are conveniently grouped in a test console used at U.S. Testing Co., Hoboken, N. J. The transformer is loaded to rating by the adjustable resistive and rectifier load banks at the right, while voltage to the primary is adjusted by the Variacs at the operator's left hand.

Ceramic Tooling Helps Metal-Glass Sealing



Ceramic is used with carbon molds (A) or inserts (B). Metal cups permit all-ceramic molds (C)

GLASS-TO-METAL sealing molds and yields can be improved with high temperature ceramic tooling materials, according to a recent report. Duramic Products Inc., Palisades Park, N. J., states that its materials are four times as hard as carbon, do not create an atmosphere which reduces oxides on metal seal parts and do not oxidize or change shape at 1,000 C.

Since glass will adhere to the ceramics, suggested tool designs prevent ceramic-to-glass contact. The ceramic can be used to reduce the volume of carbon and to provide a long-lasting base for carbon molds (Fig. A) or inserts (Fig. B). The carbon is replaced as it wears out. In Fig. A, the distance between top and bottom plates also sets lead lengths. Fig. C shows an all-ceramic mold.

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of excellence



MARKEL SILICONE RUBBER PRODUCTS



**Tubing, Sleeving
Insulated Wire**

**ABRASION RESISTANCE
TEMPERATURE RESISTANCE
OVERALL STRENGTH**

HYGRADE SR-398 SILICONE RUBBER-COATED FIBERGLASS SLEEVING

A superior silicone rubber compound over fiberglass produces a tough, nearly glass-smooth surface for higher abrasion and cut-through resistance. Tested to MIL-T-5438 specs. Tensile strength 1000-1200 psi, yet expands to slip over terminals, connections. High dielectric strength (8000v) maintained even after continuous use at rated 210°C temperature.

HYGRADE SR-404 FIBERGLASS REINFORCED SILICONE RUBBER SLEEVING

Highest cut-through resistance obtained by use of high strength rubber compound with embedded fiberglass braid reinforcement. Exhibits almost no longitudinal stretch, yet expands in diameter and returns to normal size; especially useful where sleeving must slip over odd shapes in installation. Excellent corona, oil resistance. Available only in larger sizes.

FLEXITE SR-200 SILICONE RUBBER EXTRUDED TUBING

The answer where superior flexibility is required. Rated for continuous use at 200°C, yet equally suitable for low temperature applications. Outstanding elasticity, durability, compatibility, and electricals. Excellent corona resistance makes FLEXITE SR-200 the first choice for high-voltage, high-temperature uses. Performs to MIL-R-5847C specifications.

FLEXLEAD SILICONE RUBBER INSULATED WIRE AND CABLE

Extruded silicone rubber insulation over a variety of conductors from solid to extra flexible. Combines outstanding electricals with high resistance to corona, oils, abrasion and weathering. Meets MIL-W-16878C (600v and 1000v ratings). Special cables with jackets of braided fiberglass or metal shielding are engineered and manufactured to your specification.

Write, phone, or wire for test samples and additional data.

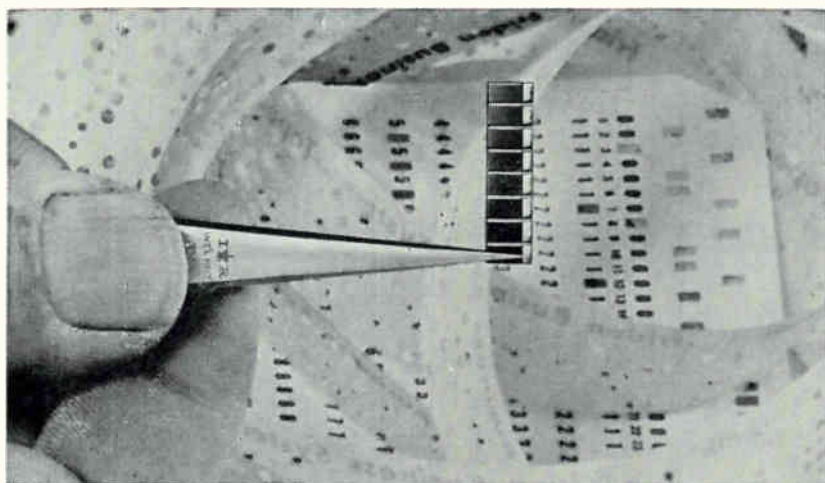
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SINCE 1922



SOURCE for EXCELLENCE in
Insulating Tubings, Sleeveings, and Lead Wire
NORRISTOWN, PENNSYLVANIA



NEW ON THE MARKET at the **ire** Show



Silicon Photocells

READ 10,000 CHARACTERS PER SECOND

SILICON readout photocells with response time from 5 to 20 microseconds are capable of reading 10,000 characters per second in perforated tape and punched card data reading systems. Manufactured by International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., the cell series is available with 5, 6, 8, 9, or 10 readout positions, with an active cell area (per seg-

ment) of 0.128×0.067 inch, and center-to-center spacing of 0.087 inch.

The units operate to 150 C and have low noise output. Typical current generated is 350 microamperes for 0.01 square inch of active cell area at 1,000 footcandles illumination.

CIRCLE 401 ON READER SERVICE CARD

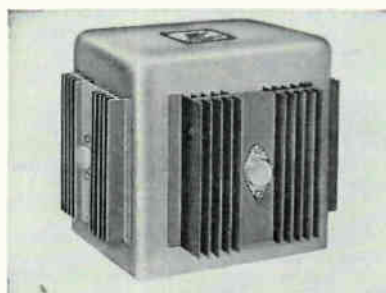
Tunnel Diode Supply

REGULATED MV OUTPUT

TUNNEL DIODE power source provides highly stable voltage and current biases in the low voltage and millivolt regions. Model TD6M tunnel diode source uses solid-state devices and provides outputs at low impedance. The unit is stable with respect to ambient temperature and long-term drift and is closely regulated.

Output is adjustable from 0 to 6 v d-c. Vernier adjustment is provided at any output over ± 0.5 volt. Current rating is 0 to 100 ma. Regulation is 0.05 percent or 2 mv for inputs from 105 to 125 v a-c, 60-400 cps and 0 to 100-percent load change.

A current-limiting device allows use as a constant-current source as well as a constant-voltage source. The power supply is available for bench use or rack mounting from



Electronic Research Assoc. Inc., Cedar Grove, N. J. at \$275 each.

CIRCLE 402 ON READER SERVICE CARD

High-Gain Transistors

FOR LOW-LEVEL USES

SILICON mesa series of low-current, high-gain transistors are especially designed for low-level amplification and high-gain at switching speeds. The series, 2N1944, 2N1946 has a typical gain-bandwidth product of 100 Mc at 20 Mc,

with minimum gain-bandwidth of 60 Mc.

Minimum h_{FE} is 150 at $V_{CE} = 2$ v and $I_C = 1$ ma. At $I_C = 250 \mu a$, $h_{FE} = 60$ minimum. Maximum h_{FE} under similar conditions is 450 and 250 respectively. The transistors are manufactured by Industro Transistor Corp., 35-10 36th Ave., L. I. C. 6, N. Y.

CIRCLE 403 ON READER SERVICE CARD

Closed-Circuit Camera

INCLUDES CONTROLS

SELF-CONTAINED closed-circuit tv camera is competitively priced and includes camera and camera control circuits in one unit. Only a tv monitor or home tv receiver is needed to complete a closed-circuit system.

The 20/20 has a video bandwidth



of 8 Mc, permitting 650-line horizontal resolution, with resolution limited by the video amplifier of the tv receiver. An optional sync generator provides 2:1 interlace and locks the vertical sweep to the 60-cps line.

Price is \$1,400, from Kin Tel Div. of Cohu Electronics Inc., 5725 Kearny Villa Rd., San Diego, Calif., with off-the-shelf delivery scheduled June 30.

CIRCLE 404 ON READER SERVICE CARD

Magnet Wire

FILM COATED

TENSOLITE INSULATED WIRE CO., INC., West Main St., Tarrytown, N. Y. Type ML magnet wire is film coated with duPont ML Polymer. Rated for Class H temperature service (180C) or better, tests have shown it to have a life in excess of 10,000 hr at 240C. Cut-through resistance is

To better serve your instrumentation needs...Cain & Company. An integrated, nationwide network of application specialists, Cain & Company fulfills a vital mission for the complex technology of instrumentation. That mission is to creatively apply to your instrumentation problems a wide range of high-performance products. ■ With offices in 14 principal cities across the nation, Cain & Company combines national scope with the on-the-spot professional services of highly skilled representatives. A continuous training program keeps Cain specialists abreast of tech-

nological and application developments... enables them to help you with your particular instrumentation problem.

■ Providing wide-range instrumentation coverage, Cain & Company represents products spanning the following fields: *Low Level Instrumentation • Data Handling and Display • AC and DC Power Sources • Radar Simulation and Test Equipment • Microwave Tubes • Servo Test Equipment • Automatic 'White Room' Evaluation • Electron Beam Deposition and Welding.* ■ For more information about Cain & Company, its products, and its services write:



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CIRCLE 185 ON READER SERVICE CARD

in excess of 400 C. Thermoplastic flow ratings are equally superior. Solvent resistance is excellent. Dielectric strength, 3400 v per mil

dry, 1900 v per mil wet. The wire is available in sizes from Awg 20 through 44.

CIRCLE 405 ON READER SERVICE CARD

parallel trace is approximately $8\frac{1}{2}$ inches; traces are $1\frac{1}{8}$ inches apart on a common vertical line.

CIRCLE 408 ON READER SERVICE CARD



Microwave Parametric Amplifiers

VARIABLE CAPACITANCE DIODES WITH HELIX

FAMILY of parametric amplifiers uses a set of variable-capacitance diodes distributively coupled to a helix. Prototype SS-1000 parametric amplifier delivers one mw with 15-db min gain and 7.5-db max noise factor from 2,200 to 2,300 Mc.

Type SS-1000V1 delivers one mw with 17-db min gain and 6-db max noise from 2,190 to 2,210 Mc. Both amplifiers have excellent stability, do not require a circulator, and

are contained in miniture packages without tuning stubs. Pump frequency is only 30 percent above signal frequency; pump power is 300 to 400 mw. Variants of the amplifier can be supplied from 1,750 to 3,000 Mc, with bandwidths up to 100 Mc.

The amplifiers are manufactured by Electron Tube div., RCA, Harrison, N. J.

CIRCLE 406 ON READER SERVICE CARD

Magnetic Storage Drum

HEADS TOUCH DRUM

MAGNETIC storage drum that uses contact read/write heads for large capacity, nonambiguous storage is available from Computer Systems Lab., Litton Systems, Inc., 5500



Canoga Ave., Woodland Hills, Calif.

Heads contact the drum until operating speed is reached, at which time surface air movement causes the heads to rise a few millionths of an inch. The close proximity of the heads to the drum surface gives efficient electromagnetic coupling. Write currents are 3.5 to 5 ampere turns; read signals to one-volt are obtainable. Less than one percent noise is apparent from all sources. The low amount of cross-talk permits one-word recirculating tracks with 18-bit words at 160 bits per inch packing density.

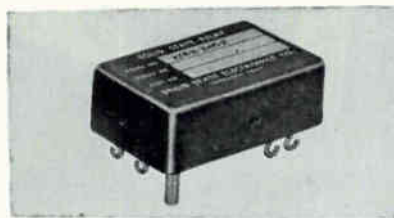
CIRCLE 409 ON READER SERVICE CARD

Solid State Relay

50-V, 50-MA LOADS

MODEL SSR-1285-5050 solid-state relay is a transistorized switching relay with no moving parts. The relay is a low inertia device capable of over one trillion operations. Actuation time is 2 microseconds and dropout time is 5 microseconds. Actuation frequency can be as high as 50 Kc. The contacts are rated at 50 volts, 50 ma.

Silicon semiconductors allow op-



eration from -55 C to 125 C. The solid-state relay is being manufactured by Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

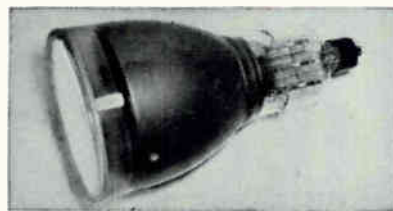
CIRCLE 407 ON READER SERVICE CARD

Multi-trace CRT

3 INDEPENDENT GUNS

MULTITRACE crt with three independently controlled electron guns for producing three displays simultaneously is announced by Sylvania Electric Products Inc., Seneca Falls, N. Y.

The Type SC-3061 10-inch tube is available in a variety of phosphors, is electrostatically focused and deflected, and has an astigma-



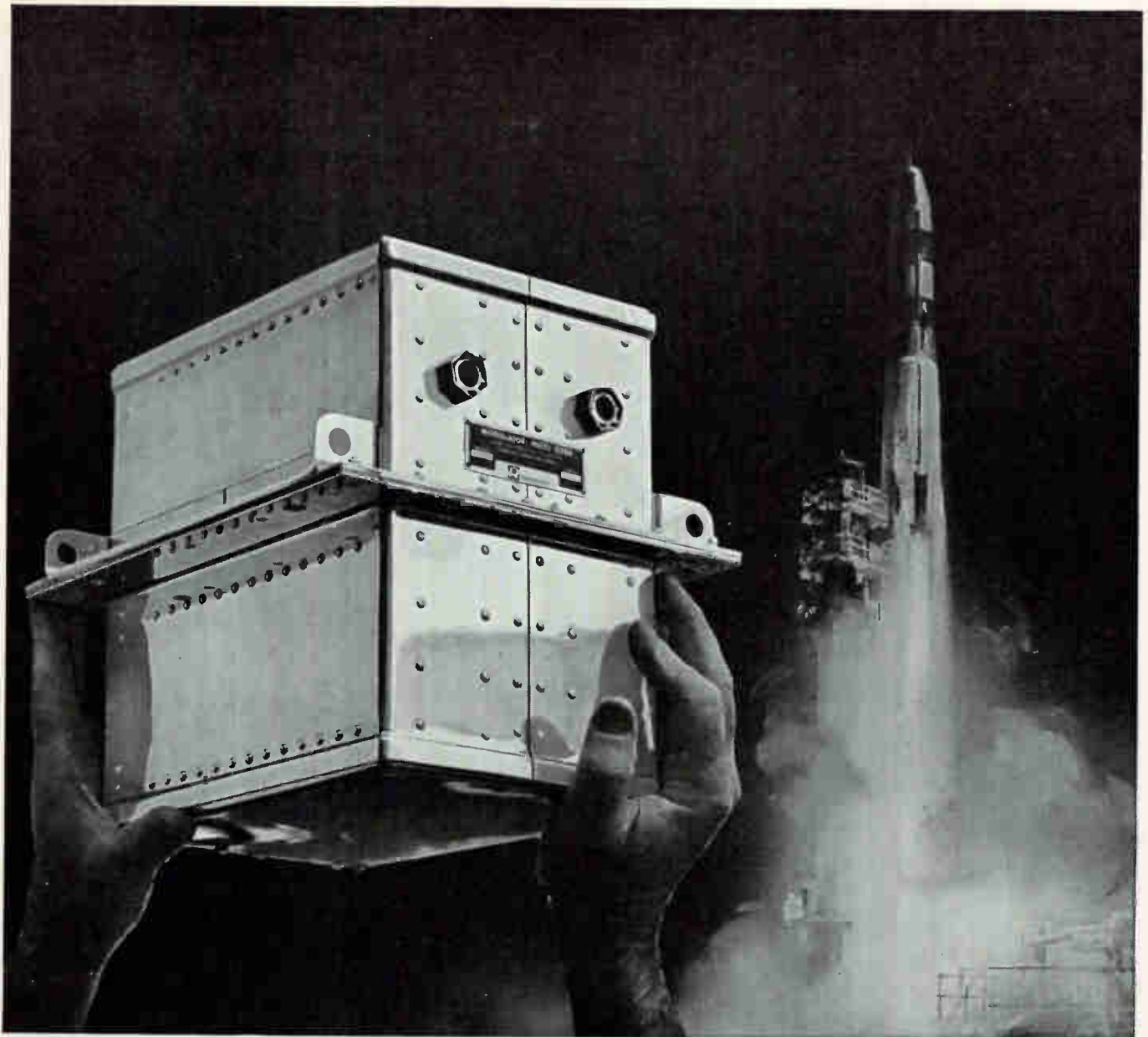
tism control electrode. Deflection factors, at 5 Kv anode voltage, are approximately 130 v per in. horizontal and 70 v per in. vertical.

Useful horizontal scan of each

T-W Tubes

HIGH-POWER

GENERAL ELECTRIC CO., Palo Alto, Calif. Two high-power compact metal-ceramic twt's designed to operate as the driver and final amplifier in a pulsed high-power chain are available for X-band radar applications. They cover the 8,500-9,600 Mc range. Both liquid-cooled tubes have focusing systems utilizing periodic permanent magnets



THEY RELY ON RADIATION FOR UNUSUAL CAPABILITIES IN TITAN'S PCM* GUIDANCE TELEMETRY

Production quantities of Radiation's PCM Telemetry systems, being delivered for TITAN I & II, represent a major contribution to the state-of-the-art. Techniques developed in this continuing program will provide the basis for PCM's larger role—and ours—in the next generation of missiles.

In present missileborne systems we have completely integrated data processing and PCM telemetry, in rugged, space saving units. First of their kind, the "unitized" solid state packages offer virtually unlimited design flexibility.

The Advanced Titan system, for example, is capable of coding a 24-bit computer word 3200 times per second, processing 64 analog inputs and 40 bi-level digital inputs. The system weighs 20 lbs., occupies $\frac{1}{3}$ cubic feet, and has a predicted MTBF of 1300 hours. Radiation-built ground support equipment includes a pre-launch Input Simulator and a Ground Checkout Rack Test Fixture for ground

synchronization and de-coding. Accuracy and reliability are attested by the system's impeccable performance record during test sled runs at Holloman AFB.

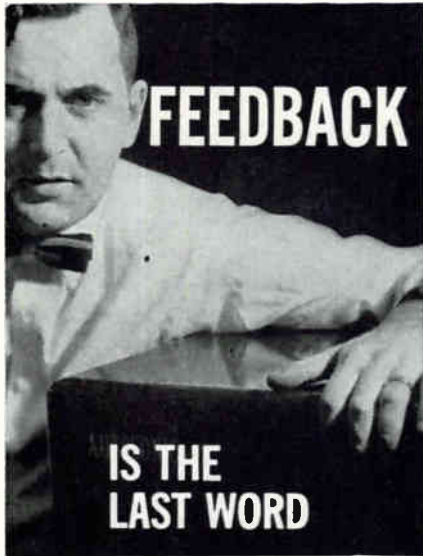
The design innovations by which digital and analog equipments are integrated in this system, and the use of PCM techniques to yield maximum data, are typical of Radiation's systems capabilities. The capabilities are at work today in major satellite and missile programs, and in industry. They are ready to work for you now.

First step: Write to Radiation Incorporated, Melbourne, Fla. for "Capabilities Report."

*Pulse Code Modulation



RADIATION
INCORPORATED



IN ULTRASONIC CLEANING

and the Autosonic by Powertron is the last word in ultrasonic cleaners because it uses feedback control to keep itself electronically tuned to peak cleaning efficiency. Feedback makes the Autosonic genuinely self-tuning, so anyone who can flip a switch can use it. What's more—the Autosonic is guaranteed to clean almost anything better, cheaper, and faster than other ultrasonic cleaners.



A complete line of Powertron Autosonic cleaners is available from 2 gals. to 75 gals.—from 100 watts to 3,000 watts—from \$395. to \$6,000.

A ten-minute demonstration in your plant will prove what feedback control can do for your ultrasonic cleaning problems. Just check your cleaning application, and mail the coupon.

- Cleaning**
- Electrical assemblies
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 - Circuit boards
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 - Surgical instruments
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- Removing**
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 - Shop dirt
 - Fluxes
 - Waxes and oils
 - Degreasing
 - Brightening
 - Radioactive contamination
 - Other describe

Check here if you'd like a free copy of our technical bulletin, "How to Clean Ultrasonically with Self-tuning."

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 Company.....
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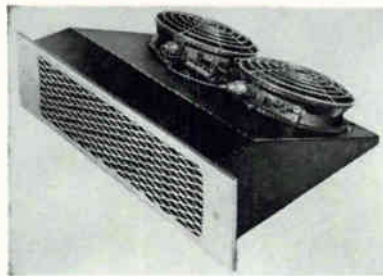
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that do not require temperature stabilization.

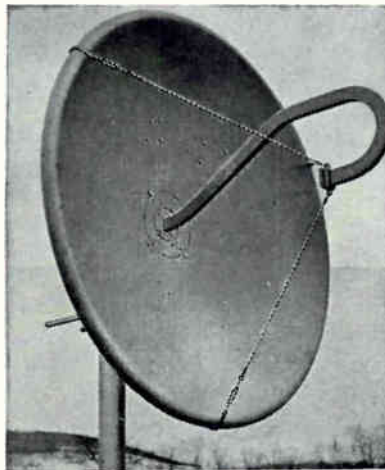
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Cabinet Flushing Fan LOW NOISE LEVEL

ROTRON MFG. CO., INC., Woodstock, N. Y. The Twinpax design makes possible the use of two saucer fans working in parallel, producing a delivery of 450 cfm free delivery, or 400 cfm at 0.1 in. wg static pressure,—when operating on either 208 v a-c 60 cps 3 phase or 115 v a-c 60 cps single phase power. Fans are placed at an angle in the assembly, thereby directing the air flow at the most advantageous path minimizing dead spots and eddying within the cabinet.

CIRCLE 411 ON READER SERVICE CARD



Microwave Antennas 2 to 12 FT REFLECTORS

TECHNICAL APPLIANCE CORP., Sherburne, N. Y. Microwave antenna line includes frequency ranges from 806 Mc to 12.7 Gc. Reflector sizes range from 2 to 12 ft, depending on frequency range. A highlight of the line is a 12-ft mesh reflector available in the 900 Mc and 2,000 Mc bands. Line offers a choice of either spun or mesh reflectors in 4, 6, 8 or 10 ft sizes for 806-960 Mc,

and 1,700 to 2,700 Mc. In the 2,000 Mc band dual polarized feeds are offered.

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Panel Meters HIGHER READABILITY

YOKOGAWA ELECTRIC WORKS, INC., 40 Worth St., New York 13, N. Y. The Prince line of panel meters has increased readability with the EZ-Read dial, which has made its scale 40 percent longer than in the same sized conventional meter. The Loc-Qwik mount has eliminated laborious stud mounting.

CIRCLE 413 ON READER SERVICE CARD



Frequency Changer MULTIPHASE

SORENSEN & CO., INC., Richards Ave., South Norwalk, Conn. The FCR 3P-300 frequency changer is capable of three-, two-, or single-phase operation and has a range of 45 to 2,000 cps. Versatile unit operates without moving parts and has an accuracy of ± 1 percent. Dimensions are 21 $\frac{1}{2}$ in. high, 19 $\frac{1}{2}$ in. wide, and 15 $\frac{3}{4}$ in. deep.

CIRCLE 414 ON READER SERVICE CARD



Filter DISTORTION MEASURING

ORTHO FILTER CORP., a division of Ortho Industries Inc., 7 Paterson St., Paterson 1, N. J., has devel-

electronics

HOFFMAN'S NEW TACAN FIRST * TO MEET "AGREE"

SPECS GREATER

Hoffman, first to be selected by the Air Force to produce major equipment under Defense Department's new "AGREE" specifications (Advisory Group on Reliability of Electronic Equipment).

RELIABILITY

Reliability increased 700%. MTBF raised from 17½ to over 150 hours with a service life in excess of 2000 hours.

MORE PERFORMANCE—

WEIGHS LESS

Operating altitude raised from 50,000 feet at half power to 70,000 feet at full power—without pressurization. Number of equipment missions increased!

48.5 lbs. compared to 61 lbs. of predecessor models.

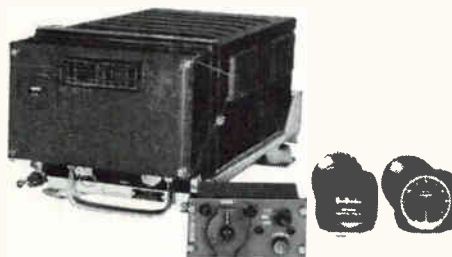
AND COSTS LESS

Government officials estimate savings on maintenance costs alone of the Hoffman-designed AN/ARN-21C will amount to over \$125 million.

* *Hoffman is the only manufacturer now delivering airborne TACAN equipment in quantity to the Air Force.*

Experience gained in pioneering AGREE Reliability for the Air Force ideally qualifies Hoffman and its proven team of designers and suppliers to solve your electronic equipment reliability problems.

FOR TRUE RELIABILITY—Turn to Hoffman



Note — This system is custom-packaged with interchangeable modules for F-104, T-38, B-58 and B-70 airplanes.

Hoffman / ELECTRONICS CORPORATION

Military Products Division

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SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER, PLEASE ADDRESS INQUIRES TO VICE PRESIDENT, INDUSTRIAL RELATIONS

CANNON ANNOUNCES CAPS

**CANNON AUTHORIZED
PLUG SPECIALIST**



Distributor Program

CANNON PLUGS...ASSEMBLED LOCALLY TO YOUR REQUIREMENTS—BY FACTORY TRAINED SPECIALISTS. Cannon Electric Company has appointed 10 of its top distributors to its new **CAPS** organization. Cannon Authorized Plugs Specialists (**CAPS**) are factory trained to assemble Cannon Plugs to your individual requirements ...offer you faster service and a wider selection than that available from any other distributor organization. You get the famous Cannon quality—fast delivery—factory prices. **CAPS** are located throughout the United States; there is one near you. Contact the **CAPS** listed below for all your plug requirements.

ATLANTA, GA.

Electro-Air Corporation
645 Antone Street N.W.
TRinity 3-1651

CHICAGO, ILL.

United Aircraft Supply Corp.
5637 West 63rd Place
PORtsmouth 7-1500

DALLAS, TEX.

Tekko
4308 Maple
LAKeside 6-8763

DENVER, COLO.

Kimball Distributing Company
1824 California Street
AComa 2-6208

INGLEWOOD, CALIF.

Liberty Electronics Corp.
339 South Isis
ORegon 8-7163

CANNON ELECTRIC COMPANY, 3208 Humboldt Street,
Los Angeles 31, California

MINEOLA, LONG ISLAND, N.Y.

Schweber Electronics
60 Herricks Road
Pioneer 6-6520

NEW YORK, N.Y.

Time Electronic Sales
373 Broadway
BARclay 7-3922

NORTH HOLLYWOOD, CALIF.

Richey Electronics
10816 Burbank Blvd.
TRiangle 7-2651

PHILADELPHIA, PA.

Aercon, Inc.
2137 Ludlow Street
LOgan 5-8101

SOUTH BEND, IND.

Radio Distributing Company
1212 High Street
ATiantic 8-4664

CIRCLE 189 ON READER SERVICE CARD

oped a distortion measuring filter which, when used in conjunction with a vtvm, permits accurate distortion measurement of an a-c signal, eliminating the need for a distortion analyzer. The harmonic content can be viewed on an oscilloscope. Stock frequencies are 400, 800 and 1,000 cps; input impedance, 50,000 ohms; range, 0.05 percent to 20 percent total harmonic distortion; overall dimensions, 5 1/2 by 3 by 2 in. Price is \$47.25.

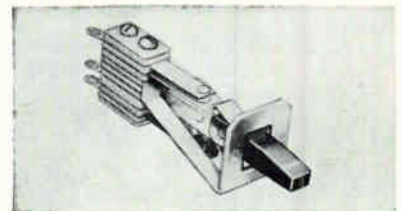
CIRCLE 415 ON READER SERVICE CARD



**Recorder/Reproducer
VIDEO BAND**

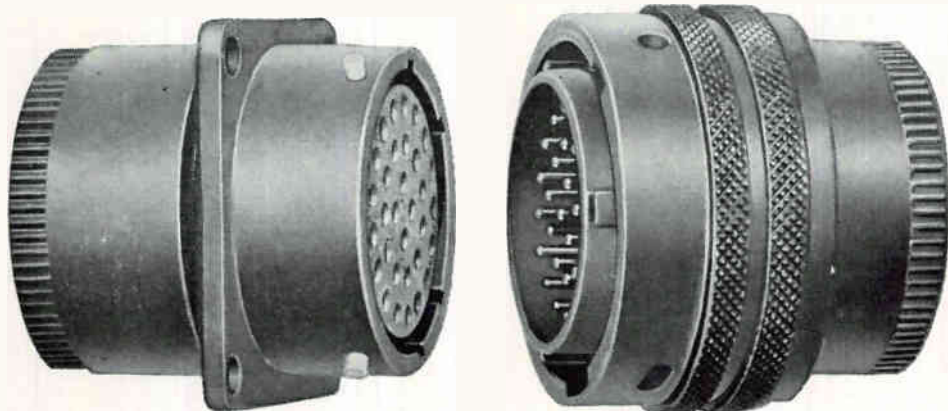
MINCOM DIVISION, Minnesota Mining and Manufacturing Co., 2049 South Barrington Ave., Los Angeles 25, Calif. Series CM-100 video band recorder/reproducer offers bandwidth extended to 1.2 Mc and advanced design concept in versatility. Standard 7-track, single-rack production model easily converts to 14 tracks by plugging in additional rack of electronics. Predetection recording is featured application.

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**Toggle Switch
SHORT FRAME**

SWITCHCRAFT, INC., 5555 N. Elston Ave., Chicago 30, Ill. The long life,



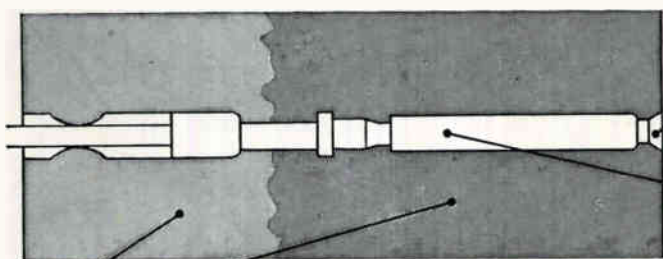
NEW

CANNON KPT/KSP MINIATURE DESIGNED TO MIL-C-26482

Quick disconnect plugs for aircraft, missiles, and all applications requiring miniature plugs. Our standard solder-pot versions, including hermetic seals, are completely interchangeable with all bayonet-lock plugs designed to MIL-C-26482

Available from Authorized Distributors April 2nd

ALSO KPT/KSP PLUGS WITH CRIMP SNAP-IN CONTACTS AND TWO SHORE INSULATOR.



Maximum lead-in chamfer for positive alignment.

MIL-C-26636 contacts (plating gold over silver)

Two shore resilient insulators molded out of two different hardness materials (polychloroprene) into a homogenous piece. The rear portion of the insulator is the softer in order that the conductors can be sealed properly, and the front portion is the harder to retain the snap-in contacts. The two shore insulator insures a continuous moisture and pressure

seal from front to back to provide superior electrical performance at high altitudes. This method of sealing and contact retention offers the industry a most reliable crimp series meeting the requirements of MIL-C-26482. Write for catalog KPT/KSP-1 to:

SEE CANNON AT BOOTH 2727-31, IRE SHOW

CANNON PLUGS



CANNON ELECTRIC COMPANY, 3208 Humboldt St., Los Angeles 31, Calif.

March 10, 1961

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We are proud to announce our appointment as a

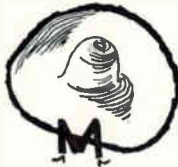
CAPS*

*CANNON AUTHORIZED PLUG SPECIALIST



CANNON AUTHORIZED ASSEMBLY LINE
producing Cannon plugs on Cannon designed tools

24 HOUR DELIVERY
on even your special requirements



WIDEST RANGE OF PLUGS
in depth always in stock at OEM prices
even in production quantities.

SOURCE INSPECTION
available.



Now, more than ever before, you can save time by calling **TIME**—
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CIRCLE 308 ON READER SERVICE CARD

reliability, dependability and quality of leaf switches is now incorporated in a short frame toggle switch. The TT, Tini-Toggle switch, series 2300, provides exceptionally long spring-action life which is accomplished by the use of relatively long springs without any forms at the point of flexing. Features: multiplicity of circuits; three position toggle-type switch or a two position switch with momentary or locking action; choice of contacts.

CIRCLE 417 ON READER SERVICE CARD



D-C Power Supply VOLTAGE REGULATED

CHRISTIE ELECTRIC CORP., 3410 W. 67th St., Los Angeles 43, Calif., announces a 30 ampere d-c power supply incorporating silicon controlled rectifiers. Operating from a 115 v, single phase, 60 cycle power source, the unit will deliver 50 ampere for one minute or 30 ampere continuous duty, with a voltage adjustment range of 2 to 36 v. The unique scr circuitry also offers ± 0.5 percent voltage regulation and 1 percent rms ripple.

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MIL-P-7788A MIL-L-25467A

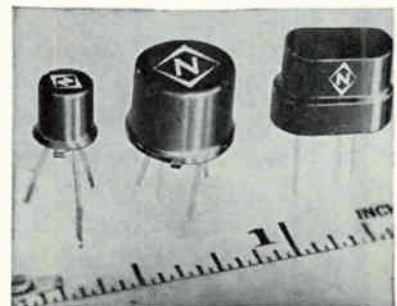
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NATIONAL SEMICONDUCTOR CORP.,
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* Hercules Powder Company, operating the Allegany Ballistics Laboratory under contract to the United States Government, has provided the propulsion units for major projects ranging from operational weapons such as Nike Hercules to development missiles such as Polaris, and from space probes such as Javelin to Pioneer V, now orbiting around the sun.

Inquiries may be directed to:

Dr. W. R. Lowstuter
Technical Personnel Department
Allegany Ballistics Laboratory, Cumberland, Maryland

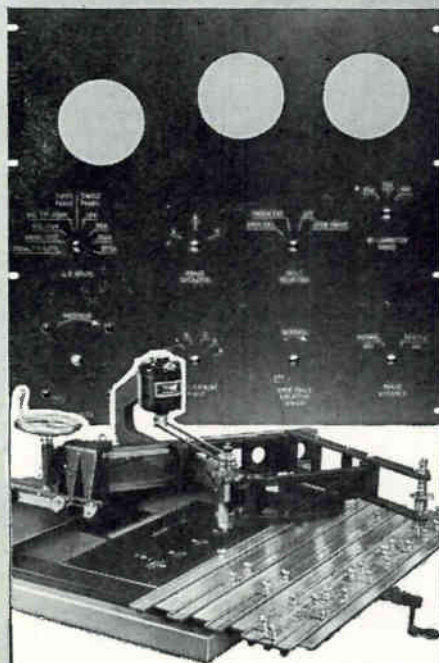
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Spindle covers 18¼" x 6" in one set-up — more than any other machine of its kind.

Bench type model I-R—\$685.



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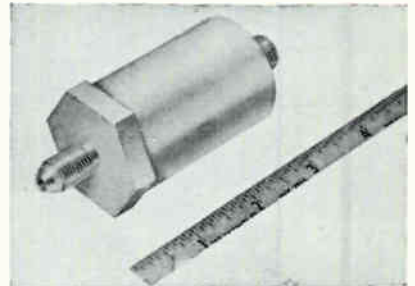
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line are silicon transistors—*mp*-alloy 2N1440 and 2N327A series, in both TO-5 and TO-18 miniature package; inverted switch in both TO-5 and TO-18 package offering low saturation drop and low leakage current; new NS192 series—TO-18 amplifier types. *NPN*-mesa-2N702, 3,706,560 switching, 2N756 series in TO-18 package, and 2N696, 7, 9 and 2N497 medium power series.

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Digital Transducer MINIATURE PACKAGE

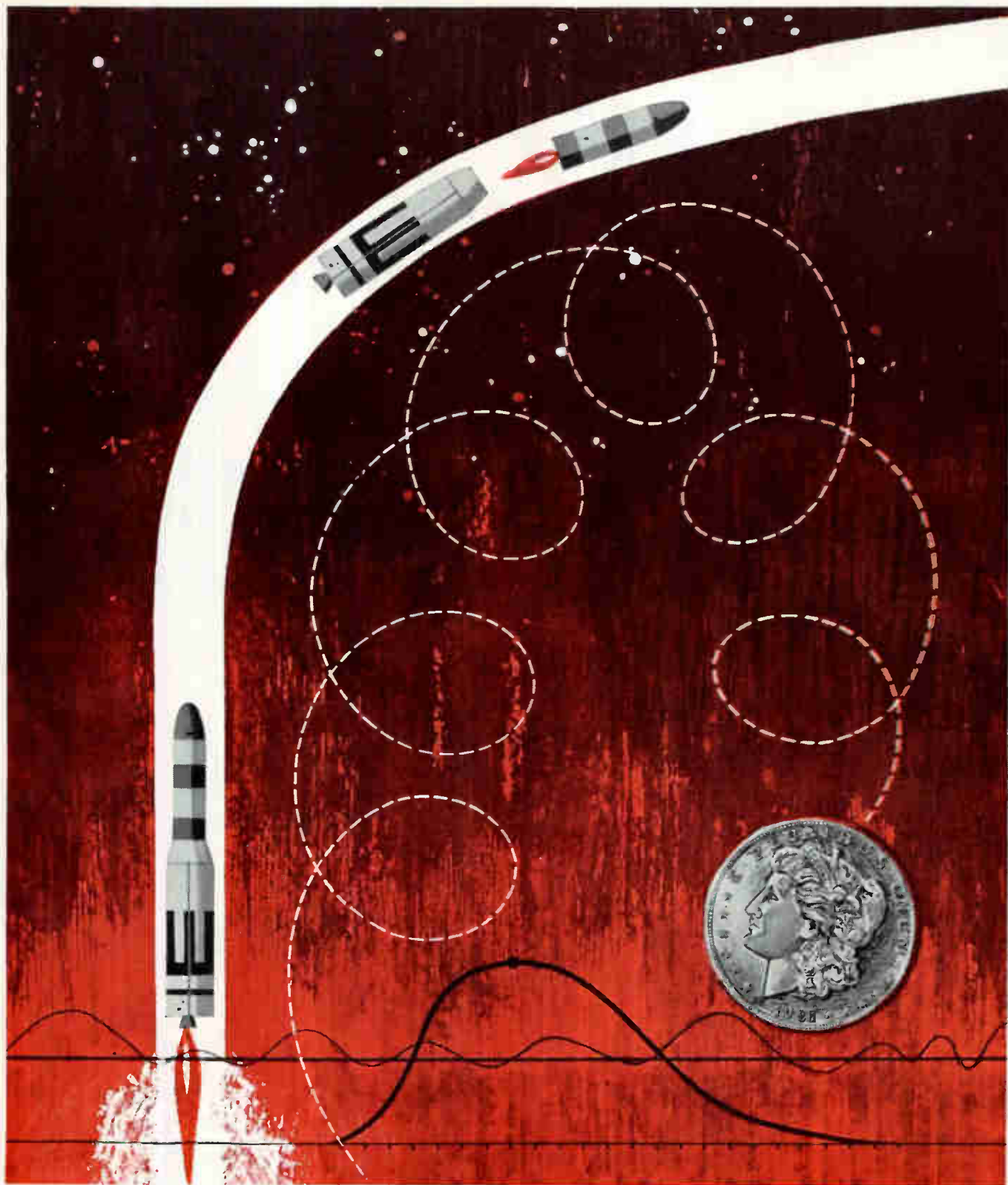
DEJUR-AMSCO CORP., Northern Blvd. at 45th St., Long Island City 1, N. Y. Features of this digital transducer include its ability to sense many different sources of energy in one miniature package, and deliver a true digital signal output directly proportional to the amount of energy monitored. Its solid state circuit configuration makes the transducer relatively impervious to ambient environmental variations.

CIRCLE 420 ON READER SERVICE CARD



Semiconductor Kits FOR BREADBOARDING

SANDERS ASSOCIATES, INC., 95 Canal St., Nashua, N. H., announces Tri-Plate semiconductor mount kits for breadboarding advanced varactor, tunnel diode and transistor circuits. The kits make it possible to assem-



BUT, MONSIEUR BERTRAND, OUR COINS HAVE MEMORIES!

You said, "A coin has neither a memory nor a conscience." The reliability of our inertial guidance systems depends on their having both. Thus our reliability engineers must go beyond your venerable formulae in developing dependable guidance packages for missiles like Titan.

If the application of existing theory into usable reality challenges you, and if you have a BS, MS or PhD in EE, ME, Physics or Math, please contact Mr. F. C. Allen, Director of Scientific and Professional Employment, 7929 S. Howell, Milwaukee 1, Wisconsin.

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NOW

Design your own Voltage Regulating Transformer with NEW Sorensen Series M

A new concept in magnetic regulator engineering —
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Line regulation to $\pm 1\%$. Complete line isolation. Low external field. Four convenient case styles. Output ratings from 10 to 10,000 VA. Includes all popular a-c voltages and windings rated for d-c supply service at voltages from 2.3 to 1000 vdc. Harmonic filtered units available.

Get complete information on this new concept in voltage regulating transformers today. Write for Sorensen's 10-page Series M bulletin. Sorensen & Co., Richards Ave., South Norwalk, Connecticut, or contact your local Sorensen representative.

1.1



CONTROLLED POWER PRODUCTS

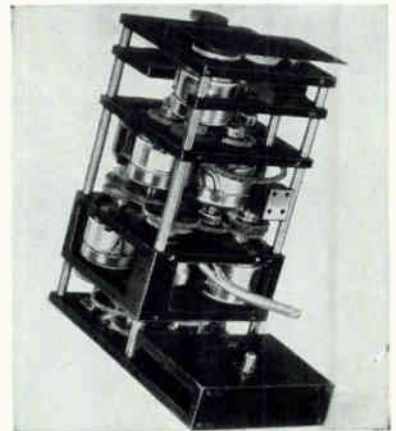
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ble harmonic generators, parametric amplifiers, oscillators, pulse amplifiers and down converters in minutes. Such configurations as series or shunt connected, double-ended cartridges, pigtail devices, TO-18 and TO-5 packages, and several types of pill packages are merely placed in the respective Tri-Plate semiconductor mounts included in the kit.

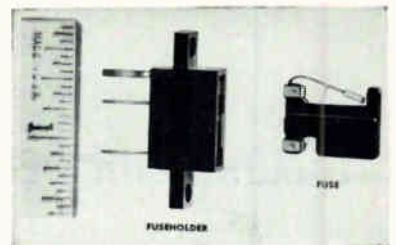
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Transmission Units MULTIPLE SPEED

AUTOTRONICS INC., P. O. Box 208, Florissant, Mo. Use of subminiature electromagnetic clutches in the company's speed transmission designs makes it possible to have instantaneous changes between predetermined speed ratios, manual or automatic selection of speed ratios, remote control of speed changes, light weight and compact design. The units are useful in computers, instrument and control mechanisms.

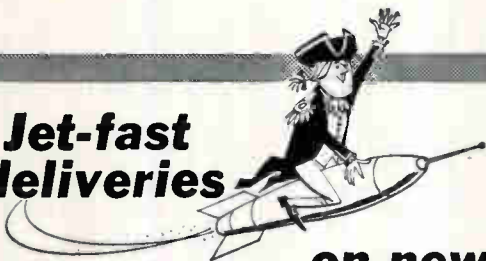
CIRCLE 422 ON READER SERVICE CARD



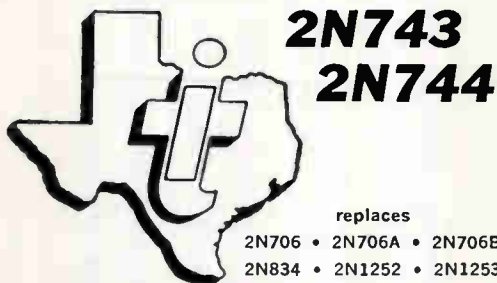
Fuse & Holder VISUAL-INDICATING

BUSSMANN MFG. DIVISION, McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo. The GMT fuse and HLT holder are designed to permit

Jet-fast deliveries



on new epitaxial transistors



replaces
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2N834 • 2N1252 • 2N1253

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1/2" Dia.
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Adjustable from
2 to 12 positions!

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RATING:
5 Amps @
115 VAC
OVERLOAD:
Over 200%.

CASE:
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On/Off Cycles.
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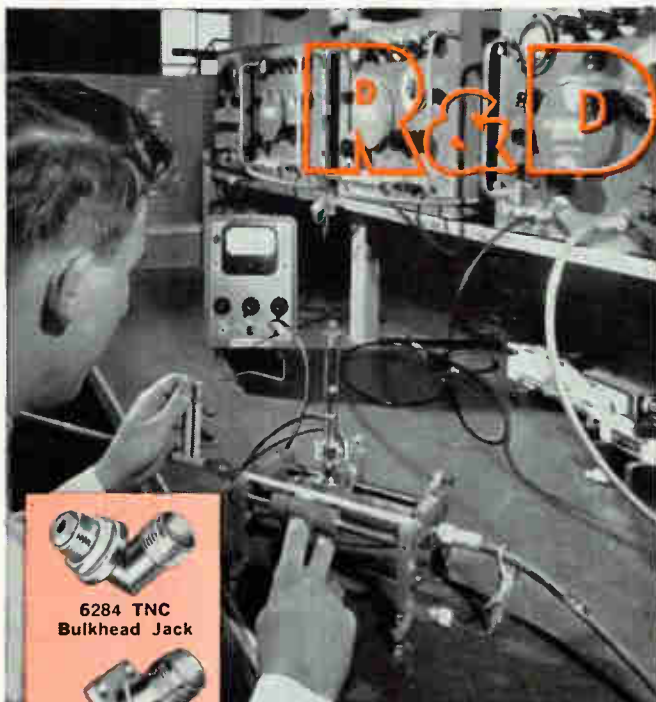


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6171 TNC (F) Receptacle



6930 Tee Cable Termination



6195 TNC (M) Receptacle



7107 Adapter HN (M)-C(M)



5863 Adapter HN (F)-MHV(F)

Recent developments . . . all Greomar exclusives . . . are now extending the use of RF connectors. Power dividers and impedance transformers with integral connectors. Firewall connectors that withstand 2000°F. Red Line miniatures . . . half the size and weight of Greomar TNC connectors . . . for use with MIL-type subminiature coaxial cables. New subminiature connectors . . . half again as small as miniatures . . . soon to be announced. And many more!

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CIRCLE 195 ON READER SERVICE CARD

HIGHER OUTPUT, GREATER EFFICIENCY FROM PL-177A BEAM PENTODE

For use in low to medium-power single-sideband applications, the Penta PL-177A beam pentode provides higher output, greater efficiency and less distortion than comparably rated tubes and at frequencies up to 175 Mc. Of nearly equal importance is the small size of the PL-177A: slightly over two inches in diameter and less than four inches from the base to the top of the plate cap.

The superiority of the PL-177A results from the use of Penta's exclusive, patented vane-type suppressor grid, which channels the electron flow to provide true beam-tube performance.

Operating as a Class-AB₁ linear R-F amplifier, a single PL-177A will deliver up to 210 watts of useful output. In Class-C service, one PL-177A will provide 220 watts. Plate voltages as high as 2000 volts can be used, yet the tube

will operate with nearly equal efficiency at only 600 volts.

The PL-177A, rated at 75 watts plate dissipation, is both mechanically and electrically rugged, and can withstand prolonged periods of overload operation. This Penta beam pentode is the answer to many application problems wherein a small, dependable tube, capable of operation at full ratings well into the VHF range, is required.

Write for the PL-177A data sheet, and for your free copy of "Transmitting Tubes for Linear Amplifier Service," which explains in detail why Penta beam pentodes are clearly superior.

PENTA LABORATORIES, INC.

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Santa Barbara, Calif.
Trade Mark Reg. U. S. Pat. Off.

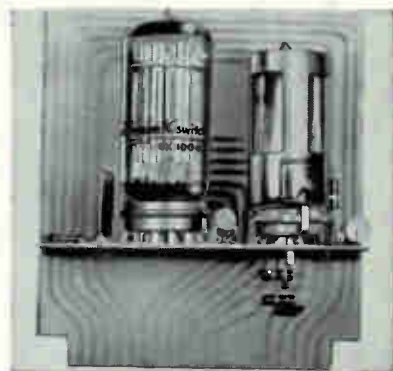


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CIRCLE 196 ON READER SERVICE CARD

multiple mounting of fuses in extremely small places. Fuseholders can be panel mounted on $\frac{1}{4}$ in. centers. Wafer thickness of fuse permits removal of any bloom fuse without disturbing adjacent fuses. When the fuse opens it flashes a colored flag to draw attention to the open circuit. The spring carrying the flag also makes contact with an alarm circuit which can be used to light a lamp or ring a bell or other signals either at the panel board or at some remote location.

CIRCLE 423 ON READER SERVICE CARD



Beam-X Module

HAS VARIED USES

BURROUGHS CORP., Box 1226, Plainfield, N. J., has available a universal Beam-X™ module (DC-112). Unit has counting, distributing, multiplexing and scanning capabilities. It features an ability to perform all these functions by merely reconnecting the input and output terminals. The module, utilizing the general purpose Beam-X^R switch (BX-1000), permits assembly of complex electronic digital systems with a minimum of original circuit design. Price is \$55 in single quantities.

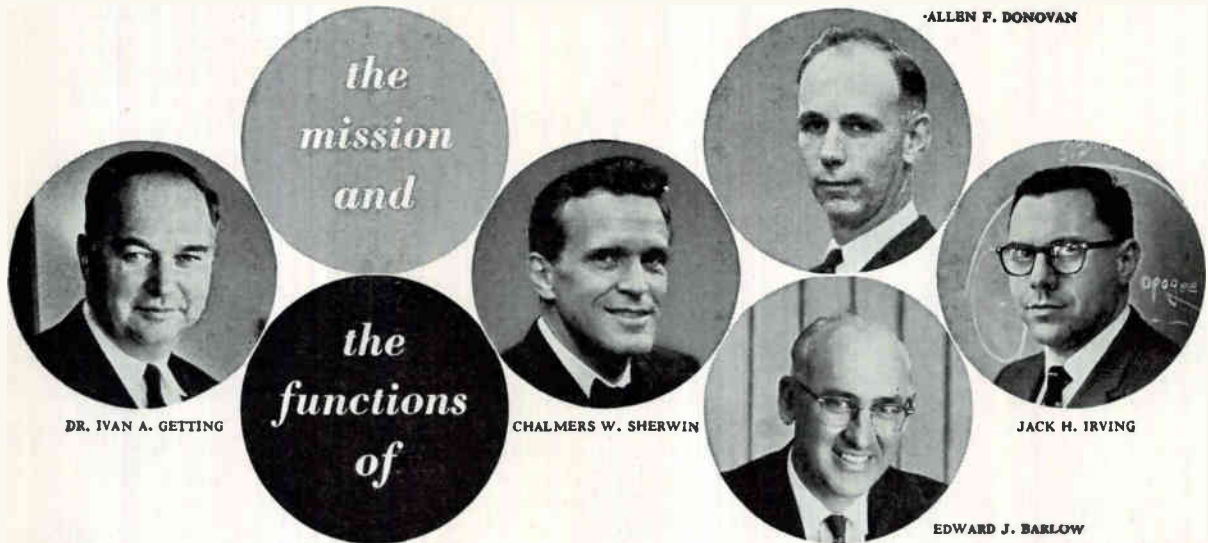
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Coaxial Relays

VACUUM TYPE

JENNINGS RADIO MFG. CORP., P. O. Box 1278, San Jose 8, Calif., has completed a series of vacuum co-



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Aerospace Corporation scientists and engineers are already engaged in a wide variety of specific systems projects and forward research programs, under the leadership of scientist/administrators including corporation president Dr. Ivan A. Getting, senior vice president Allen F. Donovan, and vice presidents Edward J. Barlow, William W. Drake, Jr., Jack H. Irving, and Chalmers W. Sherwin.

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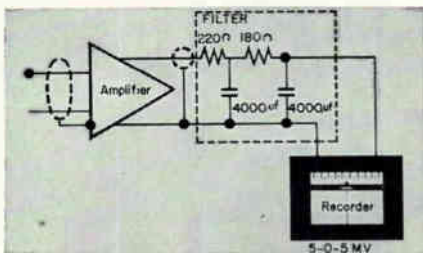
ZERO DRIFT

Accuracy in d-c amplifiers is fundamentally dependent on zero drift. This error, defined as any zero offset appearing at the amplifier output but not present in the input, is indistinguishable from the d-c input signal, and varies more or less sporadically with time and/or ambient temperature. Elimination of zero drift is a prime d-c amplifier design objective.

Evaluation of the amplifier zero drift characteristic is quite simple, but elimination of the effect is not. For example, any direct-coupled stage of amplification will drift due to the inability of circuit operating levels to remain constant. The use of inverse feedback does not have any beneficial effect on drift. The best generally accepted method of drift elimination is to make all amplification drift-free through a-c coupling, and converting the incoming d-c to a-c directly by means of a low-level modulator, such as a chopper or magnetic converter. After amplification, the a-c is demodulated into d-c which may be further amplified at high levels without appreciable zero error. This system is used in both the so-called chopper amplifier (where the band pass is limited by the chopper frequency) and the chopper-stabilized amplifier (where the chopper amplifier is combined with a wide band amplifier to give frequency responses well beyond the chopper excitation frequency).

Testing Amplifiers for Zero Drift

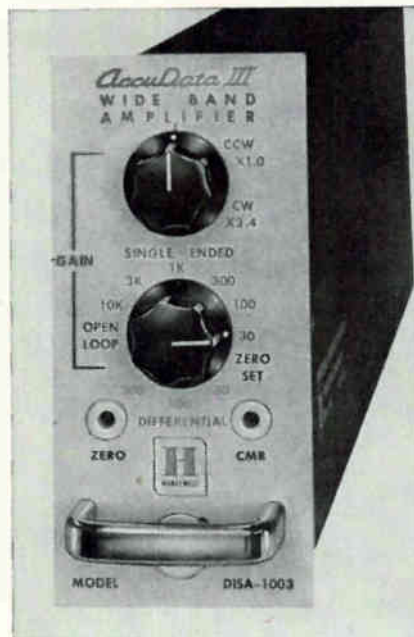
Zero drift is measured at the amplifier output with a strip chart potentiometer such as the Honey-



well ElectroniK Recorder connected through a low pass filter as shown. The amplifier input should be shorted. Equivalent input drift is the absolute amount recorded at the output divided by the amplifier gain measured under known conditions of temperature and line voltage, and, if necessary, for a specified time. There do not seem to be agreed-upon definitions of short or long-term time periods. For further details, write for Bulletin BE AN122.

Zero Drift Less Than 0.02 Per Cent at 10 mv

The AccuData III, Honeywell's all-transistor, wide-band, differential input, chopper-stabilized, d-c amplifier, has the lowest drift of any amplifier in its field — something less than 0.5 microvolts at reasonably constant ambient temperature, or less than $2 \mu\text{v}$ with a 10°F change in ambient. The effect of line voltage never exceeds $1 \mu\text{v}$ for a $\pm 10\%$ change, hence, under conditions most frequently advertised for amplifiers, its zero error with a 10mv input signal would be less than 0.02%.



The AccuData III has single-ended as well as differential input ranges, input impedance of 2 megohms differential (20 megohms single-ended), and power output sufficient to drive the highest frequency galvanometer oscillograph to its maximum deflection. In addition to excellent drift characteristics, the AccuData III offers exceptional linearity, very low noise, and frequency response to 20kc. Write for Bulletin BS-DISA-3 to Minneapolis-Honeywell, Boston Division, Dept. 7, 40 Life Street, Boston 35, Mass.

Visit us IRE Show Booth No. 2208

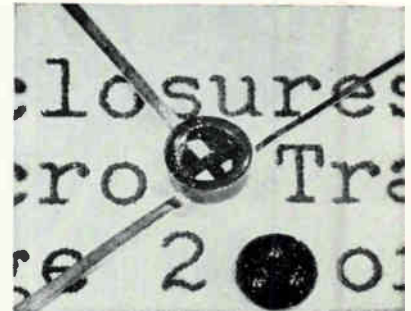
Honeywell



First in Control
SINCE 1885

axial relays for use at higher frequencies and high power levels. They rely on newly designed housings and the inherent advantages of vacuum to handle up to 15 Kw peak power at 600 Mc. Vacuum guarantees permanently low contact resistance that does not change even if the relay is accidentally switched under load.

CIRCLE 425 ON READER SERVICE CARD



All-Glass Enclosure FOR MICRO-TRANSISTORS

CORNING GLASS WORKS, Corning, N. Y., offers a glass microminiature transistor enclosure. It consists of two parts—a case and flat cover. Diameter of the enclosure is only 150 mils, and height after sealing is 60 mils. Three coplanar, ribbon leads are an integral part of the case. A glaze with a low melting point, applied by Corning to the top rim of the case, allows a transistor manufacturer to hermetically seal the case and cover with ease.

CIRCLE 426 ON READER SERVICE CARD



Static Inverter SILICON TRANSISTORS

VARO MFG. CO., INC., 2201 Walnut St., Garland, Texas. Model 4333 is a 30 v-a static inverter. Application: gyro motor power supply for a high performance ballistic missile. It converts 28 v d-c battery power to single phase 400 cps a-c power. It features output voltage regulated to 26 v a-c ± 1 percent; continuous operation over temperature range -54°C to $+71^\circ\text{C}$ with-

out heat sink or external cooling means; vibration 10 g's to 2,000 cps; miniature size; light weight.

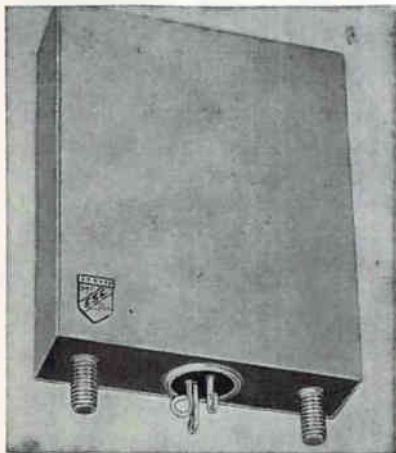
CIRCLE 427 ON READER SERVICE CARD



Molded Screws ACETAL RESIN

GRIES REPRODUCER CORP., 151 Beechwood St., New Rochelle, N. Y., offers a wide range of molded Delrin screws. By means of GRC's injection molding technique, fasteners are molded of engineering thermoplastics to precise tolerances and exacting specifications in a single automatic operation. Delrin (du Pont acetal resin) offers many strength characteristics approaching those of metals.

CIRCLE 428 ON READER SERVICE CARD



Delay Line MINIATURIZED

ESC ELECTRONICS CORP., 534 Bergen Blvd., Palisades Park, N. J. Model 37-74 delay line has a delay time/rise time ratio of better than 40/1 in a case size less than 3½ cu in. Delay time is 2.5 μsec ± 5 percent; rise time, 0.07 max; attenuation, 2 db max; impedance, 500 ohms.

CIRCLE 429 ON READER SERVICE CARD

Laminated Plastic FLAME-RETARDANT

SYNTHANE CORP., Oaks, Pa. The paper-base Grade FR-2 has a flame-

retardant phenolic resin binder. It has all of the outstanding electrical properties of paper-base XXXP, but may be punched at room temperature and is self-extinguishing. Available in sheets and strips, either plain or copper-clad, Grade FR-2 has excellent flame-retardance and possesses unusual arc resistance for a phenolic laminate; these properties are unaffected by service or aging.

CIRCLE 430 ON READER SERVICE CARD



Pulse Generator PORTABLE UNIT

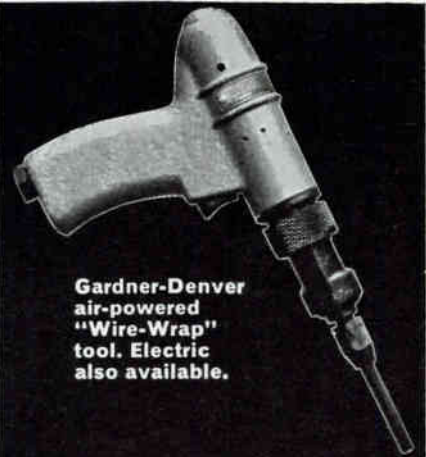
RUTHERFORD ELECTRONICS CO., 8944 Lindblade St., Culver City, Calif. Model B-10 transistorized, high speed pulse generator features a self contained, rechargeable battery pack. Main output pulse is continuously variable in repetition rate from 20 pps to 2 million pps, or may be triggered from an external source at rates to 2 Mc; delay (with respect to the synchronizing pulse output) continuously variable from 0 to 10,000 μsec; pulse widths continuously variable from 0.05 to 10,000 μsec; an amplitude of 18 v into 50 ohms.

CIRCLE 431 ON READER SERVICE CARD



Traveling Wave Tube WIDE-BAND

RAYTHEON CO., Foundry Ave., Waltham 54, Mass. The QKW750A wide-band twt is ideal for frequency-diversity radar applications. It is a 60 Kw unit designed for



Gardner-Denver
air-powered
"Wire-Wrap"
tool. Electric
also available.

Wire-wrap

Over one billion permanent solderless wrapped electrical connections without a reject.

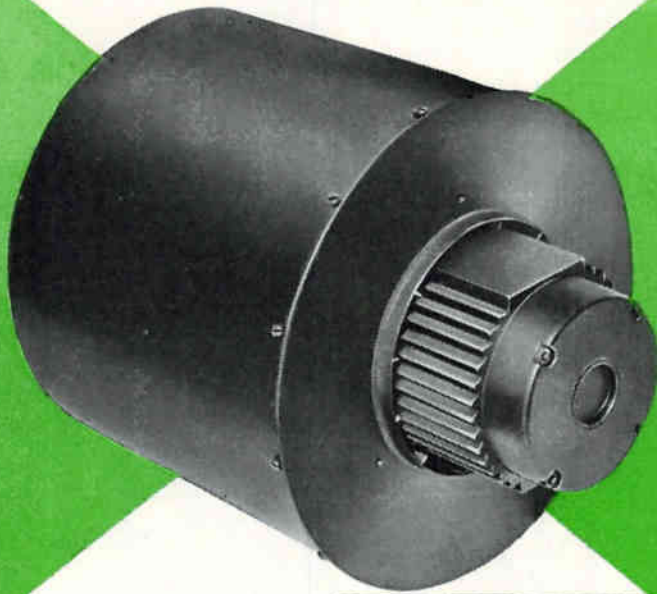


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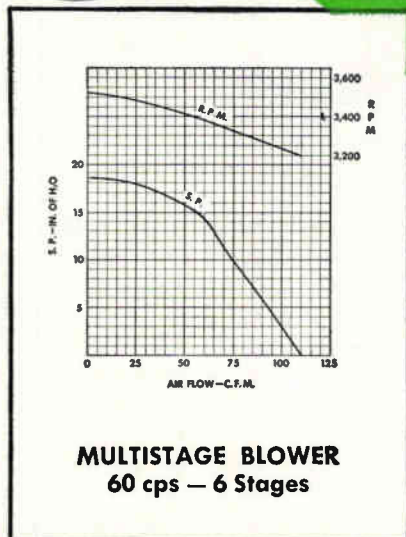
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the pressure's on for '61



MULTI-STAGE BLOWER

60 cps or 400 cps
1 ϕ or 3 ϕ
To 440 Volts
10" O.D. by lengths up to 14"
Ambient Range: -55° + 85° C
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MULTISTAGE BLOWER
60 cps — 6 Stages

When engineering specifications require continuous duty and quiet long life, Air Marine offers multistage blowers for low volume, higher pressure applications to 1 psi with air delivery to 100 CFM. Featured is long life with low noise. Where high pressure is required or on such vacuum applications as tape retention, the Air-Marine multistage blowers are the efficient answer.

Our field engineers will gladly assist you in the selection and application of motors, blowers or fans.

Air Marine motors, blowers and fans have been designed and tested to meet the specifications of both the military and industry.

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pulsed operation in S-band frequencies from 2,900 to 3,100 Mc. It may also be used as a driver for the QKS622 Amplitron. Peak power of the liquid-cooled tube is 60 Kw with average power output of 720 w. Pulse width is 30 μ sec. Load vswr is 1.5 max. Overall dimensions are 4 in. by 26 in. Weight is 16 lb. Price is \$8,750.

CIRCLE 432 ON READER SERVICE CARD



A-C Potentiometers PRECISION UNITS

HELIPOT DIVISION of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., has available several series of precision pots for a-c excited circuits. These single- and multi-turn units have high input impedance and low output impedance, thus greatly reducing quadrature and loading effects. A new design departure also minimizes the chance of catastrophic failure and produces linearity that is stable over the pot's entire life.

CIRCLE 433 ON READER SERVICE CARD

P-C Layout Tools AND MATERIALS

KEUFFEL & ESSER CO., Hoboken, N. J., announces the Cut-'N'-Strip method of producing printed circuit layout. This technique features the use of Stabilene film, a dimensionally stable film that is actinically opaque with a visually transparent peelable surface. K&E representatives will demonstrate to engineering and drafting personnel the

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SPECIALIST

A new approach to better serve you our customer. We buy components for assembly to hundreds of variations. Former specials are now same day delivery. Inspecting & testing to meet your exacting requirements. For further information call or write, also see the cannon ad on page 219.



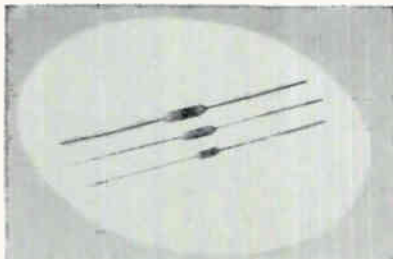
10816 Burbank Blvd., North Hollywood, Calif.
PO 1-6133 TR 7-2651

CIRCLE 319 ON READER SERVICE CARD

March 10, 1961

many advantages of Cut-'N'-Strip including ways to obtain accurate pad placement, controllable line width, stripping and touch-up techniques.

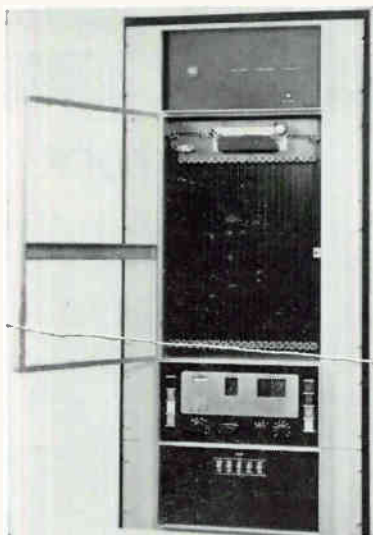
CIRCLE 434 ON READER SERVICE CARD



Metal Film Resistors EPOXY-COATED

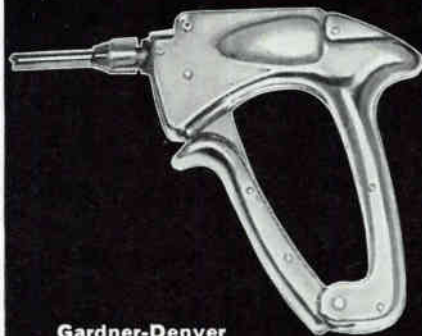
INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa., announces a line of epoxy-coated metal film resistors. These M-coat resistors are introduced in $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ w sizes, and will be available in standard temperature coefficients. Their main feature is size, and they can be effectively used where their molded counterpart is unable to be fitted. Delivery time is 3 weeks.

CIRCLE 435 ON READER SERVICE CARD



Training Simulator REPETITIVE PLAYBACK

PRECISION INSTRUMENT CO., 1011 Commercial St., San Carlos, Calif. A continuous tape loop simulator provides 50 or more channels for repetitive playback of data in training, computer, and control applications. Additional channels are obtained through multiplexing. The simulator utilizes one-inch tape



Gardner-Denver hand "Wire-Wrap" tool.

Wire-Wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



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DENVER**

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CIRCLE 361 ON READER SERVICE CARD

231



Who is TODAY'S LEADER in Counters?

Look at the Record:

- FIRST** 8 place readout
- FIRST** High stability oscillator (5 parts 10^8 per week)
- FIRST** Transistorized power supply

IMMEDIATE SHIPMENT FROM STOCK

The Facts:

- **DEPENDABILITY** proven by thousands of hours of service-free field operation on major missile programs.
- **STABILITY** proven by impartial tests of independent labs, government agencies, customers' labs.
- **SIZE** — smaller, lighter — the product of true design leadership.
- **EXPERIENCE** in building THOUSANDS of military counters on prime contracts.
- **DEMONSTRATIONS** in your labs, by leading sales reps — Write for name and address of rep nearest you.

NORTHEASTERN ENGINEERING
 An Affiliate of Atlantic Research Corp.
 MANCHESTER • NEW HAMPSHIRE

CIRCLE 362 ON READER SERVICE CARD

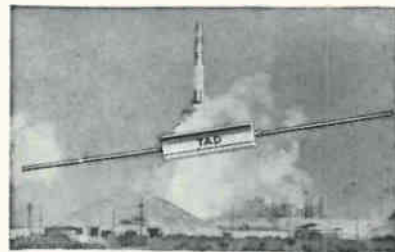
with 33 tracks in standard IRIG head configuration. Bandwidth capabilities extend from d-c to 5 Kc at a tape speed of 15 ips.

CIRCLE 436 ON READER SERVICE CARD

Frequency Counter
 BUILT-IN RELIABILITY

GENERAL RADIO CO., West Concord, Mass. Type 1130-A digital tune and frequency meter features a unique display system. Instrument measures frequencies from d-c to 10 Mc with a precision of 0.1 cps, periods from 10 μ sec to 10^7 sec with a precision of 0.1 μ sec, and time intervals from 1 μ sec to 10^7 sec with a precision of 0.1 μ sec.

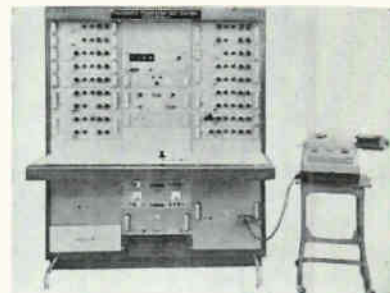
CIRCLE 437 ON READER SERVICE CARD



Capacitors
 SOLID TANTALUM

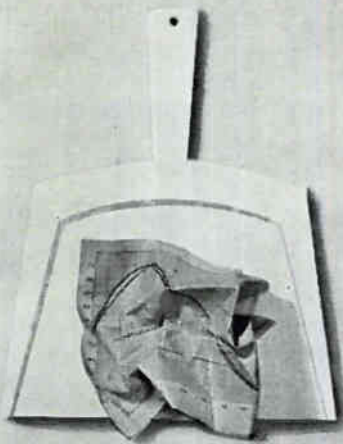
PYRAMID ELECTRIC CO., Darlington, S. C. Type TAD is a miniature dry electrolyte tantalum capacitor made to meet or exceed military specifications MIL-C-26655A. Operating temperatures range from -80 C to $+125$ C, with very low leakage current and dissipation factor.

CIRCLE 438 ON READER SERVICE CARD



Transistor Tester
 AUTOMATIC SYSTEM

OPTIMIZED DEVICES, INC., 864 Franklin Ave., Thornwood, N. Y. This semiconductor reliability test system will provide repetitive test data



WHATEVER HAPPENED TO A-C QUADRATURE?

Helipot got rid of it, that's what ... by designing new A-C potentiometers with low quadrature and negligible phase shift!



They are the 3" diameter 5800 single-turn series and the 2" 7800 multi-turn series. Both have high input impedance and low output impedance. Which means: 1) reduced loading effects, and 2) you'll wonder where the quadrature went.

Helipot's new A-C versions straddle a frequency range of 400 to 1,000 cps. And they can be built to provide exceptional linearities ... within resolution and without padding!

You'll also find it well to remember that Helipot's A-C potentiometers can be cascaded in series or parallel to obtain unique functions. (And, with low quadrature and all, they'll improve signal-to-noise ratios in high performance servos!)

To find out more about Helipot's A-C pots, ask for our new 32-page potentiometer catalog!

Beckman / **Helipot**

POTS : MOTORS : METERS

Helipot Division of
Beckman Instruments, Inc.
Fullerton, California

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CIRCLE 320 ON READER SERVICE CARD

March 10, 1961

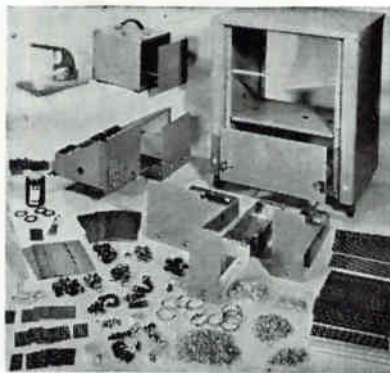
from lots of transistors and/or diodes. Purpose of the system is to automatically program, test, evaluate and record continuous test data on an IBM output writer or card punch. Test accuracy is ± 1 percent. Repeatability is ± 0.2 percent.
CIRCLE 439 ON READER SERVICE CARD



A-M Generator TUNES 10 KC-72 MC

MARCONI INSTRUMENTS, 111 Cedar Lane, Englewood, N. J. Model 144H a-m generator has frequency range from 10 Kc to 72 Mc. Features include a precisely calibrated fine frequency control, automatic level control and output voltage accuracy to 0.5 db. Carrier frequency drift does not exceed 0.002 percent in a ten minute period.

CIRCLE 440 ON READER SERVICE CARD



Building Block Kit SPEEDS PRODUCTION

ALDEN PRODUCTS CO., 39 N. Main St., Brockton, Mass. Electronic test, measurement, control or communications equipment can be designed with kit No. 40—moved intact and set up anywhere for immediate operation and easy maintenance. It utilizes the company's complete plug-in unit construction system. All necessary components from the

Handy, manual
wrapping and
unwrapping tools



Wire-wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



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CIRCLE 363 ON READER SERVICE CARD

**IRE Show
Booth M-15**

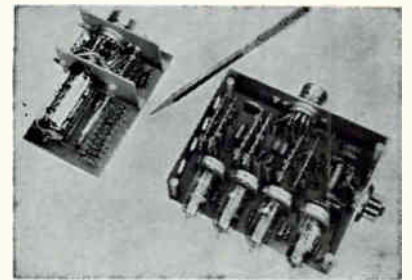
PRECISION IN MINIATURE

Collector's items—the Babcock Gallery of precision miniature and subminiature relays. Complete series in power and sensitive types, single, double and 4 pole with switching capabilities from dry circuit to 10 amps. Hermetically sealed BR-1SZ requires only 5 mw power, features very critical pull-in to drop-out ratios. BR-7 subminiature 10 amp DPDT accepts 30g vibration @ 10-2000 cps, 50g shock @ 11 millisecc. BR-8 AC or DC crystal can, dry circuit to 2 amp, 30g vibration to 2000 cps. BR-9 DPDT magnetic latching, operates on 15 millisecc nom. pulse, dry circuit to 10 amp contacts. BR-12 DPDT 200 grid crystal can, 3 amp contacts, 30g vibration to 3000 cps. BR-14 4PDT, 5, 7½ or 10 amp contacts, temp. range —65°C to 125°C. Technical Bulletins on request.

BABCOCK RELAYS, INC.
1640 Babcock Avenue, Costa Mesa, California

Uni-Rack with rack adapters and a universal tool for staking, eyeletting, punching are all included.

CIRCLE 441 ON READER SERVICE CARD



Plug-In Counter HIGH RELIABILITY

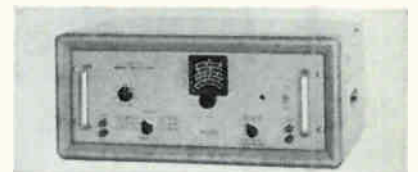
FRANKLIN ELECTRONICS INC., Bridgeport, Pa., has developed a high-reliability counter (shown at left) that uses 75 percent less parts than the previous Franklin counter (at right in picture). Much of the increased reliability comes about through the use of a single counting tube, instead of the usual ring-counter employing four tubes. The numerical indicating tube is the new long-life Nixie.

CIRCLE 442 ON READER SERVICE CARD

A-C Voltmeter HIGH PRECISION

MUIRHEAD INSTRUMENTS INC., 441 Lexington Ave., New York 17, N. Y. The D-930-A precision rms voltmeter has a voltage range of 1 mv to 300 v and useful frequency range of 5 cps to 100 Kc. Over the greater portion of this range, measurement accuracy is 0.05 percent and reading accuracy over the whole range is 0.025 percent. Unit is suitable for precision industrial testing as well as laboratory standardization. Price is \$3,670.

CIRCLE 443 ON READER SERVICE CARD



Band-Pass Filter UNITY VOLTAGE GAIN

DYTRONICS CO., 5485 N. High St., Columbus 14, Ohio. Model 718 narrow band-pass filter covers the

**CANNON
PLUGS**



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SPECIALIST

A new approach to better serve you our customer. We buy components for assembly to hundreds of variations. Former specials are now same day delivery. Inspecting & testing to meet your exacting requirements. For further information call or write, also see the Cannon ad on page 219.



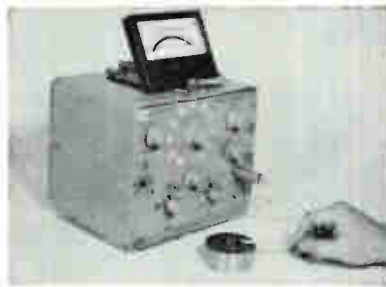
10816 Burbank Blvd., North Hollywood, Calif.
PO 1-6133 TR 7-2651

CIRCLE 321 ON READER SERVICE CARD

March 10, 1961

frequency range from 3 Kc to 400 Kc. Bandwidth is dependent upon the frequency of operation but has an average value of about ± 2.5 percent to the 3 db down points and ± 3.86 percent to the 6 db down points. The harmonic rejection averages about -65 db for $2 f_0$ and $\frac{1}{2} f_0$ and about -70 db for $3 f_0$ and $\frac{1}{3} f_0$.

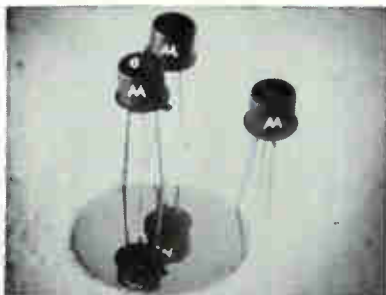
CIRCLE 444 ON READER SERVICE CARD



**Differential Gaussmeter
TRANSISTORIZED**

RADIO FREQUENCY LABORATORIES, INC., Powerville Road, Boonton (Twp.), N. J. Model 2000 differential gaussmeter employs dual Hall effect probe elements to measure magnetic field gradients, as well as absolute field values. Provides 17 ranges from 0-0.1 gauss full scale to 0-20,000 gauss. Field gradient measurements are used to determine amount and location of residual magnetism in ferrous parts after fabrication.

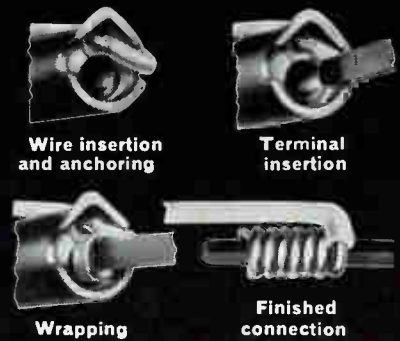
CIRCLE 445 ON READER SERVICE CARD



**Epitaxial Transistors
SILICON & GERMANIUM**

MOTOROLA SEMICONDUCTOR PRODUCTS INC., 5005 East McDowell Road, Phoenix, Ariz., offers silicon and germanium epitaxial mesa transistors, both switch and amplifier types, which are electrically equivalent to micro-alloy types, but retain the high power capability and high reliability facets nor-

Connections in only three seconds



Wire-wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



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CIRCLE 365 ON READER SERVICE CARD

235

New

SIG GEN AM BRIDGE 1/4% SIG GEN FM

at **IRE SHOW**
BOOTHS 3702-4-6

LF/MF/HF SIG GEN MODEL 144H

New Signal Generator 144H has exceptional frequency coverage and electronic calibrated incremental frequency control—a popular feature borrowed from our 1066 series FM generators. The highly accurate level monitoring is by protected thermocouple which cannot be overloaded. A full-view dial, ALC and two crystal checks contribute to accuracy and ease of use.

Freq: 10Kc to 72Mc; 8 bands
Stability: .002%/10 minutes
Output: .1 μ V to 2V \pm .5db. ALC
 Δ f: calibrated, .01 to 1% of f_c
AM: 0-80%, 20cps to 20Kc \pm 1db
Price: \$1190



1/4% LCR BRIDGE MODEL 1313

This new Universal Bridge adds to the wide variety from which an engineer must choose. But Model 1313 has both 1/4% accuracy and direct readout; combines exceptional discrimination with ease of use. Detector AGC, variable frequency of operation, functional styling are all plus features.

L: 1 μ H to 110H, 7 decades
C: 1 μ F to 110 μ F, 7 decades
R: .01 Ω to 110M Ω , 8 Decades
Accuracy: 1/4%
Discrimination: 5000 div'ns/Decade
Frequency: 1Kc, 10 Kc. 100 cps to 20Kc with ext. osc.
Readout: Direct—no multiplying factors

Make no Mistake—Measure with MARCONI 1313.



MISSILE COMMAND SIG GEN MODEL 1066B/2

Marconi 1066 series FM signal generators are in use wherever FM equipment is designed or maintained. Because it was designed for this specific job, new 1066B/2 precisely meets requirements for aligning Range Command Receivers. It has freq. accuracy .01%, wide deviation, handles 100Kc modulation with multiple tones, and measures peak deviations.

Frequency: 400-550 Mc
Accuracy: .01% at 1Mc points
Output: .1 μ V to 1V into 52 Ω
FM: 0-300Kc
 Δ f: Frequency calibrated, 0-100Kc
Mod. Freq. 100cps—100Kc



MARCONI
INSTRUMENTS



111 CEDAR LANE • ENGLEWOOD, NEW JERSEY
MAIN PLANT, ST ALBANS, ENGLAND

mally associated with mesa type transistors.

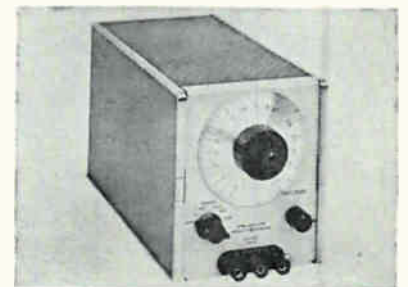
CIRCLE 446 ON READER SERVICE CARD



Wirewound Pots INFINITE RESOLUTION

VOGUE INSTRUMENT CORP., 381 Empire Blvd., Brooklyn 25, N. Y., announces 1 to 40 turn wirewound pots with resistance range from 1 ohm to 30,000 ohms. They feature infinite resolution, 0.01 percent linearity, low noise, long life, low torque, low inductance and capacitance for use in a-c circuits.

CIRCLE 447 ON READER SERVICE CARD



Portable Oscillator TRANSISTORIZED

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Fully transistorized and battery operated, model 204B oscillator is useful in both field and laboratory work. No warm-up is needed. Stable, accurate signals are instantly available over a frequency range from 5 cps to 500 Kc. Unit can drive balanced and unbalanced loads, and loads referenced either above or below ground. It has a fully floating output, and provides excellent frequency stability, even with rapidly changing loads.

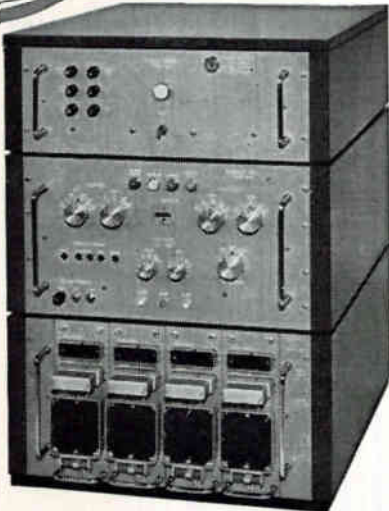
CIRCLE 448 ON READER SERVICE CARD

Ceramic Insulation IMPROVED FABRICATION

AMERICAN LAVA CORP., Manufacturers Road, Chattanooga 5, Tenn.,



**high speed
automatic
cable testing**



CABLE HARNESS ANALYZER

- simultaneously tests for continuity, leakage and hi-pot
- checks complex branch circuitry
- rapid, low cost programming
- ease of operation

Ease of programming, fail safe circuits, wide range of programming, latest state of art design, reliability, rapid automatic go/no-go tests and low cost are features of the CTI Model 165 Cable Harness Analyzer. A wide combination of test parameters, continuity current, hi-pot voltage, continuity resistance, leakage resistance and time on conductor, may be independently programmed. The Cable Tester automatically checks up to 10,000 simple circuits in increments of 200, or an equivalent combination of main and branch circuits. Connections provide control of external relays in the circuit under test. CTI has pioneered the field of automatic testing, and has applied its experience to developing the CTI Cable Tester, Model 165, into the most versatile and economic wire harness analyzer available.

Write for full information



**CALIFORNIA
TECHNICAL
INDUSTRIES**
DIVISION OF TETRON INC.
BELMONT 3, CALIFORNIA

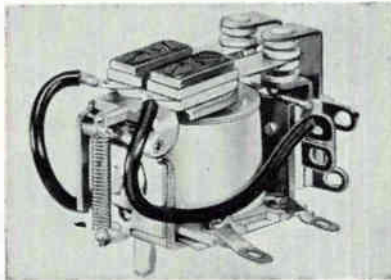
Foremost in Automatic Testing

CIRCLE 322 ON READER SERVICE CARD

March 10, 1961

introduces AlSiBase ceramic. Features include: fabrication of thin sections especially suited for substrates; flatness and dimensional accuracy within normally accepted ranges without grinding expense, contaminants or scratches; ability to fabricate complex designs to more precise detail without machining after firing.

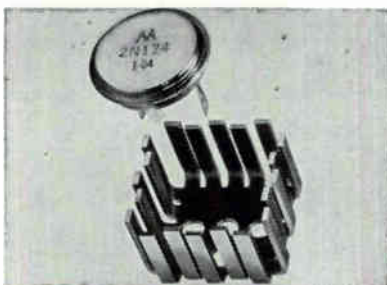
CIRCLE 449 ON READER SERVICE CARD



Small Power Relay EXTRA RELIABILITY

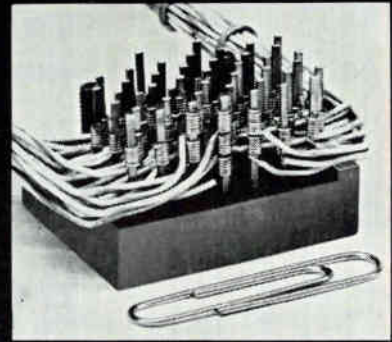
MAGNECRAFT ELECTRIC CO., 3350 B West Grand Ave., Chicago 51, Ill., announces a small a-c/d-c power relay. A pin type armature hinge with centerless ground stainless steel pin and precision reamed bearing surfaces assures adjustment stability with long life, low friction and positive contact effectiveness. Fiber glass melamine insulation, rugged independently riveted coil terminals and riveted contacts with built-in contact wipe are featured.

CIRCLE 450 ON READER SERVICE CARD



Heat Dissipator FOR POWER TRANSISTORS

INTERNATIONAL ELECTRONIC RESEARCH CORP., 135 W. Magnolia Blvd., Burbank, Calif. The UP series is designed to provide positive cooling of power transistors by radiation and convection. The design arrangement, of the displaced vertical pickets in a forced-air application, provides more air passageways and induced turbu-



Close terminal spacing for compact electrical assemblies.

Wire-wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



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CIRCLE 367 ON READER SERVICE CARD

237

Now! the lowest reactance resistor available

G B COMPONENTS

recently announced the availability of a low reactance, encapsulated, precision wire wound resistor.

In every case with frequency up to 100 KC, regardless of range, reactances of these new wire wound resistors are significantly less than equivalent composition, deposited carbon and deposited metal film resistors.

They are obtainable in all styles, sizes, ranges and tolerances.

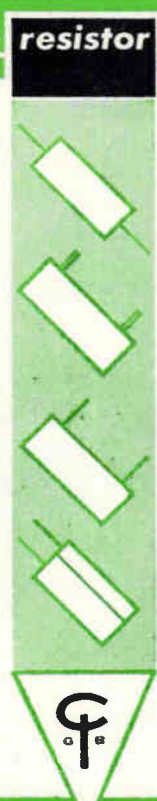
Manufacturers of . . .

- Encapsulated Precision Wire Wound Resistors
- Networks
- Resistance Standards
- Resistance Certification and Calibration Service

G B COMPONENTS, INC.

14621 ARMINTA STREET • VAN NUYS, CALIFORNIA

CIRCLE 324 ON READER SERVICE CARD



a unique catalog showing comparative oscilloscope signal trace comparisons is available upon request.

SHEPARD WINTERS CO.
3193 Cahuenga Blvd.
Hollywood 28, Calif.

ARTHUR L. BOLTON
Box 944
Menlo Park, Calif.

KOCH ENG. & SALES CO.
309 Meadows, Bldg.
Dallas 6, Texas

LOUIS TESSITORE
Box 22, Barrington, N.J.



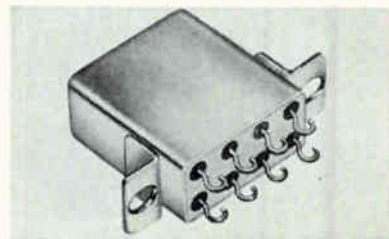
lence for increased efficiency and rapid carry-off of heat.

CIRCLE 451 ON READER SERVICE CARD

X-Y Recorder RACK-MOUNTED

F. L. MOSELEY CO., 409 North Fair Oaks Ave., Pasadena, Calif. Precision Autograf X-Y recorder draws Cartesian coordinate curves automatically from two related sources of d-c electrical information. It also plots one variable against time, accepts a-c input data on either or both axes, and operates directly from a variety of Autograf accessories.

CIRCLE 452 ON READER SERVICE CARD



Crystal Can Relays SUBMINIATURE

BABCOCK RELAYS, INC., 1640 Babcock Ave., Costa Mesa, Calif. Featuring 0.200 in. grid space headers, the ½ oz series BR-12 crystal can relays have 5 amp contacts and are conservatively rated at 100,000 operations at 3 amp resistive where temperature is +125 C. Designed for missile-space applications, the series is shock rated for 125 g for 11 millisecc with vibration immunity of 30 g from 50 to 3,000 cps.

CIRCLE 453 ON READER SERVICE CARD



Packaged Oscillator HIGH STABILITY

BLILEY ELECTRIC CO., Union Station Building, Erie, Pa., has produced

GOING TO THE
I. R. E. SHOW?

Then visit our **NEW YORK PLANT** and watch some remarkable demonstrations!

see the new Edward Segal TW-ESSM eyelet attaching machine that can automatically feed, stake and resistance solder eyelets as small as .030" barrel dia. to printed wiring boards as thin as .015".

- Learn why this process is, to our knowledge, the only one that meets MIL Standard 275A.
- Unit has 15" throat depth; will eyelet large boards.
- Interlocked operation of mechanical and electrical cycles requires the eyelet be completely set before it can be fused.
- Has easy-to-change tooling.
- Heat cycle may be varied from 1 to 60 cycles.

For arrangements call
Worth 6-3935 (NYC)
ask for Bob Garretson ▶

...THIS AND OTHER DEMONSTRATIONS,
INCLUDING
FUNNEL FLANGE EYELET SETTING
from 9:00 AM to 5:00 PM Daily
Mon., Mar. 20th through Fri., Mar. 24th.

Sales Manager Bob Garretson is just one of the highly qualified Segal engineers who will conduct demonstrations. Bob was formerly Manufacturing Engineer in the Advanced Manufacturing Development Unit of G. E.'s Light Military Electronics Department



Manufacturers of Automatic Eyelet Attaching Machines, Riveting Machines, Special Hoppers and Feeding Devices

132 LAFAYETTE STREET, NEW YORK 13, N. Y. • WORTH 6-3935

CIRCLE 368 ON READER SERVICE CARD

Automatic Sequencing Controls



AiResearch's design and manufacturing capability covers many types of automatic sequencing controls such as those for missile ground checkout, controlling drone and missile flight profiles, and automatic elevation and leveling of radar antennas and missiles.

Above is an AiResearch sequence controller for cabin temperature of a jet airliner. It assimilates 25 sensor element inputs and supplies command signals to 18 amplifier channels. Consisting of servo-operated potentiometer cards, cam switch programmer and other electromechanical components, it is another example of AiResearch's over-all ability to design and produce intricate and complicated servo systems.

The most experienced company in the development and production of control systems for airborne and ground use, AiResearch is an industry leader in electromechanical systems and components of all types for aircraft, ground handling, ordnance and missile systems.

OTHER ELECTROMECHANICAL COMPONENTS AND SYSTEMS

AC and DC Motors, Generators and Controls • Static Inverters and Converters • Linear and Rotary Actuators • Power Servos • Hoists • Temperature and Positioning Controls • Sensors • Programmers • Missile Launchers • Radar Positioners • Power Supplies • Williamsgrip Connectors

Your inquiries are invited.



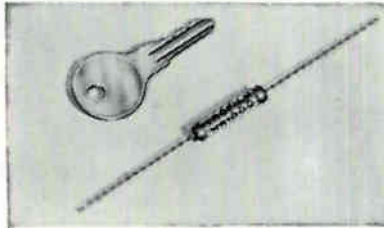
AiResearch Manufacturing Division

Los Angeles 45, California

CIRCLE 323 ON READER SERVICE CARD
March 10, 1961

a 1,000 Kc packaged crystal oscillator with transistorized circuitry. It is designed for use in frequency counters or as a master oscillator in frequency control systems. This plug-in package is supplied with a high precision glass crystal at 1,000 Kc and has a frequency stability of one part in 100 million under ambient temperature conditions.

CIRCLE 454 ON READER SERVICE CARD

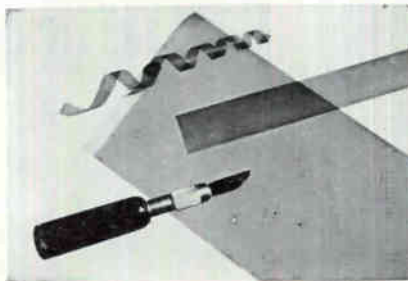


Resistors

ULTRARELIABLE

PYROFILM RESISTOR CO., INC., U.S. Highway 46, Parsippany, N. J., announces the HR 1000 series of ultrareliable high resistance resistors. Use of the PyroSeal technique and a new type of coating assures long term stability. Typical applications are for Geiger and scintillation counters, phototube circuits, computers, radar equipment, facsimile equipment, and many other uses. Diameter is $\frac{3}{8}$ in.; length, 1 in.; leads $1\frac{1}{2}$ in. Maximum voltage is 1000; standard resistance range, 10^7 to 10^{14} ohms.

CIRCLE 455 ON READER SERVICE CARD



Flexible Absorber

FOR MICROWAVE USE

FILMOHM CORP., 48 W. 25th St., New York 10, N. Y. Metal film Mylar is a thin and completely flexible microwave absorbing material. The resistance material is a thin film of pure metals, approximately 50 millionths of an inch thick, uniformly deposited on the surface of the Mylar. The absorber is suited for applications requiring a thin film



Gardner-Denver automatic "Wire-Wrap" machines expedite multiple operations.

Wire-Wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



GARDNER DENVER

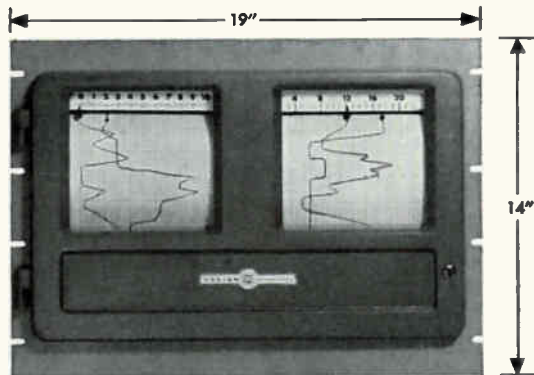
See us at...

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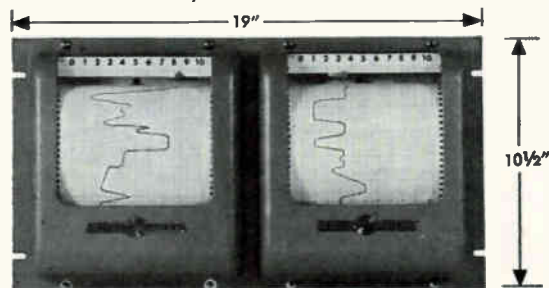
CIRCLE 369 ON READER SERVICE CARD

VARIAN Potentiometer RECORDERS

More performance in less space



G-22 FOUR CHANNELS IN 14", DEPTH ONLY 11½" BEHIND FRONT PANEL



G-11A TWO CHANNELS IN 10½", DEPTH ONLY 5½" BEHIND FRONT PANEL

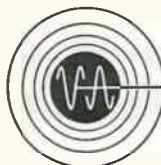


G-10 ONE CHANNEL < ½ CU. FT.

THREE COMPACT CHOICES

Using one quarter the space of many comparable potentiometer recorders, the Varian family packs exceptional function into very little space. Interchangeable input chassis accommodate full-scale signal voltages from 10mv to 500v d.c., temperatures from -200°C to +1500°C, and 1mA current recording. The Varian recorders have 1% accuracy, ¼%-of-span sensitivity, 1 or 2½ second balancing time, full-span zero adjust, Zener diode or mercury cell reference. A selection of chart speeds from ½"/hour to 16"/minute lets you pick the time resolution you need.

In addition to being rack-mountable, the G-22 and G-11A are portable for use in many locations. A wide range of accessories—such as retransmitting slidewires, alarm contacts and event markers—helps broaden the outstanding functional versatility outlined above. Chances are a Varian recorder can serve your need. Write Instrument Division for detailed specifications.

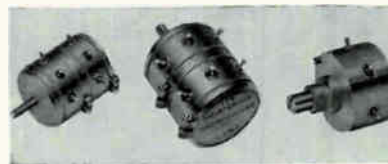


VARIAN associates
PALO ALTO 1, CALIFORNIA

NMR & EPR SPECTROMETERS, MAGNETS, FLUXMETERS, GRAPHIC RECORDERS, MAGNETOMETERS, MICROWAVE TUBES,
MICROWAVE SYSTEM COMPONENTS, HIGH VACUUM EQUIPMENT, LINEAR ACCELERATORS, RESEARCH AND DEVELOPMENT SERVICES

applied to a circular or eccentric contour.

CIRCLE 456 ON READER SERVICE CARD



Precision Pots

DEPOSITED FILM

MECHATROL, a division of Servomechanisms, Inc., 1200 Prospect Ave., Westbury, L. I., N. Y., announces deposited film precision pots that provide resolution of better than 0.01 percent. The units shown, which measure 1½ in. in diameter, are designed to meet environmental specs for airborne and space equipment. They are available in single or ganged types.

CIRCLE 457 ON READER SERVICE CARD

Battery Systems

THREE TYPES

YARDNEY ELECTRIC CORP., 40-52 Leonard St., New York 13, N. Y., recently developed three battery systems. One is a unique sea-water battery; another is a sealed form of rechargeable silver-cadmium battery; the third is a new automatically activated primary battery system having a minimum of parts and offering maximum flexibility in packaging.

CIRCLE 458 ON READER SERVICE CARD



Wire Stripper

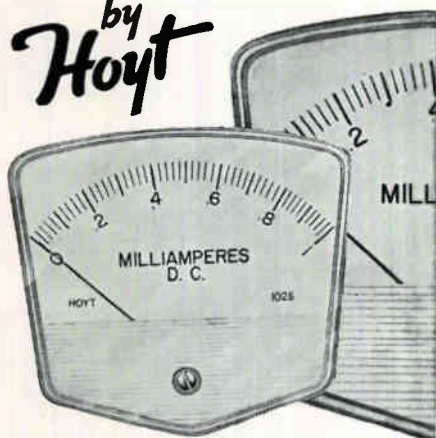
AUTOMATIC MACHINE

EUBANKS ENGINEERING CO., 260 North Allen Ave., Pasadena, Calif. Quick-change devices that greatly reduce set-up times are features in the model 810A automatic wire stripper. These include a dial indi-

METERS

You can SEE and READ

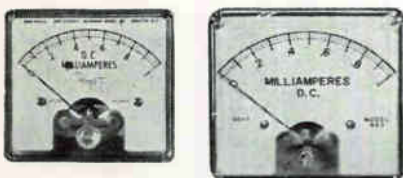
by
HOYT



New Series 1025-1026 Interchangeable with Round Bakelite Case Type

Brilliantly new in their high visibility polystyrene cases are these modern type Meters by HOYT which give a true reading at a glance! Here longer scale length and the elimination of shadows plus clean design add up to a top-notch combination to incorporate in any panel.

The Famous HOYT high torque movement with precise and rugged craftsmanship gives you what you've been looking for in Meters. These models are directly interchangeable with all round Bakelite meters, and are available in all AC and DC ranges as Ammeters, Milliammeters, Microammeters, Voltmeters and Millivoltmeters. Similar styles #1037 3½" and #1060 6" meters are also available for any modern panel meter application.



The HOYT square plastic case series (#649 and #653 shown) is available in 2½", 3½" and 4½" types. Just right for use where equipment needs to be revised to meet modern design requirements. These instruments are interchangeable with square Bakelite meters and can be supplied with a frosted or colored band on the case front in any AC and DC range. Extra long scales in shadow free cases give you the most value and quality for your money.

Write us for the NEW HOYT PANEL METER Brochure showing a complete line of plastic and Bakelite models.

VISIT THE HOYT BOOTH NO. M-13
AT THE I.R.E. SHOW



BURTON-ROGERS COMPANY

Sales Division, Dept. E-3

42 Carleton Street, Cambridge 42, Mass.

CIRCLE 325 ON READER SERVICE CARD

March 10, 1961

cator on the measuring device, a slide lock to hold feed rolls in place on keyed shafts, quick-release clamps to hold strip assemblies in place, and an air-operated wire straightener that automatically opens and closes to positive stops, obviating the need for adjustment each time wire is threaded through the machine. The machine cuts and strips 32 to 12 Awg wire in lengths from 1 in. to 300 ft. at speeds up to 8,000 pieces per hr.

CIRCLE 459 ON READER SERVICE CARD



Tiny Circuit Modules
ENCAPSULATED UNITS

WALKIRT CO., 141 W. Hazel St., Inglewood, Calif., announces the 789 series of subminiature encapsulated, transistorized digital and logic circuit modules. They are constructed of high reliability components with a mean time before failure (mtbf) of over 30,000 hr at 40 C and over 20,000 hr at 100 C for a typical binary counter. Other circuits have a mtbf of over 136,000 hr.

CIRCLE 460 ON READER SERVICE CARD



Insulating Material
CERAMOPLASTIC

MYCALEX CORP. OF AMERICA, Clifton Blvd., Clifton, N. J. Supramica 620BB ceramoplastic is an electronic insulation that will operate at 1,200 F, mold to intricate shapes with superior accuracy, and provide a true hermetic seal. It expands and contracts under temperature changes at the same rate as many metals including titanium. Uses

Only Gardner-Denver offers a complete line of equipment for making permanent, solderless wrapped connections. Write for bulletins.

Gardner-Denver Company
Quincy, Illinois
Gardner-Denver Company
(Canada), Ltd., Toronto.

Wire-wrap

Over one billion permanent solderless wrapped electrical connections without a reject.



GARDNER DENVER

See us at...

I. R. E. SHOW
Booths 4524-4526

CIRCLE 371 ON READER SERVICE CARD

NEW HIGH IN A.C. CALIBRATION ACCURACY



MODEL TV-1

from **HOLT** / Originators of the
AC Precision Power Source

THERMAL TRANSFER VOLTMETER N.B.S. CERTIFIABLE

A new AC-DC transfer standard. Transfer measurement is made to a calibrated DC supply of the same voltage as the unknown AC being measured; thus eliminates ratio errors in the high frequency multiplier resistors.

Range — Three decade range multiplier. .5 volt to 1200 volts. Full resolution in 1 volt steps from 1 to 999 volts.

Frequency Response — .5 to 290 volts .02% to 50KC. 300 to 1200 volts .02% to 10KC.

Null Sensitivity — .004%/mm.

Thermocouple — DC reversal error less than .02%. Couples, plug in replaceable, at \$40.00.

Input Resistance — 143 ohm/volt.



AUDIO VOLTAGE STANDARD

MODEL AV5-321



The output is continuously variable in frequency as well as voltage so that complete information about the response of the unit or system under test may be obtained.

Range — 1 to 1000 volts RMS 35 cps to 2 KC. 1 to 300 volts RMS 35 cps to 10 KC. **Accuracy** — Regulated voltage equal to dial setting \pm (0.1% + 2 mv) From 300 to 1000 volts accuracy is \pm 0.25%.

Stability — 30 days. Long-term drift may be corrected by simple adjustment. **Internal Oscillator** — 60 cps, 400 cps or 1000 cps.

Wave Form — **Sinusoidal**: The unit is driven by a low distortion sine wave oscillator. Distortion added by the AV5-321 is less than .1% in the mid band rising to a max. of 0.15%.

For further details write to

HOLT / INSTRUMENT LABORATORIES
OCONTO, WISCONSIN

include connectors, transducers, tube sockets, coil forms, etc.

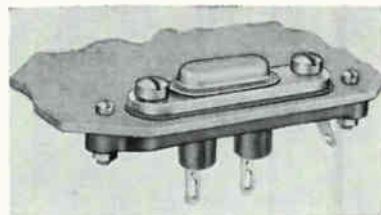
CIRCLE 461 ON READER SERVICE CARD

Noise Analyzer

COMPACT UNIT

QUAN-TECH LABORATORIES, INC., 60 Parsippany Blvd., Boonton, N. J. Model 317 analyzer establishes the amplitude-probability distribution of random signals, and is useful for determining threshold requirements, error or false alarm probabilities. A voltage threshold level is preset by a front panel control; noise levels exceeding the preset voltage level are read, or monitored, by a scale calibrated in percentage —referred to time. The transistorized unit operates over a 5 cps to 0.5 Mc range.

CIRCLE 462 ON READER SERVICE CARD



Transistor Socket

NARROW WIDTH

AUGAT BROS., INC., 33 Perry Ave., Attleboro, Mass., announces a high quality socket that accommodates the complete series of Spacesaver power transistors. Its narrow width permits utilization of the space saving size of the mating transistor. It is designed to be fastened beneath the chassis and provides direct mounting of the transistors with its mica insulator to the chassis. In this way, the transistor is provided with maximum heat dissipation by conduction.

CIRCLE 463 ON READER SERVICE CARD

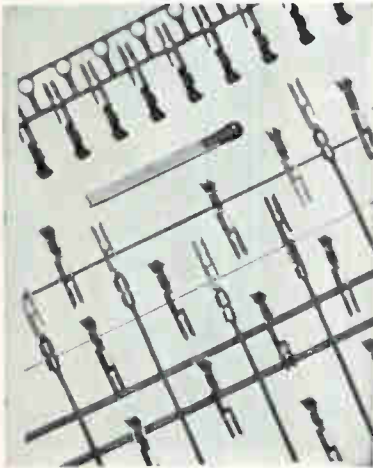
Crystal Unit

ALL GLASS

MC COY ELECTRONICS CO., Mt. Holly Springs, Pa., announces a vacuum sealed hard glass micromodule crystal unit in frequencies from 7,000 Kc to 200.0 Mc. Maximum dimensions are 0.280 in. wide, 0.280 in. high, and 0.075 in. thick. This new crystal type is said to be the smallest ever produced and vacuum

sealed in hard glass. Also available are vacuum sealed hard glass crystal units in the HC-6/U size; frequency range 1,000 Kc to 200.0 Mc; and in the HC-18/U size; frequency range 4,000 Kc to 200.0 Mc.

CIRCLE 464 ON READER SERVICE CARD



Crimp-Type Contact 18 TO 30 GAGE WIRE

ELCO CORP., M St., below Erie Ave., Philadelphia 24, Pa. The Varilok is a crimp-type contact which, in the self-same size and design, will accept all wire sizes from numbers 18 gage to 30 gage; and in addition to the reliability of its Varicon contact design, is said to offer easier and faster production characteristics, as well as the positive locking of contacts when inserted into connector castings.

CIRCLE 465 ON READER SERVICE CARD



D-C Amplifier OPERATIONAL TYPE

MICROGEE PRODUCTS, INC., 6319 W. Slauson Ave., Culver City, Calif. Model 505A d-c operational amplifier features response to 5 Kc and an open loop gain of 5,000. The 8 ma bipolar output current capability allows use with servovalves, recorders, galvanometers and the like. Dual inputs are provided for use in command-feedback servo loops. Featured is a front panel

AIRPAX

Space-Saver Discriminators for

TELEMETRY



COMPACT MODEL
Integral power supply optional

The unique use of a MAGMETER® saturating magnetic core frequency detector permits stable, accurate performance at a minimum cost in these completely solid state units. Power requirement is relatively small and the low internal dissipation eliminates rack cooling problems.

This latest addition to the Airpax CALIBRATOR Series of frequency discriminators features high performance in an exceptionally small package. Versatility is inherent—plug-in components permit accommodation of all IRIG bands. Deviation of 40% as well as other bands supplied on special order.

See the latest developments in Choppers, Circuit Breakers and Telemetry . . . IRE Booths 2306 - 08



CAMBRIDGE, MARYLAND • FORT LAUDERDALE, FLA.

SOLID STATE
for high reliability, service free life, and low power dissipation.

COMPACT SIZE
1 27/32" wide, 4 3/8" high. Eighteen units mount in a standard 19" rack panel, 8-3/4" high.

STANDARD IRIG
center frequencies, percentage deviation and intelligence bandwidths.

PLUG-IN COMPONENTS
Unit supplied for a given band may be converted to any other IRIG band by changing plug-in frequency detector and filters.

INPUT SENSITIVITY
and **DYNAMIC RANGE**
10 mv RMS min.; 60 db.

LINEARITY
Deviation 0.25 % of bandwidth or better.

STABILITY
Drift will not exceed 0.3 % of bandwidth over 36 hour period.

TEMP-R-TAPE®

**CLASS H INSULATION
FOR -100°F TO 500°F APPLICATIONS
POSSESSES EXCELLENT ELECTRICAL
AND MECHANICAL PROPERTIES**

Choose the right Temp-R-Tape for your job from a variety of types which combine some form of Teflon*, Fiberglas or Silicone Rubber backing with a silicone polymer adhesive. Temp-R-Tapes are all pressure-sensitive, even those which are thermal curing, and adhere securely to most materials, including Teflon, at extremely high temperatures. Each of these versatile tapes possess a superior combination of electrical, mechanical and physical properties suitable for a variety of applications where high dielectric strength, thermal stability, moisture resistance, durability, low coefficient of friction, non-stick properties, non-corrosiveness, non-aging characteristics or fuel resistance may be required.

TYPICAL USES:

ELECTRICAL — slot lining; interlayer and interphase insulation; harness bundling; splicing; wrapping for microwave components, transformer coils, capacitors and high voltage cables.

MECHANICAL — facings for film guides in electronic instruments, heat sealing bars, chutes, guide rails, and for protection for metals and other materials being chemically cleaned or coated.

AVAILABLE FROM STOCK:

¼" to 2" widths, 18 yd. and 36 yd. rolls and 12" width on liner by lineal yard. Special roll widths slit to order. Temp-R-Tape is sold nationally through distributors.

FREE SAMPLE and folder — write, phone or use inquiry service.

ELECTRICAL AND INDUSTRIAL SPECIALTY TAPES

CHR CONNECTICUT HARD RUBBER CO.

*duPont TM

Main office: New Haven 9, Connecticut

presentation of the operational block diagram.

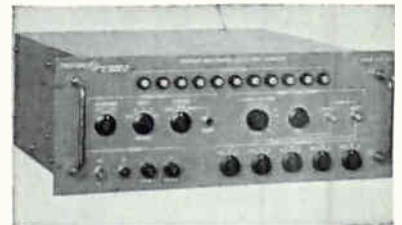
CIRCLE 466 ON READER SERVICE CARD



**Spark Gap
CERAMIC-METAL**

EDGERTON, GERMESHAUSEN & GRIER, INC., 160 Brookline Ave., Boston 15, Mass. The GP-12 triggered spark gap was designed as a replacement for hydrogen thyratrons in electronic crowbar applications for the protection of radar modulators, h-v oscillators, and heavy power supplies. It has a high voltage holdoff capability of 25 Kv, is capable of handling high peak currents in excess of 10,000 amperes, has low trigger energy requirements.

CIRCLE 467 ON READER SERVICE CARD



**Frequency Calibrator
FOR TELEMETERING**

PANORAMIC RADIO PRODUCTS, INC., 520 S. Fulton Ave., Mount Vernon, N. Y. Simultaneous 11 point telemetering frequency calibrator, model TMC-411E, features all-electronic operation and 0.002 percent frequency accuracy. Unit provides 11 equally spaced calibration frequencies for each IRIG f-m/f-m channel including 15 percent channels A-E in a single 7 in. high package.

CIRCLE 468 ON READER SERVICE CARD

**Test Equipment
FOR SEMICONDUCTORS**

MOLECULAR ELECTRONICS, INC., a subsidiary of Precision Circuits,

C
S
C

ALL-TRANSISTORIZED DC VOLTMETER

ACCURACY TO
± .025%
+5 UV ABSOLUTE

for \$595*



MODEL DC-110A
PRECISION VOLTMETER

For premium accuracy at much-less-than-premium price, the Model DC-110A provides a rugged, compact, completely self-contained, precision DC Voltmeter that is ready to use the moment it is turned on. It's completely transistorized, with an ultra-stable zener package for reference. Simple to operate, the DC-110A is *self-calibrating* and easily portable between laboratory and production line.

range: 0 to 1000 volts D.C.

stability: ± .005% from 100 to 130 V.A.C.

temp. stability: 3 PPM/°C.

Model DC-100A: similar to DC-110A except for ± .05% accuracy and ± 5 PPM/°C. temperature stability... Price: 475.*

CSC offers a wide selection of performance-proved, readily available precision voltmeters, volt-amp meters, wheatstone bridges and regulation monitors. *For complete information, contact any CSC representative (shown on right)... or write directly to CSC for technical bulletin E-1313-2A.*

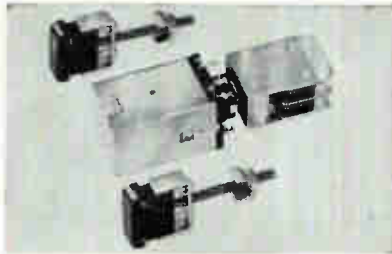
* F. O. B. ALHAMBRA, CALIF.
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

C Calibration
S Standards
C Corporation

CIRCLE 326 ON READER SERVICE CARD
March 10, 1961

Inc., New Rochelle, N. Y., introduces four types of semiconductor-device test equipment. They include: an in-circuit test set, which measures both transistors and diodes in electronic circuits; a general purpose test set, which can measure a-c and d-c parameters for both diodes and transistors, and can detect leakage currents down to 1.5 μ a (full scale); and alpha-cutoff and gain-bandwidth test sets, which feature direct-reading scales with simple calibration.

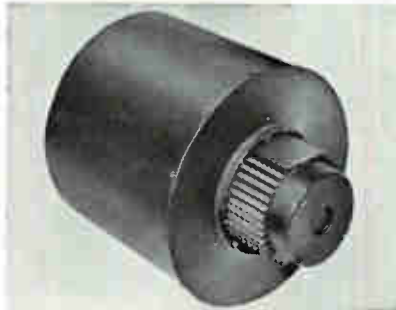
CIRCLE 469 ON READER SERVICE CARD



Pushbutton Switch LIGHTED TYPE

LICON SWITCH & CONTROL DIV., Illinois Tool Works, 6606 W. Dakin St., Chicago 34, Ill. The panel-mounted 04-111220 combines a panel light indicator with a double-pole subminiature switch module in a compact package only $\frac{1}{4}$ in. sq by 3 $\frac{1}{8}$ in. long. Miniature lamps project through colored filters onto the switch's display screen. The display screen, when pushed, serves as actuator for a pair of tiny switches.

CIRCLE 470 ON READER SERVICE CARD



Multistage Blowers LOW NOISE LEVEL

AIR MARINE MOTORS, INC., Bayview Ave., Amityville, L. I., N. Y., announces multistage blowers designed to meet the basic requirements of continuous, quiet duty and

C
S
C

ALL-TRANSISTORIZED DC VOLTMETER

ACCURACY TO
± 0.01%
+5 UV ABSOLUTE

for \$985*



MODEL DC-200AR
PRECISION VOLTMETER

The Model DC-200AR is the most precise differential voltmeter to be found—unmatched in reliability, unbeatable in price. It is compact and lightweight... uses transistors and zener diodes exclusively... is *self-calibrating*... and warms up completely in less than 30 minutes. Here are a few typical specifications to check against your requirements:

range: 0 to 1000 volts D.C.

pot accuracy: ± 0.002%

temp. stability: 2 PPM/°C. from 10 to 40°C.

regulation: ± 0.001% for a 10% line change

long term stability: reference and potentiometer better than .003%

Complete information is available from any of these CSC Representatives:

QED Electronic Sales, Inc. Mt. Vernon, N.Y.
Holdsworth & Company Lansdowne, Pa.
Stanley Enterprises Seattle 8, Wash.
Smith-Dietrich Sales Co. Inglewood, Calif.
N. S. Brown Associates Dallas 30, Texas
The Jay Company Arlington, Va.
Charles Winick Company Schenectady, N.Y.
Frazar & Hansen (Export) . . . San Francisco 11, Calif.

Or write directly to CSC for technical bulletin E-1313-2B.

* F. O. B. ALHAMBRA, CALIF.
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

C Calibration
S Standards
C Corporation

A subsidiary of ROYAL INDUSTRIES, INC.
1021 Westminster Ave., Alhambra, Calif.

CIRCLE 245 ON READER SERVICE CARD 245

RED HEAD* Triumph

WITH *New* CONCEPT**

BY WEST-CAP



SUB-MINIATURE CERAMICS

FOR **HIGH PRODUCTION** and
HIGH RELIABILITY

TO MIL-C-11015 /18 /19 (USAF) 200 VDC (NO DERATING) —55° C
TO ±150° C 47 THROUGH 10,000 MMF

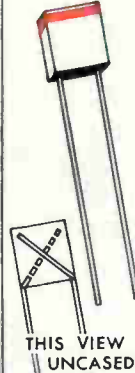
SIZES { .2 x .2 x .1 through 1,000 MMF
.3 x .3 x .1 through 10,000 MMF

NOW AVAILABLE WITH AXIAL LEADS, SAME PHYSICAL SIZES.
CASED OR UNCASED

Featuring

- NEW MOLDED pastel grey CASE—IS FIRE RESISTANT and has minimum HEAT ABSORPTION CHARACTERISTICS.
- NEW CONCEPT** —introduces PRECISE CONTROLLED MARGINS (both sides) OF ELECTRODES. Eliminates short circuits, breakdowns, flash over and silver migration across edges when subjected to 4 times rated voltage. ALL UNITS TESTED for 100% performance before being shipped.
- WRITE FOR SAMPLE OF THIS DOUBLE MARGIN ELECTRODE — A DOUBLE FACTOR TO ASSURE RELIABILITY. It is far superior to any single margin unit used today.

TRULY A
RED HEAD*



THIS VIEW
UNCASED

SEE IRE BOOTH 2523

REGD. T.M. PAT. APPLIED FOR

1509 FIRST STREET,
SAN FERNANDO, CALIFORNIA

EMpire
1-8681



CIRCLE 327 ON READER SERVICE CARD

long life. Typical applications are pressure requirements to 1 psi and delivery ability to 100 cfm. Low noise level of this series makes them ideal for computer application. Specifications: 60 cps or 400 cps; 1 phase or 3 phase; to 440 v; 10 in. o-d to lengths of 14 in.; ambient range -55 C to +85 C.

CIRCLE 471 ON READER SERVICE CARD

Vibration Exciters CERAMIC MAGNET

MB ELECTRONICS, a division of Textron Electronics, Inc., 781 Whalley Ave., New Haven 8, Conn. Series of permanent magnet shakers incorporates a ceramic magnet which exhibits desirable coercive force and operating life characteristics.

CIRCLE 472 ON READER SERVICE CARD

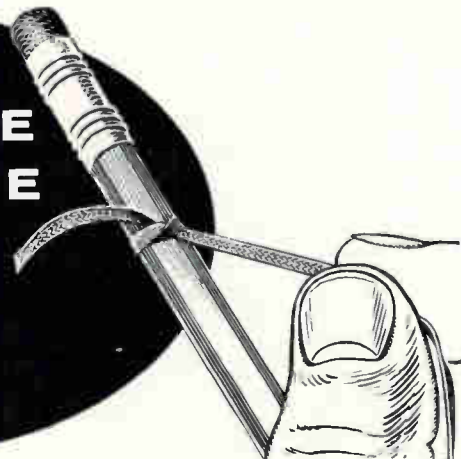


Slicing Machine REDUCES SCRAP LOSS

THE DOALL CO., Des Plaines, Ill. The I/D Micro-Slicer cuts scrap loss in half and yields many more wafers per ingot. Material savings in cutting rare metals used in the semiconductor industry are achieved by cutting with the interior perimeter of a doughnut-shaped wheel. This wheel is 0.08 in. thick compared with two to three times that thickness for conventional peripheral sawing.

CIRCLE 473 ON READER SERVICE CARD

**GUDELACE
TAKES THE
SLIPS
OUT OF
LACING**



Try this simple test. Tie a piece of Gudalace around a pencil in a half hitch and pull one end. Gudalace's flat, nonskid surface grips the pencil—no need for an extra finger to hold Gudalace in place while the knot is tied!

Gudalace makes lacing easier and faster, with no cut insulation, or fingers—no slips or rejects—and that's *real* economy. Gudalace is the original flat lacing tape. It's engineered to *stay* flat, distributing stress evenly over a wide area. The unique nonskid surface eliminates the too-tight pull that causes strangulation and cold flow. Gudalace is made of sturdy nylon mesh, combined with special microcrystalline wax, for outstanding strength, toughness, and stability.

Write for a free sample and test it yourself. See how Gudalace takes the slips—and the problems—out of lacing.

GUDEBROD

BROS. SILK CO., INC.

Electronic Division
225 West 34th Street
New York 1, N.Y.

Executive Offices
12 South 12th Street
Philadelphia 7, Pa.

Visit Gudebrods Booth 4025 at the IRE Show

Printed Circuitry METAL BASE

ELECTRALAB PRINTED ELECTRONICS CORP., Industrial Center, Needham Heights 94, Mass., announces Dielox printed circuitry, which utilizes dielectric oxides on prefabricated metal bases. This may range from aluminum oxide on aluminum to magnesium oxide on steel. Dielox printed wiring is designed for long

term, continuous operation at elevated temperatures up to and in excess of 900 F. There is no limitation on size, and Dielox boards are not subject to breakage or warp.

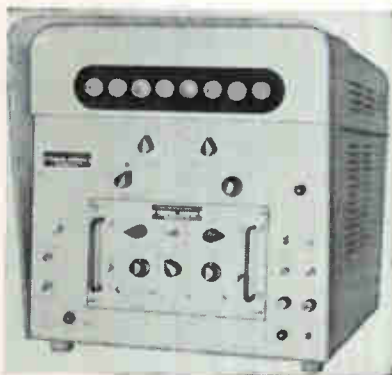
CIRCLE 474 ON READER SERVICE CARD



Switching Time Meter AUTOMATIC UNIT

LUMATRON ELECTRONICS, INC., 116 County Courthouse Rd., New Hyde Park, L. I., N. Y. Measurements from 0.5 nsec to several μ sec can be made at rates up to 3,600 tests per hr with the model 400 series automatic switching time test set. Risetime, falltime, storage and delay characteristics are read directly on a meter with accuracy of better than 5 percent. The test results can be converted to digital information, permitting automated read-out.

CIRCLE 475 ON READER SERVICE CARD



Electronic Counter VERSATILE UNIT

LAVOIE LABORATORIES, INC., Morganville, N. J. The LA-80 counter features a directly coupled in-line readout. It utilizes a true decade system which makes binary conversion unnecessary. Use of beam

March 10, 1961

EMCOR® Standard Cabinets



offer
more

advance
design
and
quality
construction
features!



7" high, 16 gauge steel center strut for ease of equipment mounting and greater over-all structural strength.



14 gauge steel frame construction assures greater ruggedness and rigidity.



Electronically controlled spot welds assure superior strength.



Jig assembly line fabrication provides rigid quality control and assures compatibility of frames.



Key Heliarc* Welds provide for greater structural rigidity.

Continuing research and development by the Roy C. Ingersoll Research Center maintains EMCOR leadership in metal cabinetry.

*Registered Trademark Linde Air Products Co.

From single cabinets to major systems, the hundreds of basic frames of the EMCOR Modular Enclosure System meet your height, width, depth and structural enclosure needs.



WRITE TODAY FOR CONDENSED CATALOG 106

Originators of the Modular Enclosure System

INGERSOLL PRODUCTS

Division of Borg-Warner Corporation
630 CONGDON • DEPT. 1242 • ELGIN, ILLINOIS



CIRCLE 247 ON READER SERVICE CARD 247

... Every component in the U.S. Navy's TARTAR, newest supersonic surface-to-air guided missile must meet the highest standards for statistical reliability.

No exception is the Bristol Syncroverter* chopper used in the TARTAR's guidance system. The TARTAR, produced for the Bureau of Naval Weapons by Convair (Pomona) Division of General Dynamics Corporation, is slated to form the primary anti-aircraft weapon aboard destroyers and secondary anti-aircraft batteries aboard cruisers.

The Bristol Syncroverter chopper has a long history as a component in U.S. guided missiles. It's the ideal miniature electromechanical chopper for use in d-c analog computers or wherever utmost reliability is required.

BILLIONS OF OPERATIONS have been completed without a failure on Bristol's continuing life tests—aimed at improving the Syncroverter's already superlative characteristics. Just one sample: A group of five choppers, with 400 cps drive and 12v, 1 ma resistive contact load have been going for more than 26,000 hours without failure. That's more than 2.96 years continuous operation or more than 37 billion complete cycles!

No matter what your chopper requirements, we're sure you can find the model you need among the wide selection of Syncroverter choppers and high-speed relays available... including low-noise, external coil types. For complete data, write: The Bristol Company, Aircraft Equipment Division, 150 Bristol Road, Waterbury 20, Conn.

O.15

*T.M. Reg. U.S. Pat. Off.

BRISTOL FINE PRECISION
INSTRUMENTS FOR OVER SEVENTY YEARS

BRISTOL
chopper
helps put

Navy
TARTAR on
target



actual size



Come visit us at Booth 1322 at the IRE Show

switching tubes eliminates germanium diodes and results in minimum maintenance and down time. Time-base stability is one part in 10⁶ per day. Basic frequency range is 10 cps to 10 Mc.

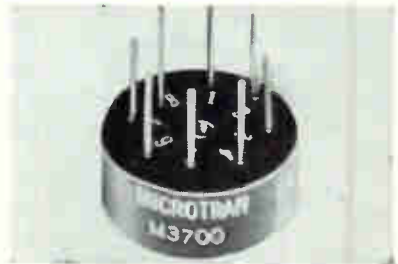
CIRCLE 476 ON READER SERVICE CARD



Circuit Packages FOR DIGITAL SYSTEMS

DIGITAL EQUIPMENT CORP., Maynard, Mass. Featuring short circuit-proof static logic and logic levels which are fully compatible with DEC's 500 Kc and 5 Mc patch-cord and plug-in circuit modules, the 10 Mc package array includes inverters, flip-flops, multivibrator and crystal type clocks, pulse amplifiers and delay lines. Prices range from \$97 to \$173.

CIRCLE 477 ON READER SERVICE CARD



Toroids EPOXY MOLDED

MICROTRAN CO., INC., 145 E. Mineola Ave., Valley Stream, N. Y., has developed epoxy molded toroids custom engineered to specifications in the following ranges: frequency range, 20 cps to 100 Kc; power level, up to 150 w; operating temperature range, -65 to 130 C; size range, approximately 1/8 to 4 in. o-d; d-c range, depending on the size, frequency and power level.

CIRCLE 478 ON READER SERVICE CARD

Calibration Console HIGHLY ACCURATE

WESTON INSTRUMENTS, Division of Daystrom, Inc., 614 Frelinghuysen Ave., Newark, N. J., announces an

instrument capable of calibrating d-c voltmeters and ammeters to an accuracy of 0.05 percent of indicated value. Designed for use in checking and calibrating all types of portable, panel, switchboard, and recording type instruments the console can be used to automatically divide any d-c range into as many as 15,000 steps.

CIRCLE 479 ON READER SERVICE CARD



Plastic Product FOR PRINTED CIRCUITS

GARLOCK ELECTRONIC PRODUCTS, Camden 1, N. J., announces flexible printed circuitry. The outstanding electrical, physical and thermal properties of Teflon FEP have been incorporated into a new circuit design concept which offers greater design freedom, maximum reliability, lower installation costs and package size and weight reduction. Use of Teflon as the insulation material also offers a wide temperature range of from -122 F to +400 F. Dielectric constant of 2.1 ± 0.1 remains stable throughout a frequency range of 10^2 to 10^8 cps.

CIRCLE 480 ON READER SERVICE CARD



Coil Winding Machine TRANSISTORIZED COUNTER

UNIVERSAL MFG. CO., INC., 1168 Grove St., Irvington, N. J. Model S toroidal coil winding machine in-

March 10, 1961



FACSIMILE RECORDER REPRODUCER...A TOTAL RECALL GRAPHIC MEMORY

The AIRCOM Modernization Program, Project Quick Fix, is aimed at improving the entire communications network which links United States military and weather installations throughout the world. An essential part of that program is the Crosby-Teletronics magnetic tape Facsimile Recorder Reproducer. It receives and stores all types of vital graphic information, retransmitting it, automatically or on command, when transmission conditions are more favorable or proper routes available.

If you have an application requiring reliable long-range transmission of maps, weather information or any other graphic material, this advance design, electronic "brain" may be your answer. Write for information on Model RR-290, Facsimile Recorder Reproducer (GXH-4). It is another example of Crosby-Teletronics Corporation leadership in test equipment, vacuum research and

communications



Crosby-Teletronics Corporation • 54 Kinkel Street • Westbury, Long Island, New York

CIRCLE 249 ON READER SERVICE CARD 249

An announcement

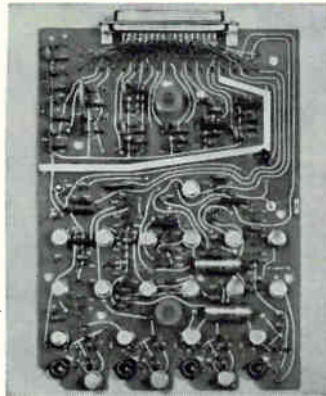
for the 1 engineer in 20 who is interested in new concepts of solutions to problems in programming, timing, and memory circuits (Read this in 55 seconds)

what is Incremag*

The component is a saturable magnetic core pulse-counting memory, or storage unit — The sub-system is a transistorized magnetic counting circuit that delivers an output pulse after having received a predetermined number of periodic or random input pulses.

areas of application

Clock and sequence timer control of both cameras in the TIROS I and II satellites to scaling, computing memory, coding, and control applications in industrial instrumentation and computer systems.



INCREMAG
Satellite Programmer



Commercial-Military INCREMAG Component

how is it used

As a counter, memory (storage), programmer (control), timer, frequency divider, as a component or circuit system.

interesting characteristics

- Extreme Reliability: with $\pm 10\%$ voltage and over 150°C range
- Counting Rate: up to 100,000 pulses/sec (random or periodic)
- Standby Power: requirements are negligible (microwatts)
- No Loss of Prior Count: even under conditions of power failure
- Maximum Counts Per Stage: up to 16 (as many stages as required, in multiple or additive)
- Compact: only $1/2$ cu. in. per counting stage
- Rugged: meets all existing applicable Military Specifications

*Patent No. 2897380 Registered Trademark

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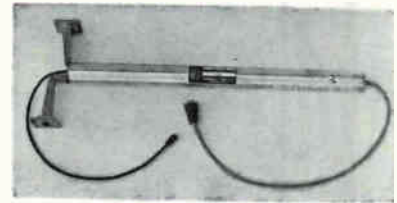
Write for complete technical data and application information on INCREMAG

CENTRAL RESEARCH LABORATORIES
GENERAL TIME CORPORATION

Progress Drive — Stamford, Conn. — DAvis 5-2691

incorporates a completely transistorized in-line digital read-out electronic counter. This, along with the many different sized heads, make it extremely versatile. The counter features four in-line digital read-outs, which means there are four squares through which numbers flash, or are projected onto a screen, indicating the number of turns being applied to the coil.

CIRCLE 481 ON READER SERVICE CARD



T-W Tubes

EIGHT MODELS

HUGGINS LABORATORIES, INC., 999 E. Arques Ave., Sunnyvale, Calif., introduces eight traveling wave tubes. Illustrated is the HA-82, a 10 to 20 Gc frequency range, solenoid focused broadband twt amplifier with 1 mw min power output, and 25 db min small signal gain. Other models range in frequencies from 0.5 to 1 Gc to 7 to 14 Gc.

CIRCLE 482 ON READER SERVICE CARD



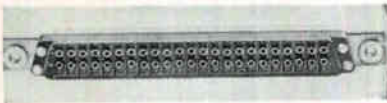
Resonant Relays

& STABILIZER UNITS

STEVENS-ARNOLD, INC., 7 Elkins St., South Boston 27, Mass., announces tuning fork resonant relays—miniature, plug-in components installed at the receiving end of low cost selective calling or remote control systems. These vibrating reed relays operate only when energized at their rated frequency. This allows individual control of up to thousands of functions at the receiving end of a cable pair or a radio channel. Available in frequencies from 150 to 1,000 cps. The tuning fork

oscillator stabilizer is installed at the transmitting end.

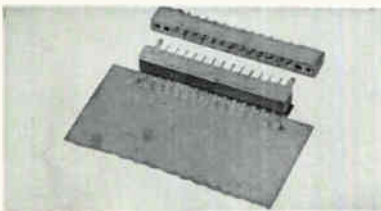
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Right Angle Connector FOR P-C BOARDS

WINCHESTER ELECTRONICS INC., Willard Road, Norwalk, Conn. Right angle p-c connector employs either a removable crimp type receptacle or a dual terminal receptacle that accepts taper pins (AMP No. 53). Both mate with standard W series plugs that contain right angle pin contacts for dip soldering to p-c board. The WC23SAA has a one-piece molding insert of Monobloc construction that eliminates internal creepage paths and reduces moisture and dust pockets.

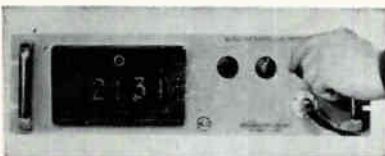
CIRCLE 484 ON READER SERVICE CARD



P-C Connectors PLUG AND SOCKET

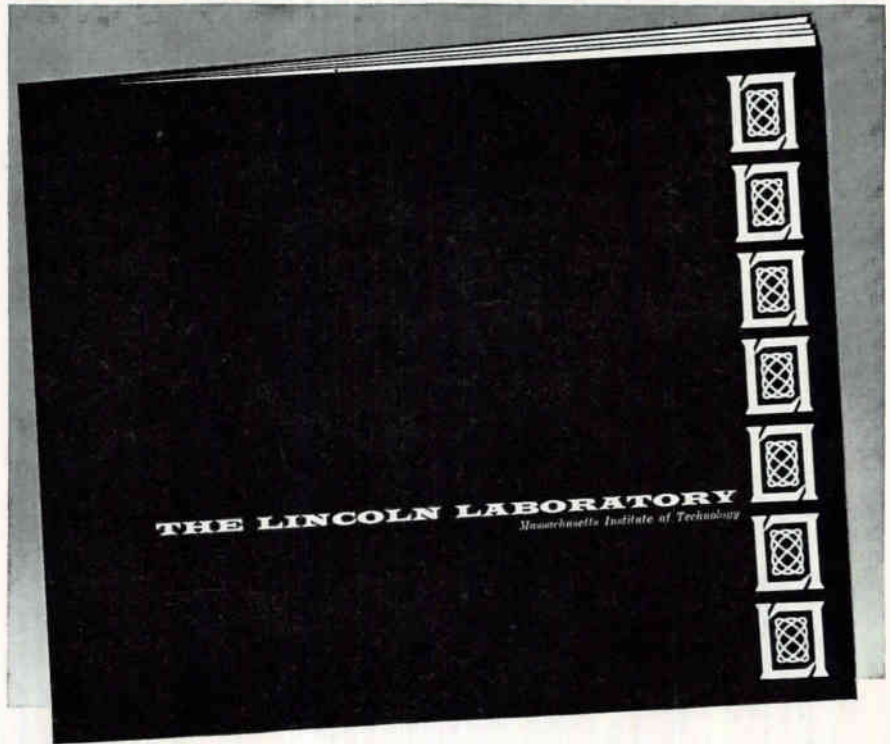
CONTINENTAL CONNECTOR CORP., 34-63 56th St., Woodside 77, N. Y. Plug and socket right angle p-c connectors are available in a variety of contact sizes from 4 to 38. All dip solder to a p-c board at right angle to the plug and receptacle contacts. Terminations include solder cups, turret terminals, wire-hole solder lugs, or taper pin terminations for solderless wiring.

CIRCLE 485 ON READER SERVICE CARD



Millivoltmeter FOUR-DIGIT

NON-LINEAR SYSTEMS, INC., Del Mar, Calif. Model 60 millivoltmeter has a range of ± 99.99 mv for making



The Lincoln Laboratory, Massachusetts Institute of Technology, announces a major expansion in its program. We urgently request the participation of senior members of the scientific community in our programs in:

RADIO PHYSICS and ASTRONOMY SYSTEMS:

- Space Surveillance
- Strategic Communications
- Integrated Data Networks

NEW RADAR TECHNIQUES SYSTEM ANALYSIS

COMMUNICATIONS:

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- Psychology
- Theory

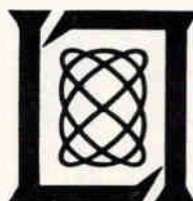
INFORMATION PROCESSING

SOLID STATE Physics, Chemistry, and Metallurgy

- A more complete description of the Laboratory's work will be sent to you upon request.

Research and Development

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Massachusetts Institute of Technology
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WBD CERAMISEAL[®]

...from -75° to +600°C!

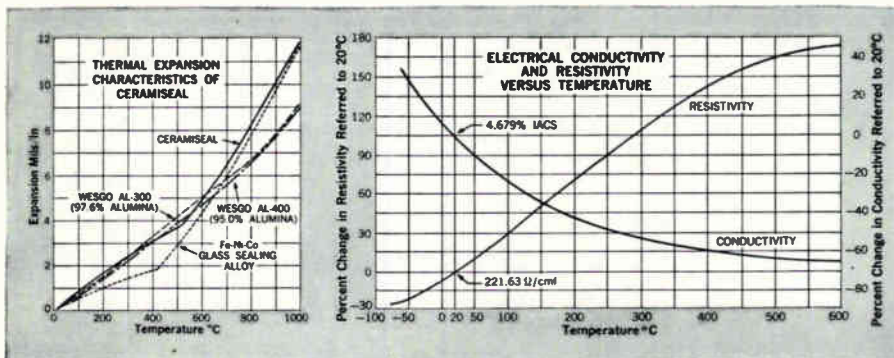


The Better Metal for HIGH ALUMINA CERAMIC SEALING

CERAMISEAL (U. S. Pat. No. 2,960,402)

Chemical Analysis: 25% Cobalt, 48% Iron, 27% Nickel

Specially designed by WBD for ceramic-to-metal sealing, CERAMISEAL alloy has expansion characteristics closely matching those of high temperature alumina ceramics. Low thermal conductivity, approximating that of ceramics, minimizes thermal stresses during rapid heating and cooling cycles. CERAMISEAL is readily brazed, deep drawn and machined; is supplied (air or vacuum melted) in wire or strip.



Call or write for Ceramiseal Bulletin and information on other WBD Sealing Alloys.

WILBUR B. DRIVER COMPANY
NEWARK 4, NEW JERSEY — Telephone: HUmboldt 2-5550

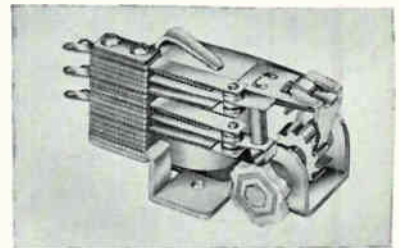
In Canada: Canadian Wilbur B. Driver Co., Ltd., 50 Ronson Drive, Rexdale (Toronto)



PRECISION RESISTANCE, ELECTRONIC AND MECHANICAL ALLOYS FOR ALL REQUIREMENTS

low level measurements without a preamplifier. Its scale factor (span) control permits making any value from 10 to 100 mv appear as 99.99 in the readout. Input impedance is 10 megohms, accuracy is ± 0.1 percent of reading or 1 digit, and precision is ± 0.01 percent of full scale. Price is \$1,625.

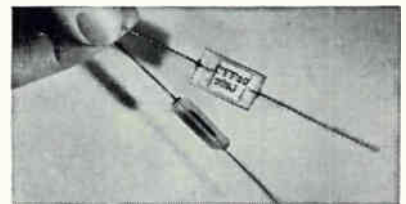
CIRCLE 486 ON READER SERVICE CARD



Impulse Relay LONG LIFE

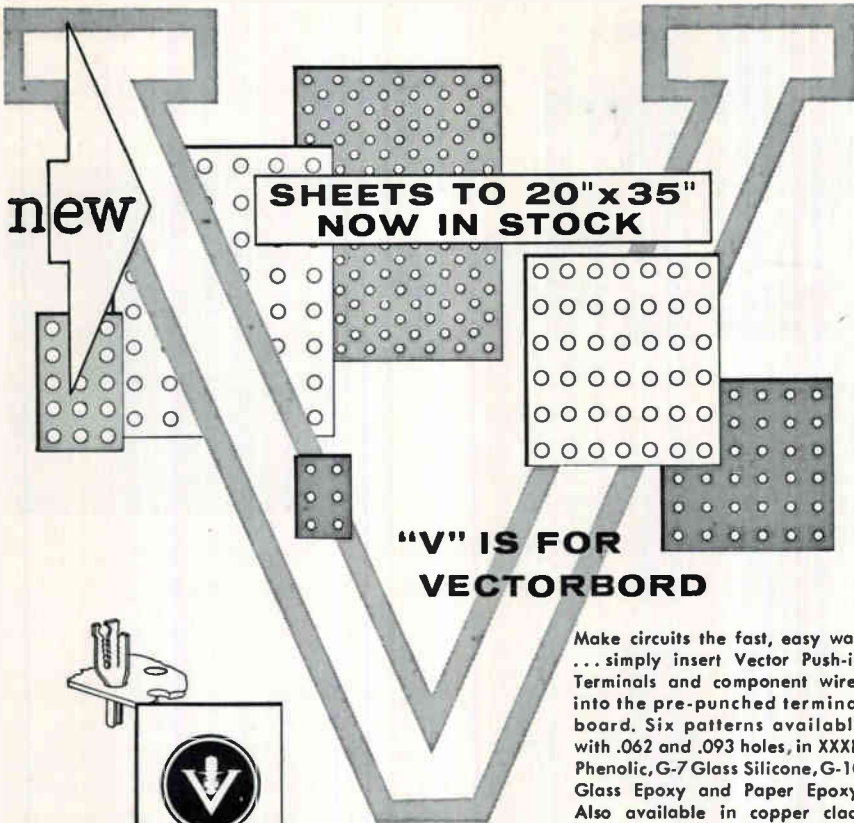
GUARDIAN ELECTRIC MFG. CO., 1550 W. Carroll Ave., Chicago 7, Ill. Series 670 impulse relay features long-life, trouble-free operation well in excess of one million steps. Each momentary impulse (up to 10 steps per sec) causes relay to reverse its cam actuated contacts. Contact arrangements up to dpdt, with ratings to 1,500 w noninductive, or up to 20 amp locked motor current, motor load control on 115 v, 60 cps.

CIRCLE 487 ON READER SERVICE CARD



Glass Capacitor FUSION-SEALED

CORNING ELECTRONIC COMPONENTS, Bradford, Pa. The CYF-20 fusion-sealed moisture resistant glass capacitor has a capacitance range of 560 to 5,100 μf . It is used in high reliability systems such as missiles, nuclear equipment, aircraft and computers. After 2,000 hours of operation at 125 C with 150 percent of rated voltage, capacitance change is less than $\frac{1}{2}$ percent at 1 Mc or 1 Kc. Temperature coefficient of capacitance is 140 ± 25 ppm/deg



Write for complete information to
VECTOR ELECTRONIC COMPANY
 1100 FLOWER STREET, GLENDALE 1, CALIFORNIA
 TELEPHONE: CHapman 5-1076
 Visit our Booth #1513 at the March IRE Show
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SKL WIDE BAND CHAIN AMPLIFIERS

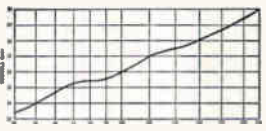
Designed to achieve stable gain and faithful reproduction over great bandwidths, SKL amplifier models are available for a broad range of applications in laboratory and systems work.



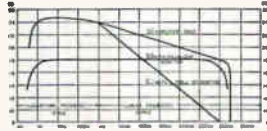
MODEL 202D



MODEL 222



MODEL 206



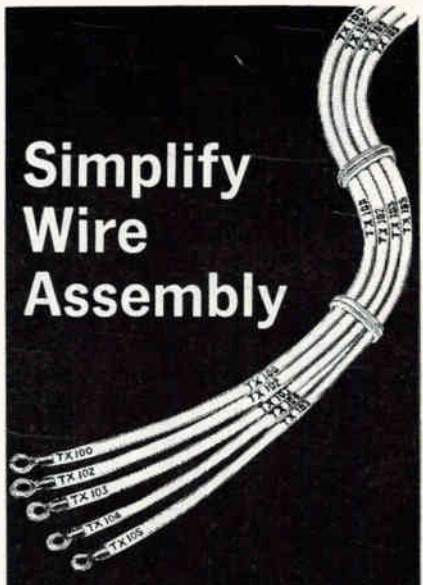
CHARACTERISTICS	MODEL 202D	MODEL 206	MODEL 211C	MODEL 222
Bandwidth	1kc - 210 mc	600 cps - 320 mc	15 mc - 100 mc	40 mc - 216 mc
Voltage Gain	20 db	18 db	33 db	28 db
Maximum Output	4 volts rms	6 volts rms	*4.2 volts peak	*4.2 volts peak
Impedance	200 ohms	200 ohms	75 ohms	75ohms

*0.1 volt, with less than 1% intermodulation distortion, for multi-channel operation.

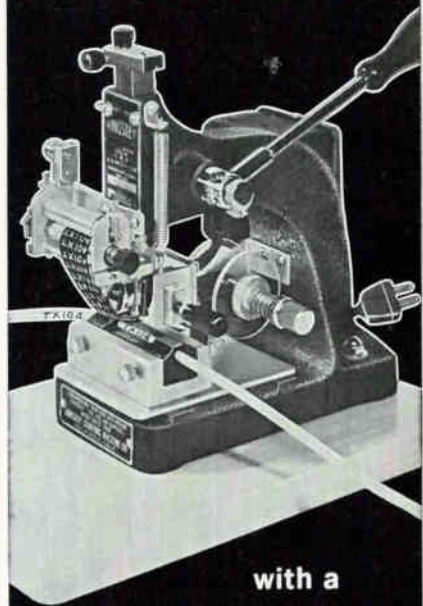
Write for further information to:

SKL SPENCER-KENNEDY LABORATORIES, INC.
 1320 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

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Simplify Wire Assembly



with a KINGSLEY Wire and Tube Marking Machine

Now you can mark each wire or piece of plastic tubing with its own circuit number...quickly...economically, right in your own plant!

You reduce wire inventories because you need only one color of wire for as many circuits as necessary.

Simplify your assembly methods and speed production with the same machine that has proved so successful in the aircraft and missile industries. Write for details.

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**crystal controlled
frequency sources
and filters**

spend your
IRE SHOW TIME
to advantage

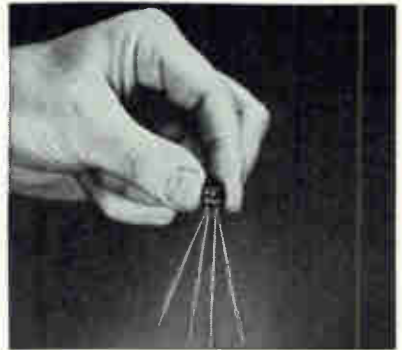
**Stop at
BOOTH 1820**

**HILL
ELECTRONICS
INC.**

MECHANICSBURG, PENNSYLVANIA

C over the operating range of -55°C to 125°C .

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Pulse Transformers TRANSISTOR-SIZED

POLYPHASE INSTRUMENT CO., East Fourth St., Bridgeport, Pa., announces pulse transformers measuring only $\frac{1}{8}$ in. diameter by $\frac{1}{4}$ in. high for high density transistor circuit packages. The Pico-Tran series B350 pulse transformers will give pulse widths from less than 1 to over $16 \mu\text{sec}$ plus other electrical characteristics of larger units. They can be used in pulse coupling or blocking oscillator circuits.

CIRCLE 489 ON READER SERVICE CARD



Band-Pass Filter HIGH POWER

FREQUENCY STANDARDS, P. O. Box 504, Asbury Park, N. J. This band-pass filter is capable of handling a peak transmitted power of 3 to 5 Mw with an average power of 15 Kw. Insertion loss is 0.15 db max. It is ideally suited for high power radar transmitters and space communications systems. Unit has a

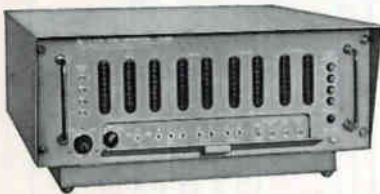
TIME TEAM

HOW EECO'S ALL-STAR LINEUP OF TIME CODE GENERATORS WINS ON EVERY POINT

Look at these unparalleled advantages offered by EECO Time Code Generators! Frequency stability, 3 parts in 10^8 , based on extremely stable crystal oscillator. 100% plug-in circuits to keep generator working for you day in and day out. Emitter-follower low-impedance outputs for long-distance transmission. Wider operating-temperature stability. Operable from aircraft power. Provision for external frequency standard. Auxiliary pulse rates.



EECO 801 BCD OUTPUT (24-BIT)



EECO 810 100 PPS CODE (36-BIT)

SEND FOR TIME CODE GENERATOR FILE 301

Model Number	Serial Code Format	Time Indication	Code Frame Length (bits)	Code Scan Rate (PPS)	Code Carrier Frequency (CPS)	Price (U.S. Santa Ana)
EECO 801	24-Bit, 24-hour, BCD	hr. min. sec.	1	25, 50, 100	1000	\$7500
EECO 802	17-Bit, 24-hour Binary (Eglin AFB)	hr. min. sec.	1	20, 100	1000	\$7000
	13-Bit, 24-hour, Binary (Patrick AFB)	hr. min. 1/4 min.	15	1	1000	
EECO 802M1	17-Bit, 24-hour, Binary (Atlantic Missile Range)	hr. min. sec.	1	100	1000	\$7000
EECO 802M2	17-Bit, 24-hour, Binary (Atlantic Missile Range)	hr. min. sec.	1	20, 100	1000	\$7000
			20	1		
EECO 803	20-Bit, 24-hour, BCD	hr. min. sec.	1	25	250	\$7500
EECO 804	20-Bit, 24-hour, BCD	hr. min. sec.	1	25	100 W/1000	\$7925
EECO 810	36-Bit, 365-day, BCD	day hr. min. sec.	1	300	1000	\$10,100
EECO 810M1	23-Bit, 365-day, BCD (R1C Member C Format Modified)		80	2	1000	\$10,100



Electronic Engineering Company of California

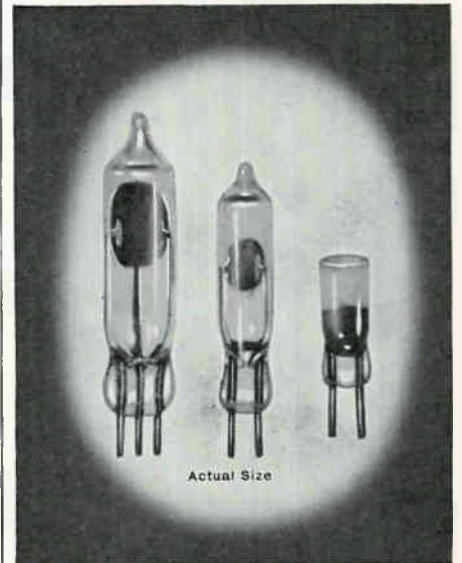
1601 East Chestnut Avenue • Santa Ana, California • Kimberly 7-5501 • TWX: S ANA 5263

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Actual Size

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CRYSTAL OSCILLATOR**
with transistorized,
proportional-controlled oven

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BOOTH 1439

REEVES-HOFFMAN

DIVISION OF DYNAMICS CORPORATION OF AMERICA

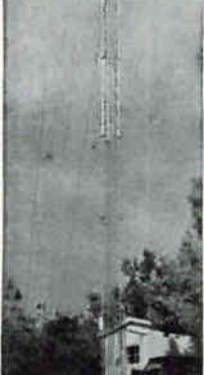
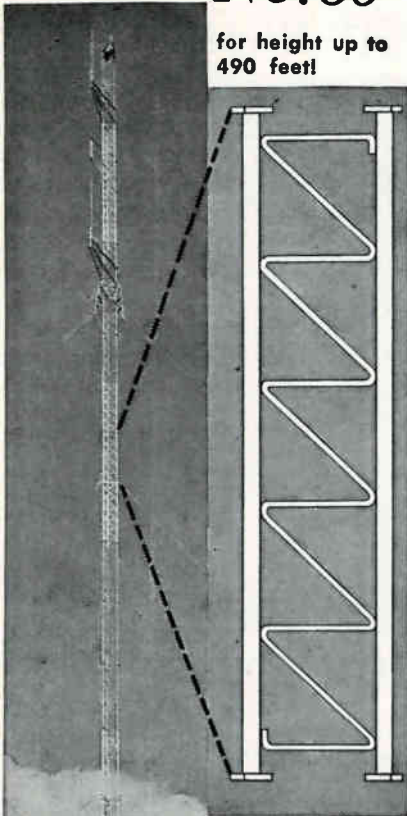
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Towers of All Kinds"**

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frequency of 400 Mc. Bandwidth is 8 percent to the three db points with rejection 50 db or greater at 1.15 F_o and 0.85 F_o.

CIRCLE 490 ON READER SERVICE CARD



Coil Turns Analyzer HIGH RELIABILITY

DELUXE COILS, INC., Wabash, Ind. Model 165 coil turns analyzer compares an internal universal standard against a production coil product, and rapidly provides coil turns error information to within 0.1 percent. It is said to reduce rejection of end products by providing precision quality count at component stages. Inline digital readout is provided on tabulator type push-button board with a maximum reading of 99,999 turns.

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UHF Oscillator ELECTRONICALLY SWEPT

MENLO PARK ENGINEERING, 711 Hamilton Ave., Menlo Park, Calif. Model 400 uhf electronically swept oscillator covers the 500 Mc to 1,100 Mc range. Output frequency is read directly from a dial calibrated to

IN LESS THAN 4 SECONDS

FROM THIS

TO THIS

OR THIS

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No accessories
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PIG-TAILORING eliminates:

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- Immediate cost recovery.

Pays for itself in 2 weeks

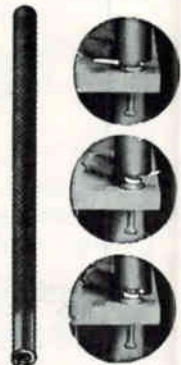
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- 22 Sizes

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electronics

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miniaturized filter series

Actual size: 3/4" x 3/4" x 1 1/8"
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ESC's new line of miniaturized low pass and high pass filters has an attenuation of less than 3 db at cutoff frequency (fco); greater than 40 db at and beyond 2.5 x fco (at and below 1/2.5 x fco for high pass filters). Insertion loss is less than 2 db. Temperature range: -20°C to +85°C. The units are hermetically sealed in a metal case and encapsulated in foamed resin. Meet all applicable Mil specifications.

LOW PASS				Cutoff Frequency (3db down)	HIGH PASS				
600Ω	1KΩ	2KΩ	10KΩ		20KΩ	10KΩ	2KΩ	1KΩ	600Ω
		AF152	AH152	AJ152	(1.5 kc)	ZJ152	ZH152		
		AF252	AH252	AJ252	(2.5 kc)	ZJ252	ZH252		
AC302	AD302	AF302	AH302	AJ302	(3.0 kc)	ZJ302	ZH302		
AC502	AD502	AF502	AH502	AJ502	(5.0 kc)	ZJ502	ZH502	ZF502	
AC752	AD752	AF752	AH752	AJ752	(7.5 kc)	ZJ752	ZH752	ZF752	
AC103	AD103	AF103	AH103	AJ103	(10 kc)	ZJ103	ZH103	ZF103	ZD103
AC153	AD153	AF153	AH153		(15 kc)	ZJ153	ZH153	ZF153	ZD153
AC203	AD203	AF203	AH203		(20 kc)	ZJ203	ZH203	ZF203	ZD203
AC403	AD403	AF403			(40 kc)	ZH403	ZF403	ZD403	ZC403
AC753	AD753	AF753			(75 kc)	ZF753	ZD753	ZC753	
AC104	AD104	AF104			(100 kc)	ZF104	ZD104	ZC104	
AC204	AD204				(200 kc)	ZF204	ZD204	ZC204	
AC304	AD304				(300 kc)	ZF304	ZD304	ZC304	

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Shaped to the hand . . . General Electric
Midget irons give:

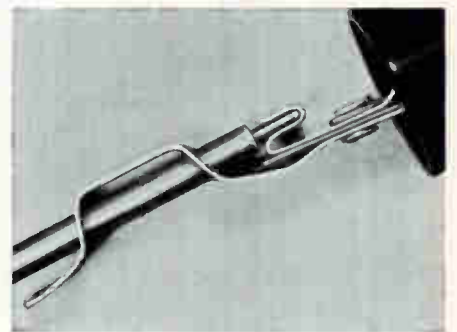
FASTER TIP AND HEATER CHANGE

General Electric's Midget soldering irons are now better than ever before. New clip arrangement saves time on your assembly line by making it easier to change the tip and heater. They're more streamlined and shaped to fit the operator's hand for maximum comfort.

Look at some other reasons why the G-E Midget iron is better:

- Low handle temperature for added operator comfort
- Tip and heater assembly will not "loosen up".
- Variety of long-life, ironclad tip sizes — 1/8 in. to 1/4 in.—with 6-volt, 18- to 35-watt ratings.

For more information on General Electric's full line of industrial soldering irons see your G-E Distributor, or call your nearby G-E Sales Office.



Simple clip arrangement makes it even easier to change the tip and heater on General Electric Midget soldering irons. Simply pull the entire assembly out of the handle, slip out the tip and heater assembly, replace it, and push assembly back into the handle. The iron is ready to go.

758-04

ACTUAL SIZE

See the redesigned Midget iron (available from authorized G-E Distributors May 1) at the IRE Show March 20-23 at General Electric Booth 2932.

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the number to remember

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KESTER "44" RESIN-CORE SOLDER



You get the fastest possible soldering action with Kester "44" Resin-Core Solder, created for today's high speed requirements. "44" Resin meets all applicable MIL and Federal specifications, latest amendments, Army, Navy, Air Force. Flux-residue non-corrosive and non-conductive. All alloys, cores and diameters... on 1 lb., 5 lb. and 20 lb. spools.

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Kester Solder COMPANY

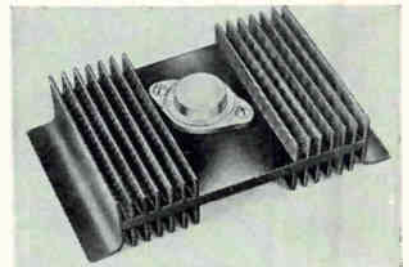
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±1 percent of reading. Sweep width is continuously adjustable and read on a direct reading meter. Internal square wave (400 to 1,200 cps) is provided for ease in making reflectometer, slotted line and antenna measurements.

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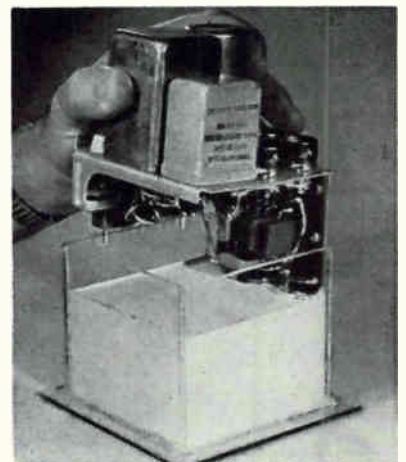


Heat Dissipaters

NATURAL CONVECTION

VEMALINE PRODUCTS CO., Franklin Lakes, N. J. Series 6071 heatsinks for transistors, diodes and rectifiers, are suitable for most applications. Mixed hole patterns are available. More than one semiconductor can be mounted on same cooler. The fins are serrated for maximum surface area to obtain utmost performance. The coolers are coined to minimize contact resistance (0.05 C 2 w). The heat sink compresses 150 sq in. of radiating surface.

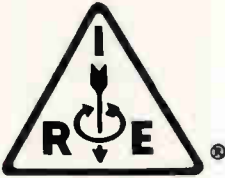
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Silicone Rubber

POURABLE MATERIAL

DOW CORNING CORP., Midland, Mich., announces Silastic RTV601 silicone rubber for deep section potting, filling, embedding and encapsulating of components or assemblies. The pourable material vulcanizes at

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March 10, 1961

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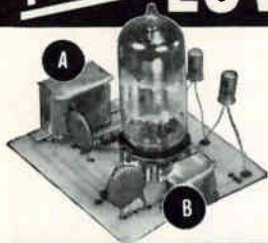
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CIRCLE 259 ON READER SERVICE CARD 259

MINIATURIZATION PLUS LOWER COST



Thin Versatile Co-Netic and Netic Magnetic Shielding Foils

Permit positioning foil-wrapped components A & B closely, minimizing interaction due to magnetic fields... making possible compact and less costly systems.

How thin Co-Netic and Netic foils lower your magnetic shielding costs:

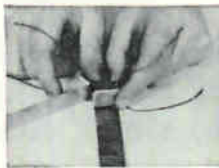
- 1) Weight reduction. Less shielding material is used because foils (a) are only .004" thick and (b) cut and contour easily.
- 2) Odd shaped and hard-to-get-at components are readily shielded, saving valuable time, minimizing tooling costs.

These foils are non-shock sensitive, non-retentive, require no periodic annealing. When grounded, they effectively shield electrostatic and magnetic fields over a wide range of intensities. Both foils available from stock in any desired length in various widths.

Co-Netic and Netic foils are successfully solving many types of electronic circuitry magnetic shielding problems for commercial, military and laboratory applications. These foils can be your short cut in solving magnetic problems.



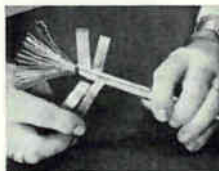
Cuts readily to any shape with ordinary scissors.



Wraps easily.



Inserts readily to convert existing non-shielding enclosures.



Shielding cables reduces magnetic radiation or pickup.



Wrapping tubes prevents outside magnetic interference.

room temperature to form solid rubbery sections of unlimited thickness. It cures without heat, pressure or moisture—even under totally confined air-tight conditions. After vulcanizing for 24 hr at about 77 F, parts or sections made from Silastic RTV601 can immediately be put into full service at temperatures from -100 F to 500 F.

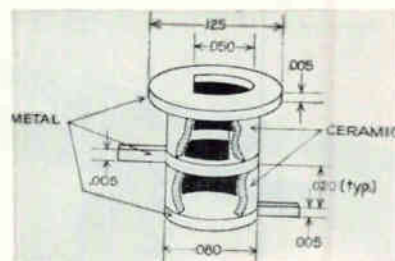
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Rack Cabinet FLEXIBLE UNIT

FALSTROM CO., 185 Falstrom Court, Passaic, N. J. Model FT-192-A standardized electronic rack cabinet is of heavy duty construction to provide for heavy loads and stable anchoring points for components. It is adaptable to a wide variety of uses with adjustable Unistrut channels to facilitate mounting slides or chassis. It has an adjustable ventilating system for cooling electrical equipment.

CIRCLE 495 ON READER SERVICE CARD



Transistor Housing HERMETICALLY SEALED

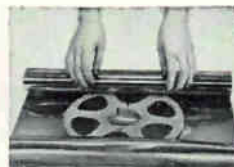
MITRONICS, INC., 1290 Central Ave., Hillside, N. J. Miniature hermetically sealed transistor housing is made from 96 percent alumina ceramic metallized with molybdenum manganese and braze sealed

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When accidentally exposed to unpredictable magnetic fields, presto!—your valuable data is combined with confusing signals or even erased.



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Composite photo demonstrating that magnetic shielding qualities of Rigid Netic Alloy Material are not significantly affected by vibration, shock (including dropping or bumping) etc. Netic is non-retentive, requires no periodic annealing.

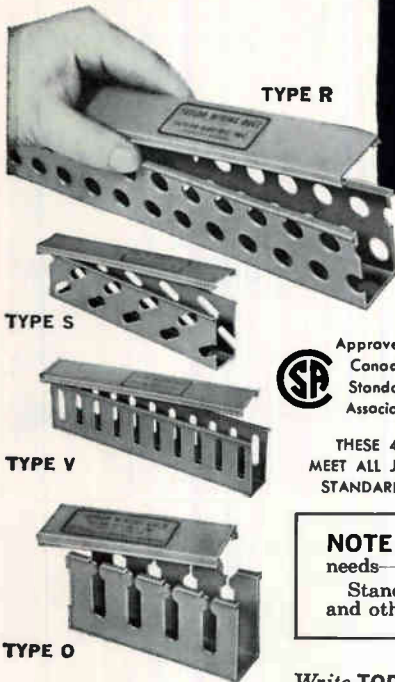
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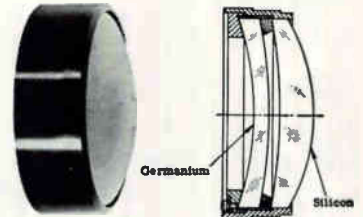
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SERVO IR Report

Achromat Lenses Extended to 1-14 Micron Range

Computer Program Optimizes Design, Speeds Fabrication of Lenses to User Specifications



SERVOCON® achromat lenses providing high resolution in the infrared spectrum are now available for selected wavelength bands in the broad 0.7-14 micron range.

Servo Corporation has instituted a new *Computer Program* to optimize achromatic lens design to user specifications. The computer program supplements existing facilities for design, fabrication and testing of infrared optical components and systems.

In addition to SERVOFRAX® (arsenic trisulfide glass), and conventional types of optical glass, optical components are being fabricated of lithium fluoride, calcium fluoride, silicon, germanium, and other IR transmitting materials.

From a simple infrared lens, to a complex infrared system . . . look to a Servo solution



Infrared Optics

Standard and special optical shapes available in all sizes and transmitting materials. Infrared wavelengths from less than 1 to more than 20 microns. Excellent refractive and reflective optics for research, laboratory, industrial, and military use.

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MODEL CK



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We'll be pleased to send you complete information. Write or phone:

Coil Winding Equipment Co.

OYSTER BAY N. Y. — WALnut 2-5660

to Kovar members. Brazed seals will withstand temperatures to 1,300 F so that subsequent welding or brazing can be performed without detrimental effect.

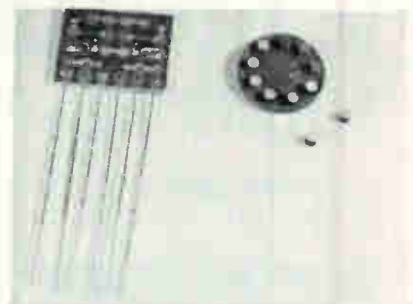
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Proportional Oven HIGH STABILITY

BULOVA WATCH CO., INC., 40-06 61st St., Woodside 77, N. Y. This proportional oven utilizes a stepless control system to assure a stability of 0.01 C at any given temperature. System includes temperature-sensitive bridge, two-stage transistorized amplifier, power transistor and integral heater. Oven eliminates such problems as noise, temperature cycling, power surges, and temperature drift.

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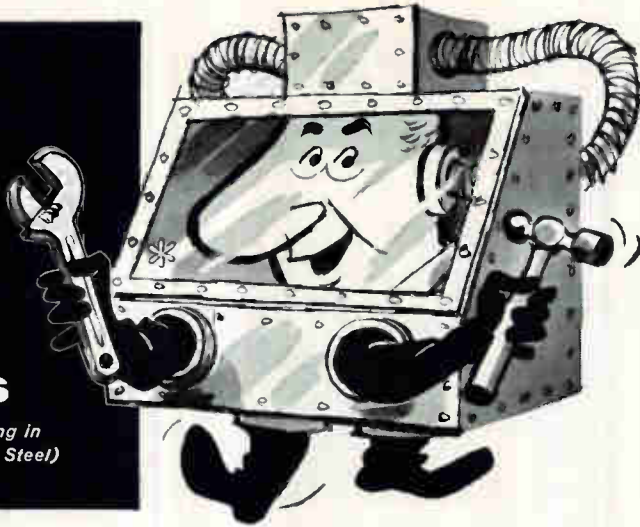


Microcomponent Pellets FOR FLEXIBLE DESIGN

P. R. MALLORY & CO. INC., Indianapolis 6, Ind., announces a micro-miniaturization technique that shrinks circuit elements to pellets $\frac{1}{16}$ in. in diameter and $\frac{1}{8}$ in. high. Pellet resistors, capacitors and diodes in combination with conventional microminiature transistors to fabricate binary dividers in the form of microcircuit logic blocks. The microcomponents fit into holes in component boards, along with

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March 10, 1961

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BRIEF SPECIFICATIONS

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.001 thru .01	.3	.15	.125
.05	.52	.25	.20
.10	.52	.3	.3

Cap. Tol. = GMV, $\pm 20\%$, $\pm 10\%$

P.F. = 2% Max.

Working Voltage = 100 VDC to 125°C.

Series Resistance <.25 ohms at 8 to 10 mc.

Leads axial #22 gauge 1½" long (fine silver)

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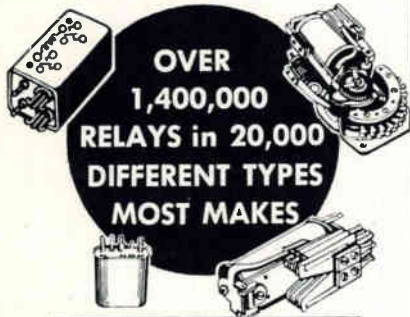
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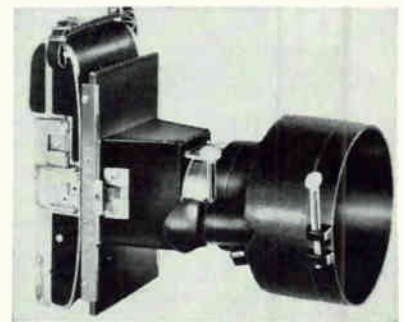
terminals which are pressed into slots along the edges of the boards.

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**Ratio Transformer
CALIBRATES IN DB**

GERTSCH PRODUCTS, INC., 3211 La-Cianega Blvd., Los Angeles 16, Calif. Model RDB-1 Ratiotran is a ratio transformer calibrated directly in db of attenuation from 0 to 110 db. The output ratio with respect to the input follows a logarithmic function as determined by the dial settings. Unit is designed to calibrate attenuators, meters, and other devices whose performance is expressed in db.

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**Oscilloscope Camera
NINE TRACES PER PRINT**

ELECTRONIC TUBE CORP., 1200 E. Mermaid Lane, Philadelphia 18, Pa. Model SM-209 oscilloscope trace recording camera allows up to 9 different trace exposures per print, with consequent savings in film and time. It allows all aperture, speed, and focus adjustments to be set without reaching through access doors or removing the camera from the scope. Price is \$345.

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**Soldering Machine
AUTOMATED**

KESTER SOLDER CO., Chicago, Ill. Illustrated on the SD-4 model 1 universal soldering machine is the



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MODEL 1145**
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Greater Readability in Less Space — only 1/3 the panel area of round or square meters, but with equal accuracy.

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• All models mount horizontally or vertically
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Accuracy	± 3% of full scale for DC, ± 5% for AC	± 2% of full scale for DC, ± 5% for AC	± 2% of full scale for DC, ± 5% for AC	
Scale Length	1.2"	2.1"	2.7"	
Panel Area	0.9 sq. in. (cutout 1.687" x .531")	2.0 sq. in. (cutout 2.656" x .781")	5.5 sq. in. (cutout 3.450" x 1.300")	
Zero Adjuster	Internal	Front, external	Front, external	



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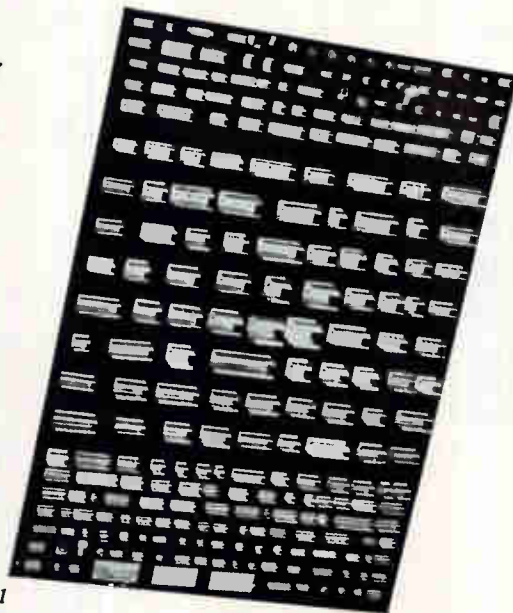
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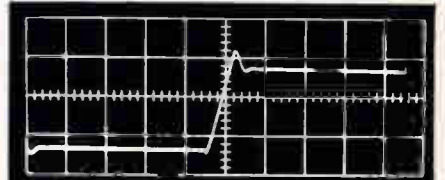


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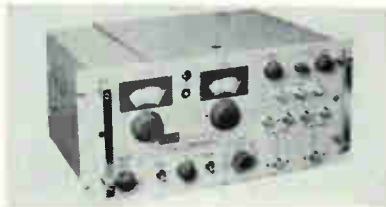
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266 CIRCLE 266 ON READER SERVICE CARD

initial soldering operation of a hermetically sealed capacitor. The tube and feed through are positioned on the adapter. Then a flux filled Solderform washer is placed on top of the feed through. The assembly then passes through the heating chamber for a given pre-established period of time and comes out completely soldered. After a cooling period the soldered unit is automatically ejected into a container of flux remover.

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JERROLD ELECTRONICS CORP., 15th and Lehigh Ave., Philadelphia 32, Pa. Model VC-12 applies the concept of measurement by comparison to lab and production line testing. It features an accurately-calibrated, variable, 2-Mc r-f signal which provides an r-f reference voltage output variable from 1 mv to 12 v and from - 40 dbm through zero to + 30 dbm in 8 overlapping ranges. It has rapid switching capabilities.

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Alloy Spheres SMALL DIAMETER

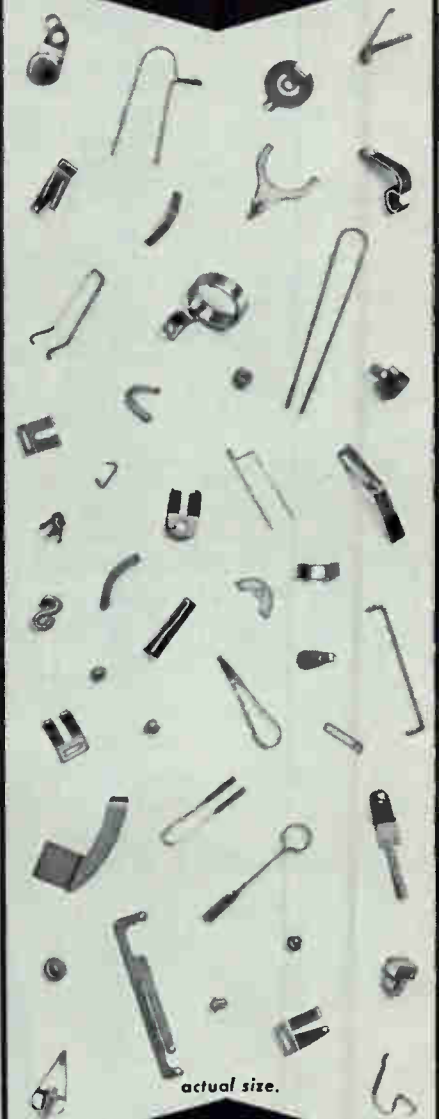
ALPHA METALS, INC., 56 Water St., Jersey City, N. J. Tin-selenium, ten-tellurium, gold-tin and gold-tellurium spheres used in the manufacture of gallium-arsenide semiconductor devices are produced in diameters as small as 0.002 in. They are available with up to 0.6 percent selenium and 1.7 percent tellurium.

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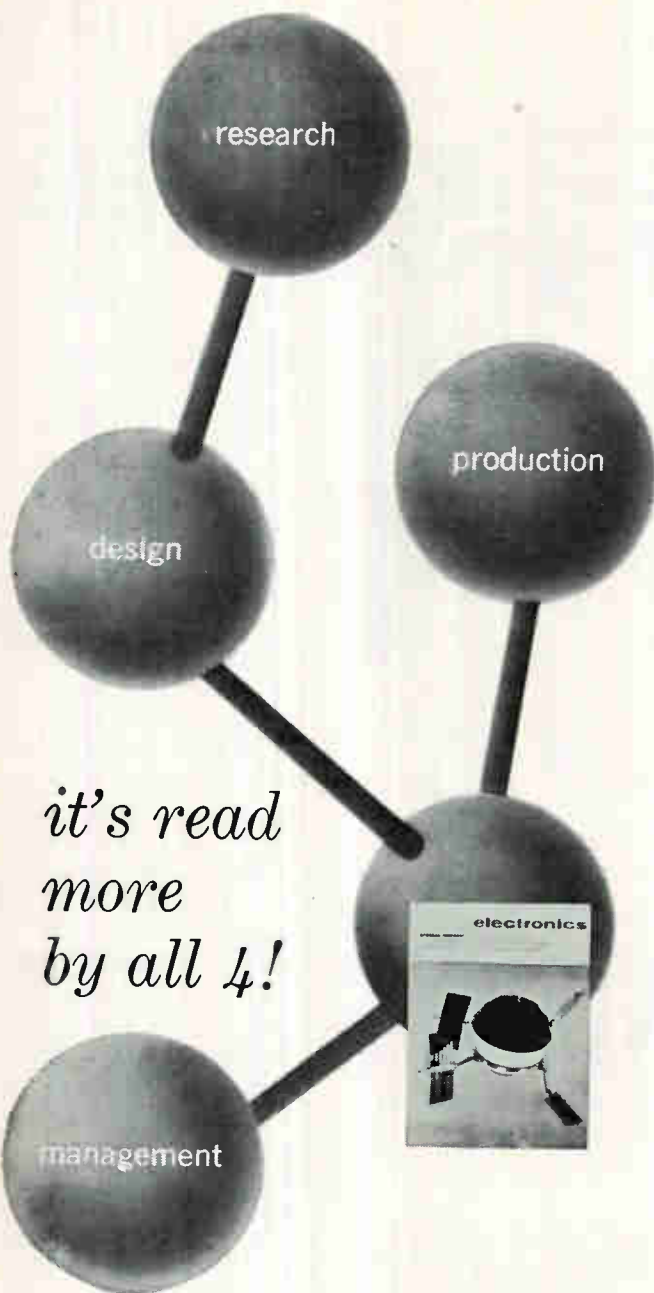
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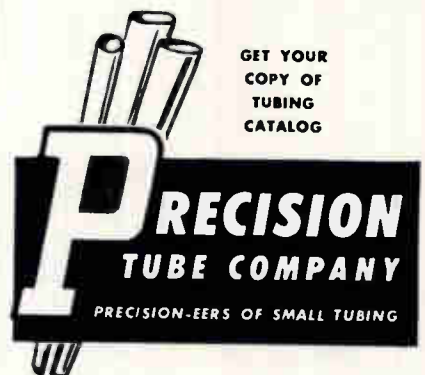
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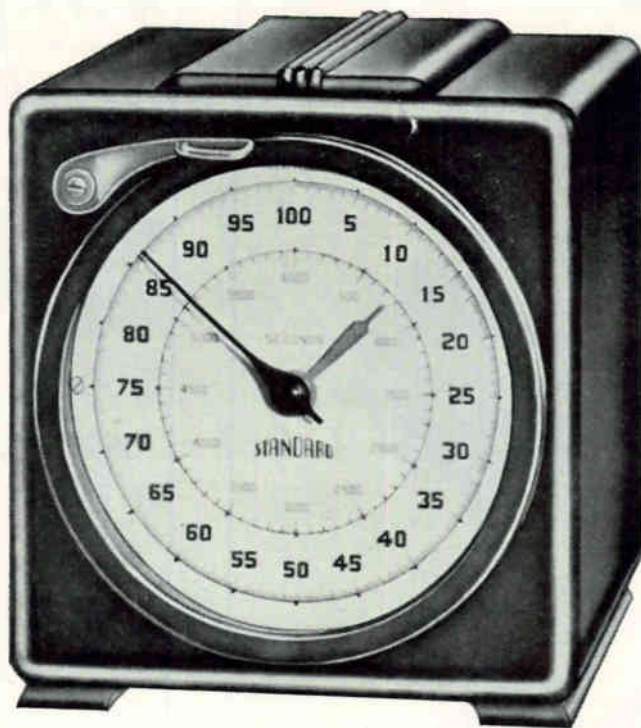
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Literature of

POWER SUPPLY Advance Electronics, 6 W. Broadway, New York 7, N. Y. Bulletin No. P-1 provides technical data on a 14v d-c, 2 amp power supply and other electronic components.

CIRCLE 504 ON READER SERVICE CARD

MULTI-SWITCHES Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill. Eight-page catalog introduces heavy duty mounting brackets and series 8000 and 18000 frames on non-illuminated and illuminated multi-switches.

CIRCLE 505 ON READER SERVICE CARD

FANS & BLOWERS McLean Engineering Labs, P. O. Box 228, Princeton, N. J., has released a 48-page catalog of fans and blowers for ventilating and cooling electronic equipment. Packaged blowers, propeller fans, single and dual centrifugal blowers, and ring fans are illustrated; performance curves and engineering drawings are included.

CIRCLE 506 ON READER SERVICE CARD

ANALOG COMPUTER Donner Scientific Co., a subsidiary of Syston-Donner Corp., Concord, Calif. Illustrated brochure describes the company's 28 pound, model 3500 analog computer.

CIRCLE 507 ON READER SERVICE CARD

MOTORS & CONTROLS Haydon Division of General Time Corp., Torrington, Conn. Timing motors and time and torque controls are covered in an eight-page bulletin which explains the company's background in design and development.

CIRCLE 508 ON READER SERVICE CARD

RECORDING INSTRUMENTS Esterline-Angus Co., Box 596, Indianapolis, Ind. Catalog reviews the profit-making features of the company's instruments.

CIRCLE 509 ON READER SERVICE CARD

ACCELEROMETERS Columbia Research Labs, MacDade Blvd. & Bullen Lane, Woodlyn, Pa., has published a short form product bulletin which illustrates a line of true compression-type accelerometers,

the Week

designed for applications in the missile and airborne vehicle shock and vibration field.

CIRCLE 510 ON READER SERVICE CARD

CRYSTALS Solid State Materials Corp., 7 Erie Drive, Industrial Park, East Natick, Mass. Brochure covers research, development, and production facilities for single crystal materials.

CIRCLE 511 ON READER SERVICE CARD

COMPONENTS Accurate Electronics Corp, 169 S. Abbe Road, Elyria, O. Bound catalog contains all available data on the company's electronic products. Both standard components and special designs are described.

CIRCLE 512 ON READER SERVICE CARD

RESINS Marlette Corp., 37-31 Thirtieth St., Long Island City 1, N. Y. Ways to make high-impact, flexible, or rigid castings from 'Maraglas' transparent epoxy resin are outlined in a single data sheet.

CIRCLE 513 ON READER SERVICE CARD

ELECTRONIC SYSTEMS American Systems, Inc., 3412 Century Boulevard, Inglewood, Calif. The company, its objectives, fields of interest, and plans, are introduced in a corporate brochure.

CIRCLE 514 ON READER SERVICE CARD

MODULAR CONVERTER Waugh Engineering Company, 7842 Burnet Ave., Van Nuys, Calif. Model FR-500 modular transistorized frequency-to-d-c converter is covered in a single sheet.

CIRCLE 515 ON READER SERVICE CARD

MICROWAVE INSTRUMENTS Aircom, Inc., 48 Cummington St., Boston 15, Mass. Product catalog reviews the company's line of microwave components, antennas and instruments.

CIRCLE 516 ON READER SERVICE CARD

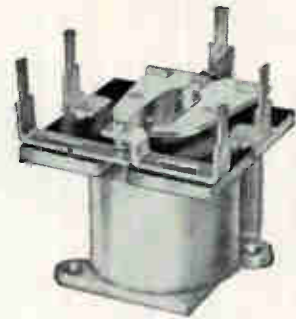
MEMORY General Ceramics, Applied Logics Dept., Keasbey, N. J. Microstack, a miniaturized memory plane for use with coincident current memory systems, is covered in a 4-page bulletin.

CIRCLE 517 ON READER SERVICE CARD

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Remote TV tuning, control circuits for commercial appliances, radiosonde, auto headlight dimming, etc.

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Standard Operating Voltages:

3 to 32 VDC; 6 to 120 VAC 60 Cycle.

Maximum Coil Resistance: 13,000 ohms

Sensitivity:

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Contact Combination: SPDT

Contact Ratings:

Standard 1 amp.; optional ratings, with special construction, to 3 amps. Ratings apply to resistive loads to 26.5 VDC or 115 VAC.

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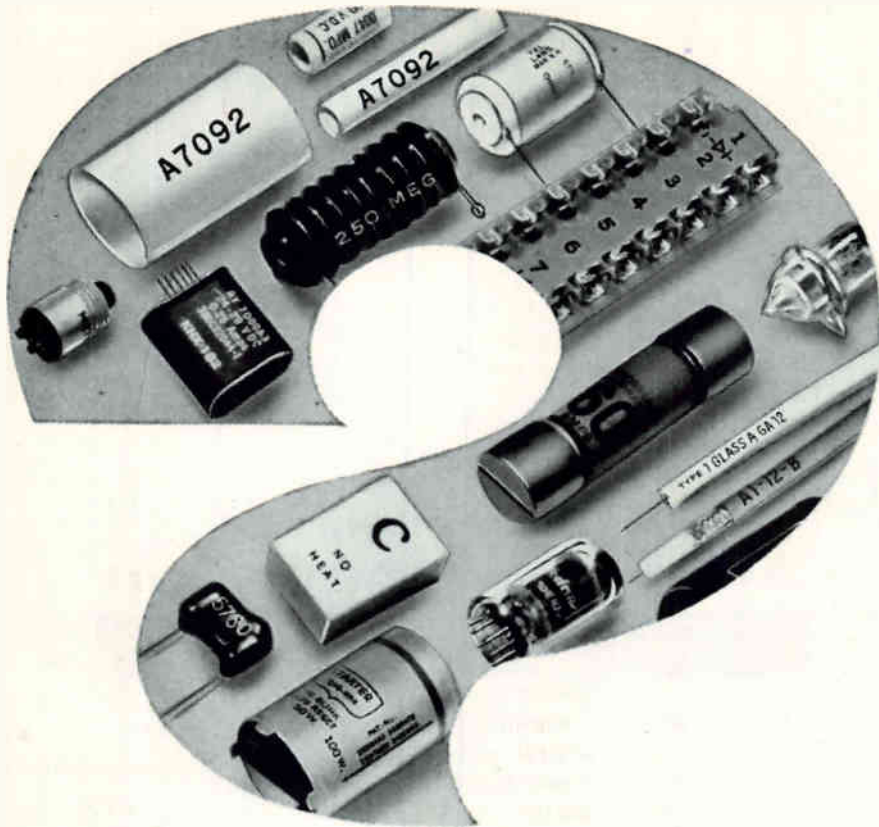
10,000,000 operations, minimum

Dielectric Strength: 500 VRMS, minimum

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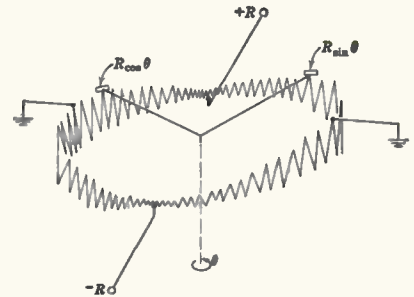


FIG. 5.2.1 Schematic of sine-cosine pot.

Design Fundamentals of Analog Computer Components

By R. M. HOWE

D. Van Nostrand Company Inc, Princeton, N. J., 1961, 261 p, \$7.50.

Written for the engineer or scientist who is already familiar with analog computers and their general application, this book explores the finer points of computer operation as related to component design. Two general chapters deal with system considerations (patchboards, check circuits) and with the effects of component errors on problem solutions. Individual chapters are then given to d-c amplifiers, multipliers, function generators, recorders and miscellaneous equipment.

The principal components are thoroughly described and several actual design procedures are traced step by step. Throughout the book, constant reference is made to specific models of contemporary equipment. The associated theory is thus well related to actual hardware, and this practical approach is one of the book's main merits. —G.V.N.

Mechanical Waveguides

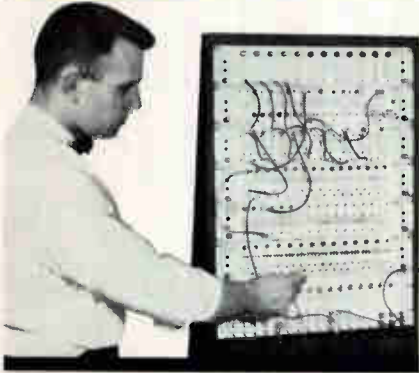
By MARTIN REDWOOD

Pergamon Press, Inc., New York, N. Y., 300 p, \$9.

This is a unique book in that it is devoted to the properties of acoustic and ultrasonic guided waves in solid and fluid media. The principles of guided wave transmission are outlined in the first few chapters. A comprehensive survey

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of recent research is attempted with considerable detail of a few important papers included and the titles and locations of several hundred other papers given at the ends of the appropriate chapters. Emphasis is placed on the theoretical analysis of guided waves. No details of experimental techniques are given but some references are included.—DR. ROBERT E. BEAM, *Professor of Electrical Engineering, Northwestern University, Evanston, Ill.*

Radio Transmitters

By LAURENCE F. GRAY and RICHARD GRAHAM

McGraw-Hill Book Co., New York, 450 p., \$12.50

Aimed at the design, operation and maintenance transmitter engineer, this book provides a practical analysis of all the components that go into a radio transmitter. It provides information on amplifier design, coupling circuits, frequency control units, power supplies, cooling equipment, control circuits, methods of modulation and keying, and typical testing and measurements techniques for complete transmitters.

Various transmitter circuits, such as used in communication links, radar, telegraph, telephone, television and the like are explained in detail. Among the topics covered are frequency-control techniques with emphasis on crystal control and synthesizers; the operation and methods of designing transmitter amplifiers; design and construction of transmitter tubes; method and design procedure for transmitter-to-antenna coupling; methods of amplitude modulation including single sideband, frequency, phase and pulse modulation showing typical circuits; power supply design including filters and automatic regulators; typical control and protective circuits; methods of applying air and water cooling; and special r-f components such as directional couplers, diplexers, power dividers and other microwave components. One chapter is devoted to measurement procedures with particular emphasis on broadcast transmitter tests.

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A major feature of Epsco's exhibit at the IRE show will be the PCM Airborne Data Gathering System . . . used during the past year for advanced flight test programs. Also on view will be Epsco's ADDAVERTER, most flexible and efficient computer linkage system on the market.

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CIRCLE 271 ON READER SERVICE CARD 271

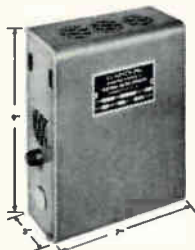
Stewart Ashton,
our Chief Engineer,
reports on
the all-new . . .

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HERE AT LAST is a simple, compact, space-saving package that provides *microsecond* response for controlling power to electric furnaces . . . and for numerous other applications and processes where temperatures must be precisely regulated.

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us about your application requirements. — C.I.HAYES, INC., 845 Wellington Ave., Cranston 10, R. I.



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books have been published in the past, most of them cover radio transmitters in a chapter or so buried within many other chapters of general electronic engineering. This well written and profusely illustrated handbook will fill the needs of engineers concerned strictly with radio transmitters. —LS

THUMBNAIL REVIEWS

Electronic Circuit Analysis—Vol. I: Passive Networks. By Philip Cutler, McGraw-Hill Book Co., New York, 454 p, \$8. This text will provide the engineering student or electronic technician with practical, thorough grounding in the basic theorems; node and loop analysis, a-c circuit theory, transient analysis and graphic analysis of vacuum-tube circuits. All basic ideas are clearly expressed and well illustrated with examples; only simple mathematics are used. Numerous exercises are given.

Basics of Induction Heating. By Chester A. Tudbury, John F. Rider Publisher, Inc., New York, 140 p, cloth binding \$8.90. This well written, well illustrated book consists of two volumes (each available separately with soft covers at a reduced price). Volume I covers the theory and practical applications of induction heating and gives many worked examples of how to calculate requirements. Volume II covers the theoretical and practical applications of induction heater power generators from motor generators to high-power vacuum tube oscillators. Both volumes are very easy to read and understand, and profuse illustrations supplement the text. Questions and problems scattered throughout the book will enable the serious reader to fully understand induction heating.

ARINC Transistor Specification Manual. ARINC Research Corp., Washington, D. C., 609 p, \$10. One function of Aeronautical Radio, Inc. (sponsored by airlines, air transport companies and aircraft equipment manufacturers) is to coordinate engineering of commercial aircraft equipment. This manual lists 81 transistors on the U.S. military or ARINC preferred type lists and five European preferred types. MIL-S-1900B and all the



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military specifications for these types, including the British, are reproduced. Abstracts of commercial specifications, in a standard format, are given for types not covered by military specifications. The British specifications include numerous diode and transistor test circuits which are not given in the U.S. military specifications. The manual will be kept up-to-date by supplements.

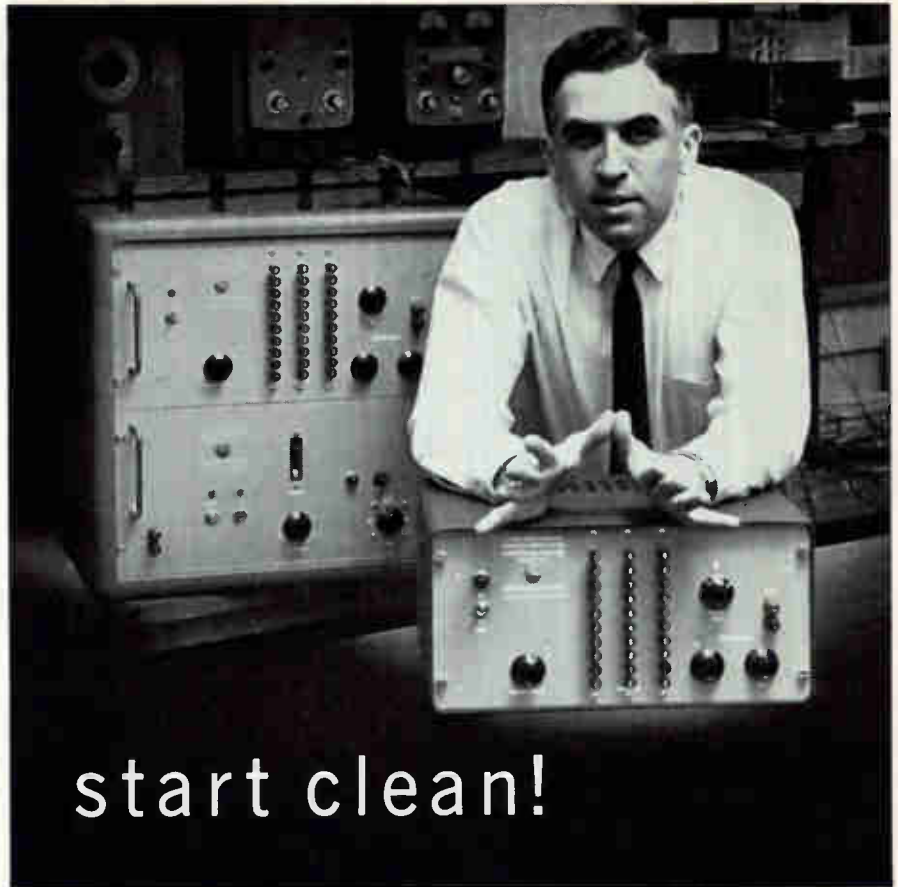
Neutron Detection. By W. D. Allen, Philosophical Library, Inc., New York 16, N. Y., 260 p, \$10.

A solid book that is well but not redundantly written, as books that compromise between the expert and the novice tend to be. Contains roughly equal parts on basic principles, instruments for neutron detection, applications of these detectors in industry and medicine, and neutron sources and their calibration. References are sprinkled liberally throughout and a generous appendix completes the book.

Fixed and Variable Capacitors. By G.

W. A. Dummer and H. M. Nordenberg, McGraw-Hill, 281 p, \$10. Presents working knowledge of capacitor design and construction. Dummer is head of components research, development and testing at the Radar Research Establishment, Ministry of Supply, England. Nordenberg is head of electronic parts unit, Bureau of ships, U. S. Navy Department. Working knowledge of both men presents design and construction material previously available only in scattered technical publications. Book belongs within easy reach of components men concerned with design and use of capacitors; the basis for their selection; future possibilities, and new types of experimental capacitors.

International Rectifier Solar Cell and Photocell Handbook. By J. Sasuga, International Rectifier Corporation, El Segundo, Cal., 112 p, \$2. This useful booklet describes, in readable terms, the theory of photovoltaic devices and then presents a large number of practical applications for them. These applications range from hobbyist projects (mailbox indicator) to industrial uses (fire and smoke detectors). An interesting introduction to the subject of photosensitive semiconductors.



start clean!

with this new ultra-low distortion,
stable-amplitude oscillator

When the specs get critical, you need an oscillator that won't add distortion and instability of its own. Here's a stable-amplitude, low-distortion oscillator — Krohn-Hite's new Model 446 — that gives you a *cleaner* sine wave than any other oscillator you've ever worked with!

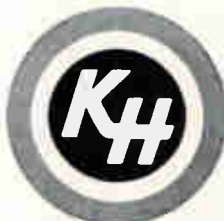
Amplitude stability is ultra-high: 0.001 db (0.01%), due to a unique infinite-gain AVC circuit (patent pending). Amplitude bounce near line frequency is no longer a problem — less than 0.05%. Distortion — phenomenally low: less than 0.01%.

But that's not all. The 446 push-button oscillator offers continuous frequency coverage from one cycle to 100 kc. Voltage output is continuously adjustable from 0 to 10 volts, with infinite resolution all the way.

And when you need *power* along with stable amplitude and low distortion, team up the Model 446 oscillator with Krohn-Hite's Model UF-101A ultra-low distortion 50-watt amplifier. Here's an amplifier which preserves the stability and distortion-free characteristics, even at a full 50 watts. Frequency response of the amplifier — from 20 cps to 20 kc at full power. A convenient load impedance switch offers a choice of 1, 2, 4, 8 and 225 ohms.

Together, this oscillator and amplifier provide a highly-stable, low-distortion, variable-frequency Power Source (Model LDS-115) — for the most critical meter calibration or measurement needs. Send for technical literature on these new Krohn-Hite instruments.

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Berkner: deeds to match the role

AFTER A RECENT MEETING with the new president of the Institute of Radio Engineers a visitor said, "It was like shaking hands with a dynamo."

Anyone familiar with Dr. Lloyd V. Berkner's impressive accomplishments in education, research, government and several other fields would understand this reaction.

A 1927 graduate of the University of Minnesota, he holds honorary degrees from Columbia, Notre Dame and Brooklyn Polytech, in addition to Upsala University in Sweden, University of Calcutta in India and the University of Edinburgh in Scotland.

While in college, Berkner was engineer-in-charge at radio station WLB-WGMS in Minnesota. During the year following graduation he worked as an electrical engineer for the Airways Division of the Bureau of Lighthouses.

In 1928-30 he was an engineer with the first Byrd Expedition to Antarctica and was awarded the U. S. Special Congressional Gold Medal, the Silver Medal of the

Aeronautical Institute and the Gold Medal of the City of New York, for his services.

For three years thereafter he was a physicist with the National Bureau of Standards, followed by an eight-year period in the same capacity with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. During 1940-1941 he was a consultant to the National Defense Committee.

The military aspect of Berkner's life began in 1926 when he became an aviator in the Naval Reserve. In 1941 he went on active service as head of the Radar Section of the Bureau of Aeronautics. From 1943 to 1945, he directed the Bureau's Electronics Material Branch and served on the *U. S. S. Enterprise* in 1945. Since 1955 he has held the rank of Rear Admiral, USNR.

In 1946-47 he was executive secretary of the Research and Development Board and continued as a consultant until 1951. From 1947 until 1951 he was once more with the Carnegie Institution, heading the section on exploratory geophys-

ics of the atmosphere.

Following this, Berkner became president of Associated Universities, Inc., in New York City. This educational institution operates such research facilities as the Brookhaven National Laboratory under contract to AEC, and the National Radio Astronomy Observatory under contract to the National Science Foundation.

Through the fabric of his activity run threads of many other services performed at scientific and government levels. In 1949, for example, he was a special adviser to the Secretary of State, Director of the Foreign Military Assistance Program and Chairman of the International Science Advisory Committee (on which he is still a consultant).

Among his honors, Berkner holds the Science Award of the Washington Academy of Sciences, the Commendation Ribbon of the Secretary of the Navy, and the U. S. Legion of Merit. In 1945, he was made an honorary member of the Order of the British Empire.

He is chairman of the Space Science Board of the National Academy of Sciences, a Fellow of the Royal Swedish Academy of Sciences, and a member of more than a dozen high-ranking scientific groups.

Presently, he is at work with a group of scientists and educators in the southwestern region of the country, seeking to upgrade the level of technological education and industry in that area.

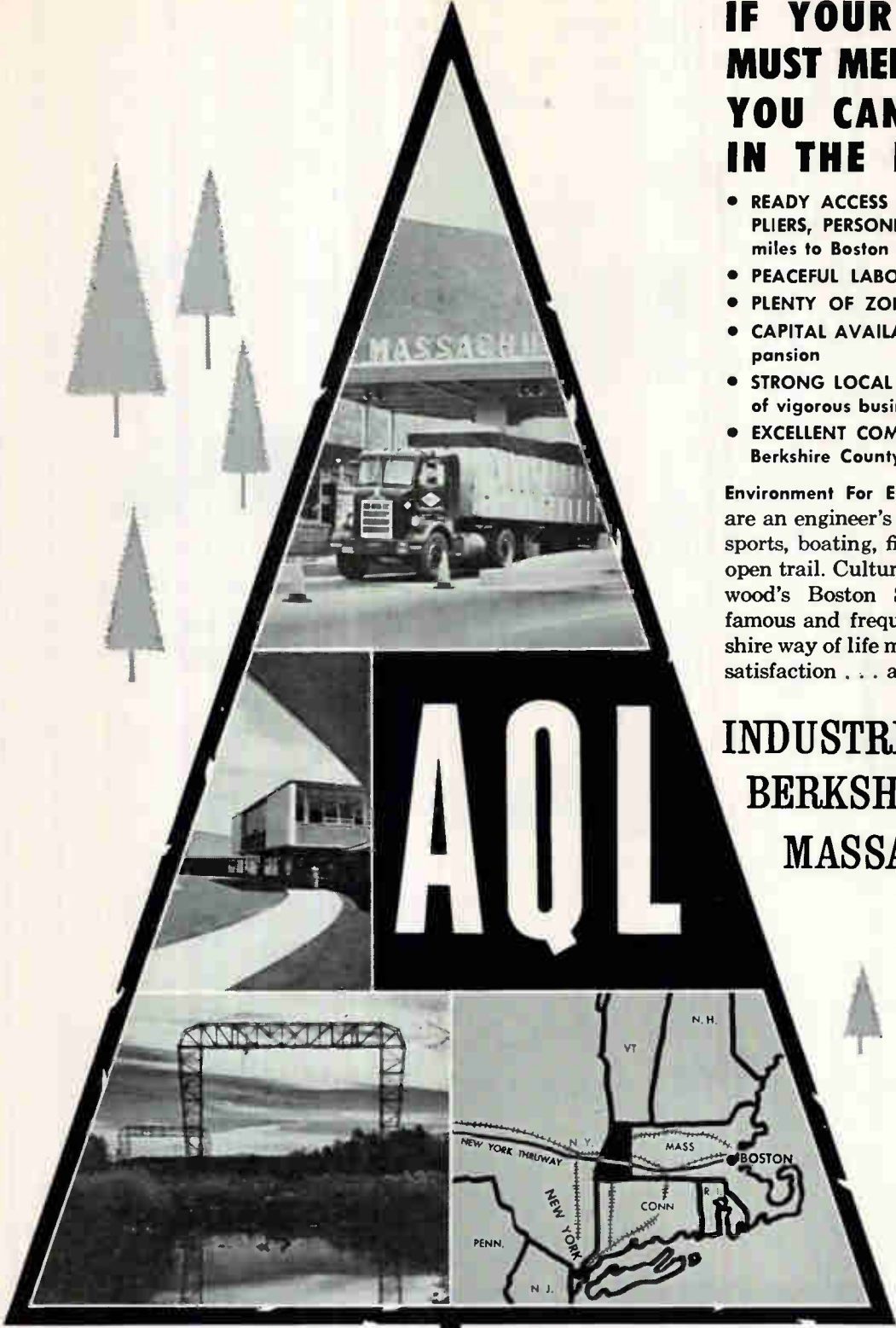
In his capacity as president of IRE, Berkner says he will work to obtain greater participation by U. S. electronics men in international affairs. He sees a serious lack of American activity at conferences where worldwide technical standards are evolved, and feels that this can only be corrected by increased awareness by U. S. companies of the job they must assume. "Their deeds should match their role," he said.

Berkner and his wife, Lillian, maintain two residences, one in Dallas, Tex., the other in Ft. Lau-

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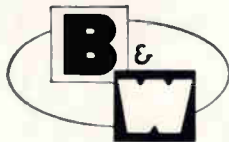
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Proved in every type of service, these quality instruments are used by experts for FCC "proof-of-performance" tests and supplied as original equipment with many broadcast station installations.

Matchmaster. This versatile test equipment combines three instruments in one self-contained unit: Built-in dummy antenna, standing wave ratio indicator, direct reading RF watt meter. Model 650 (for 52 ohm line) and Model 651 (for 73 ohm line) indicate transmitter output power up to 125 watts directly. Model 52-500 gives direct readings up to 600 watts and is designed for permanent connection into 50 ohm coaxial lines such as RG-8/U.

Model 404 Laser Detector. Combined RF detection and audio bridging circuits for use with any distortion meter. 400 kc to 30 mc range with 20-30 volt RF carrier. Essentially flat frequency response from 20 to 50,000 cps.

Model 300 Frequency Meter. Measures audio frequencies to 30,000 cps in 6 ranges. Integral power supply and input level control.



MODEL 200 AUDIO OSCILLATOR

- Frequency Range: 30 to 30,000 cycles.
- Frequency Response: Better than ± 1 db. 30 to 15,000 cycles with 500 ohm load.
- Stability: Better than 1%.
- Calibration: $\pm 3.0\%$ of scale reading.
- Voltage Output: 10 volts into 500 ohm load.
- Distortion: Less than .2% at 5 volts output.



MODEL 400 DISTORTION METER

- Frequency Range: Fundamentals from 30 to 15,000 cycles. Measures Harmonics to 45,000 cycles.
- Sensitivity: 3 volts minimum input required for noise and distortion measurements.
- Calibration: Distortion measurements $\pm .5$ db. Voltage measurements: $\pm 5\%$ of full scale at 1000 cycles.
- Residual Distortion: .05%—30—15,000 cycles.
- Residual Noise: .025% or less.



MODEL 600 DIP METER

- Covers 1.75 to 260 mc in 5 bands.
- Monitoring jack & B+ OFF switch.
- Shaped for use in hard-to-get-at places.
- Sturdy, color coded, plug-in coils.
- Adjustable, 500 microamp meter.

derdale, Fla. The Florida home contains one of Berkner's chief sources of relaxation, a workshop where he finds pleasure in wood and metalworking. The Berkner's have two daughters.



TIC of Acton Names Division Manager

JOHN W. FORREST has been named manager of the mechanical products division of Technology Instrument Corp. of Acton, Acton, Mass. He has been with the company since 1952 at which time he joined the engineering staff of the parent company as a designer of electronic instruments. He transferred to TIC of Acton, formerly known as Acton Laboratories, in 1955.

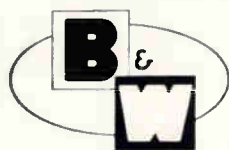
Forrest was previously a project engineer on communications equipment with the National Co.



Hatfield Assumes New GE Post

EDWARD J. HATFIELD has been named manager-district operations for General Electric's Light Military Electronics Department (LMED) in Utica, N. Y. The district operations office is in Washington, D. C.

In his new post, Hatfield is responsible for the department's five district offices, located in Los An-



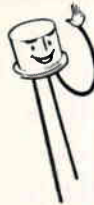
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Atherton Noyes Joins General Radio

ATHERTON NOYES, JR., formerly vice president-research and development, at Aircraft Radio Corp., has joined the General Radio Company, West Concord, Mass., as an engineering consultant.

He will specialize in the development of precision, crystal-controlled digital-frequency sources.



Ward Leonard Electric Opens New Plant

WARD LEONARD ELECTRIC CO., Mount Vernon, N. Y., has announced establishment of a new division and opening of a new plant at Hagerstown, Md., for manufacture of molded metal-film precision resistors. Roger W. Lowery (picture) will head the new division.

Opening of the new division marks Ward Leonard's first entry into the precision resistor field, and will extend the company's current line of power resistors, rheostats, motor controls, relays, and specialized military controls.

Jerrold Electronics Expands Laboratory

JERROLD ELECTRONICS CORP., Philadelphia, recently expanded its laboratory in Huntingdon Valley, Pa., to cover approximately 20,000 sq ft

inter-industry conference on **ORGANIC SEMICONDUCTORS**

April 18 and 19, 1961

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David Fox, State University of New York

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Characteristics of Charge-Transfer Complexes

Oliver Le Blanc, General Electric Research Laboratories

Interpretation of Conductivity in Molecular Crystals

Herbert A. Pohl, Princeton University

Electrical Properties of Pyrolyzed Polymers

Marvin Silver, Office of Ordnance Research

Surfaces and Contacts in Organic Semiconductors

For further information contact James J. Brophy, Co-Chairman, Physics Division, Armour Research Foundation, Technology Center, Chicago 16, Illinois.

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and doubled the size of the individual laboratory rooms.

The expansion reflects a policy of planned growth in the increasing requirements for improved and new concepts relating to equipment and systems for distribution of television and radio frequency signals.

Narda Appoints Lester Lipset

LESTER LIPSET has been appointed manager of the quality-control department of the Narda Microwave Corp., Mineola, L. I., N. Y., and will be in charge of the eight various stages of inspection and testing operations at Narda.

Prior to his new appointment, Lipset was Narda's chief test engineer and quality control engineer.

PEOPLE IN BRIEF

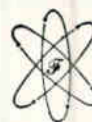
Bill Hopper, previously with Motorola, accepts the position of director of research and development at Dynamic System Electronics Corp. Wayne H. Robinson leaves Eitel-McCullough to join Watkins-Johnson Co. as applications engineer. Eugene W. Torgow promoted to chief engineer by Dorne and Margolin. Frank O. Strailman III advances at Technical Materiel Corp. to chief systems engineer. Gaelen L. Felt, formerly with the Space Technology Labs, joins Edgerton, Germeshausen & Grier, Inc., as manager of the company's Las Vegas operations. William Rosen transfers from the System Development Corp. to the Planning Research Corp. to become an associate in the firm's systems engineering division. Rudolph Lorenz, Jr. promoted to the manager's staff of the IBM general products division development lab. Cornelius J. Shackett, ex Northrop Corp., appointed production control manager of Gorham Electronics Div., Gorham Manufacturing Co. James L. Gage advances to chief product engineer at the Electric Autolite Company's Decatur, Alabama operations. Seymour Siegel named to the technical staff of Dynamic Science Corp.

HARDWARE

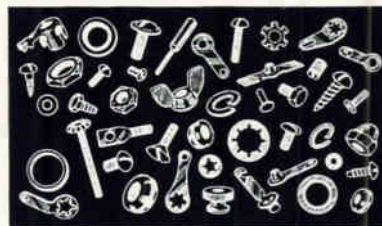


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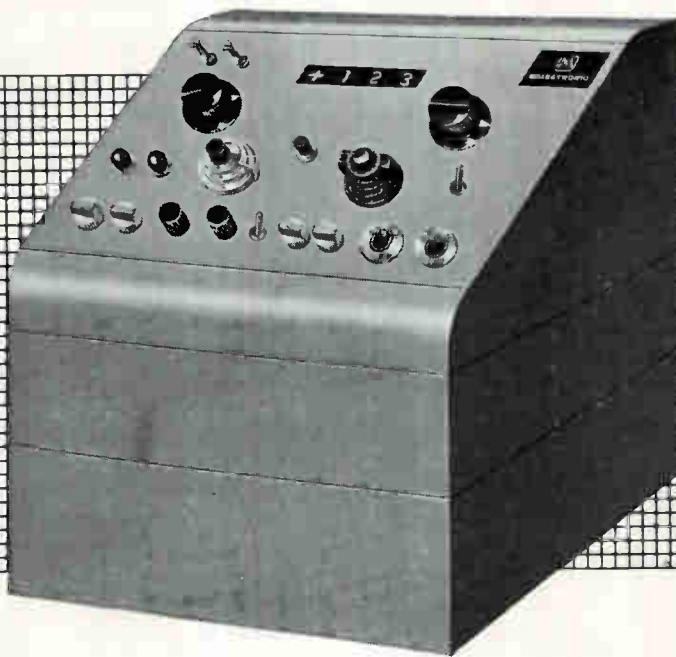
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ADC Incorporated	1623
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B

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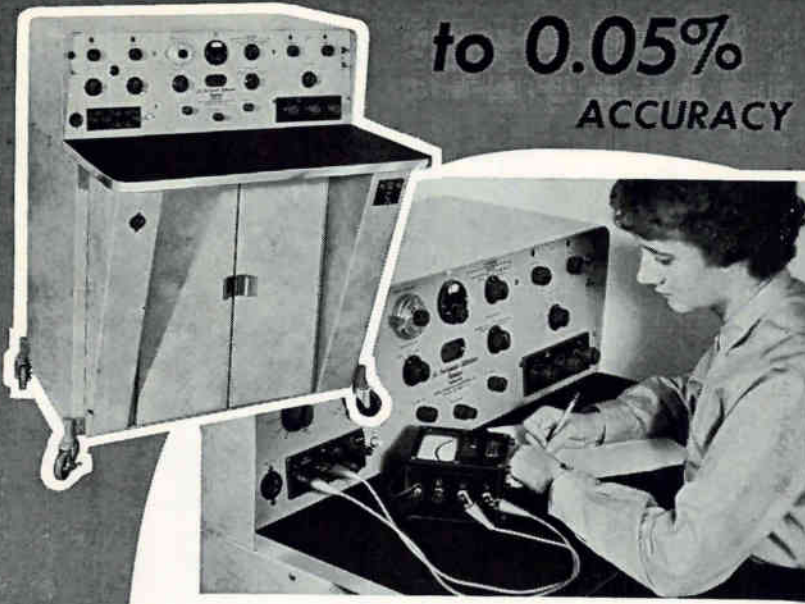
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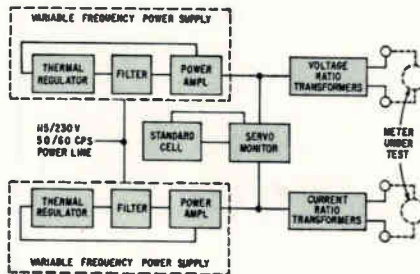
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RANGE	MIN. LOAD RESISTANCE	RANGE	MAX. LOAD RESISTANCE
0-1.5 MV	20,000 ohms	0.15 μ A	10,000 ohms
0-3.0 MV	20,000 ohms	0-30 μ A	10,000 ohms
0-7.5 MV	20,000 ohms	0-75 μ A	10,000 ohms
0-15 MV	20,000 ohms	0-150 μ A	10,000 ohms
0-30 MV	20,000 ohms	0-300 μ A	10,000 ohms
0-75 MV	20,000 ohms	0-750 μ A	10,000 ohms
0-150 MV	20,000 ohms	0-1.5 MA	1,000 ohms
0-300 MV	20,000 ohms	0-3.0 MA	1,000 ohms
0-750 MV	20,000 ohms	0-7.5 MA	1,000 ohms
0-1500 MV	1,000 ohms	0-15 MA	1,000 ohms
RANGE	MAXIMUM LOAD	RANGE	MAXIMUM LOAD
0-1.5 Volts	2 VA	0-0.15 Amp	10 VA
0-3.0 Volts	3 VA	0-0.3 Amp	10 VA
0-7.5 Volts	5 VA	0-0.75 Amp	10 VA
0-15 Volts	10 VA	0-1.5 Amp	10 VA
0-30 Volts	15 VA	0-3.0 Amp	10 VA
0-75 Volts	15 VA	0-7.5 Amp	10 VA
0-150 Volts	15 VA	0-15 Amp	10 VA
0-300 Volts	15 VA	0-30 Amp	10 VA
0-750 Volts	15 VA	0-75 Amp	10 VA
0-1500 Volts	15 VA		



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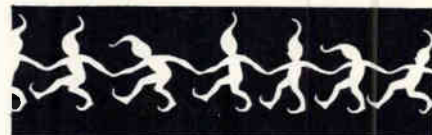
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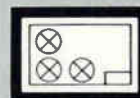


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frequency
response
analyzer



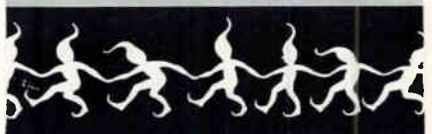
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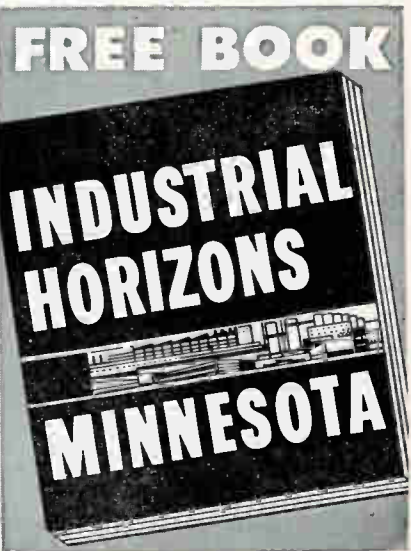
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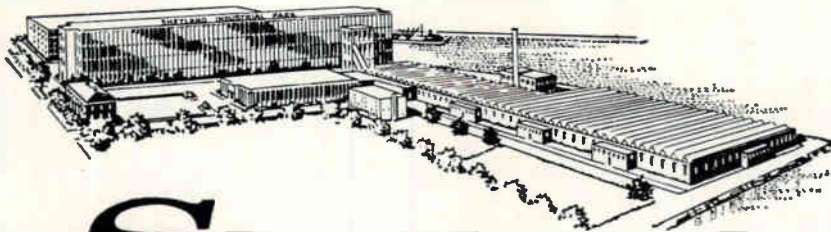
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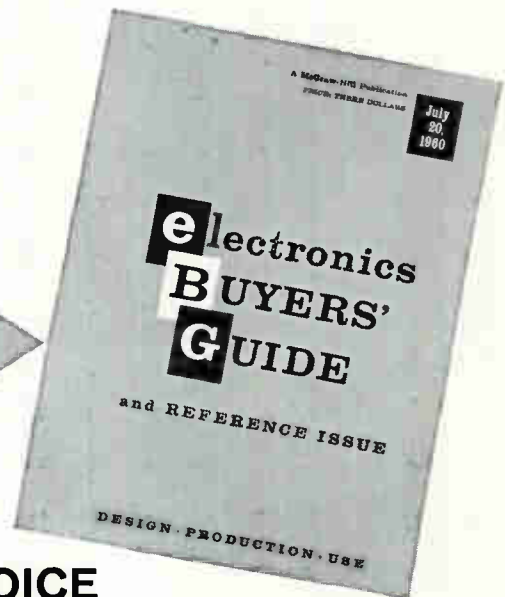
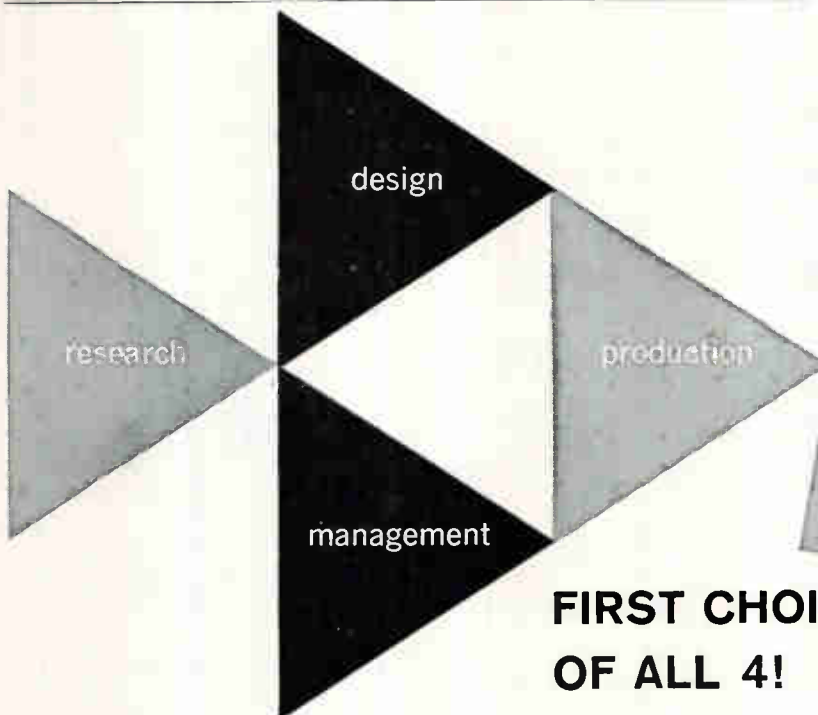
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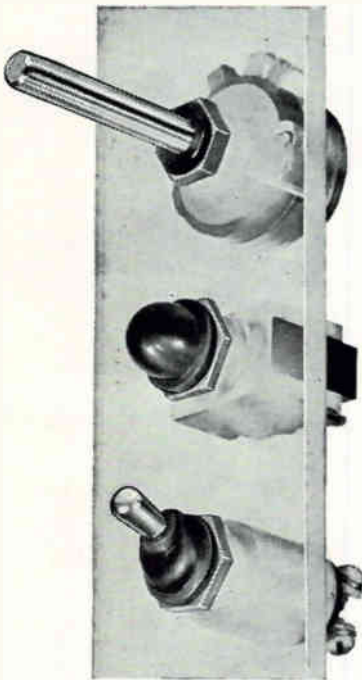
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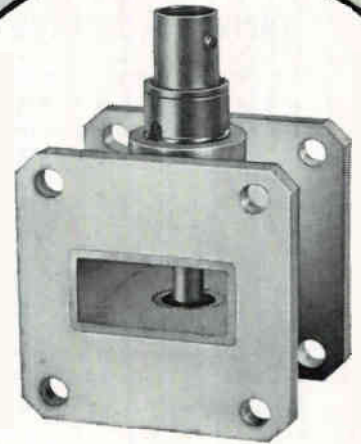
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Personal Background

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CITY ZONE STATE

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Education

PROFESSIONAL DEGREE(S)

MAJOR(S)

UNIVERSITY

DATE(S)

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26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

electronics

WEEKLY QUALIFICATION FORM

(Continued from preceding page)

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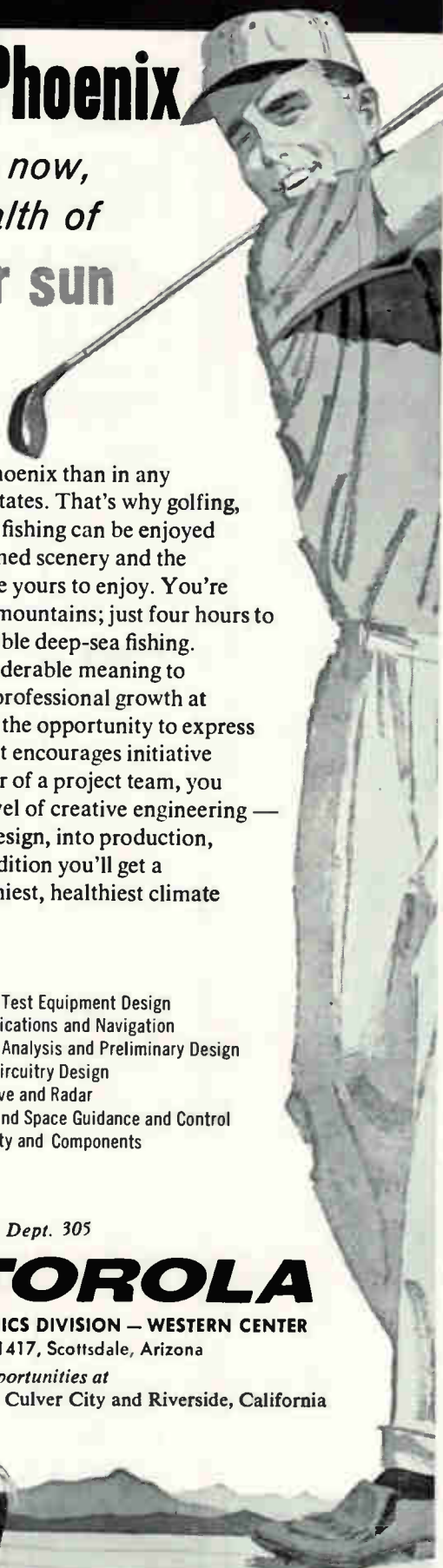
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DEFENSE SYSTEMS DEPARTMENT

PROFESSIONAL EMPLOYMENT BULLETIN MARCH, 1961

On a regular basis, General Electric's Defense Systems Department publishes opportunities of special importance to experienced Systems Engineers and/or degree Engineers interested in developing their skills to the point of Systems Engineering in its broadest sense.

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Your response to this Bulletin will be expedited to the appropriate technical managers at DSD for prompt, personal attention and a confidential reply, generally within one week. Address: Mr. E. A. Smith, Box 3-E



DSD DEFENSE SYSTEMS DEPARTMENT
A Department of the Defense Electronics Division

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electronics

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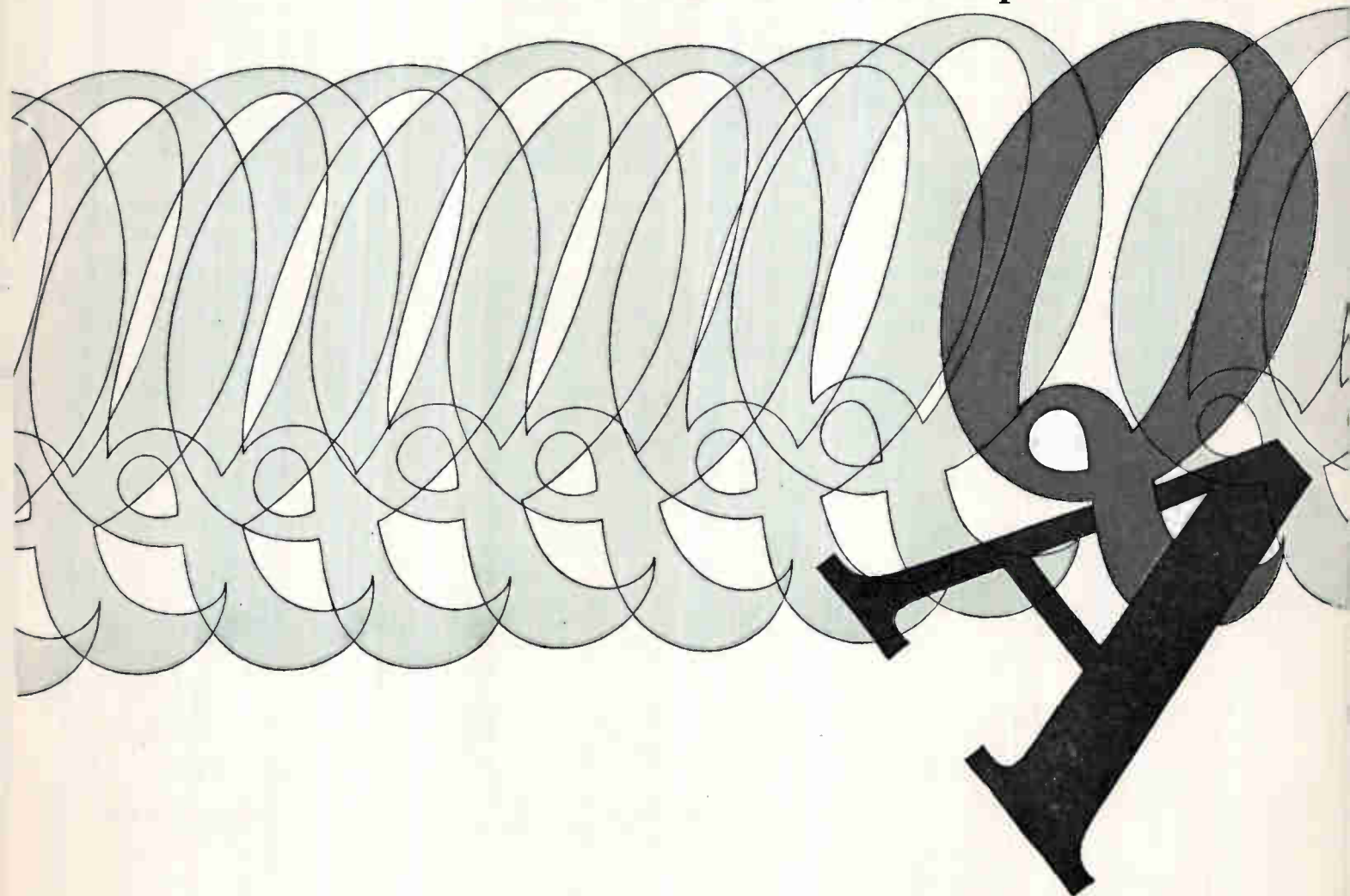
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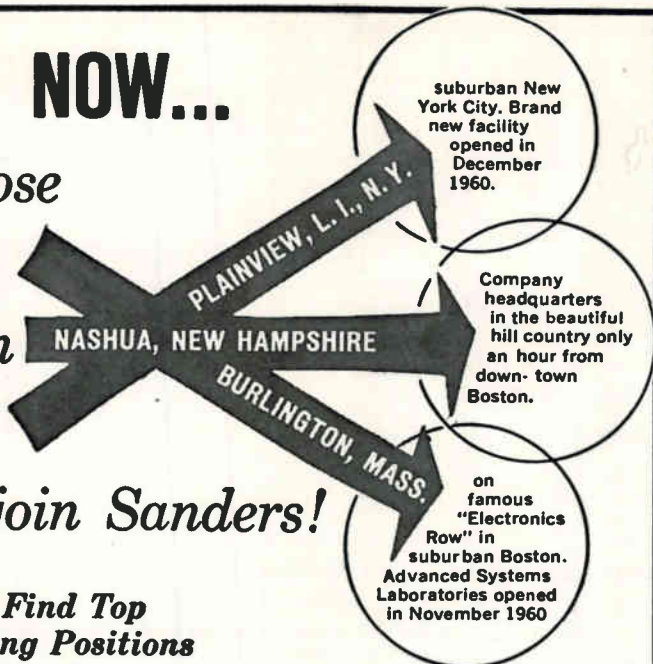
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how can it find time
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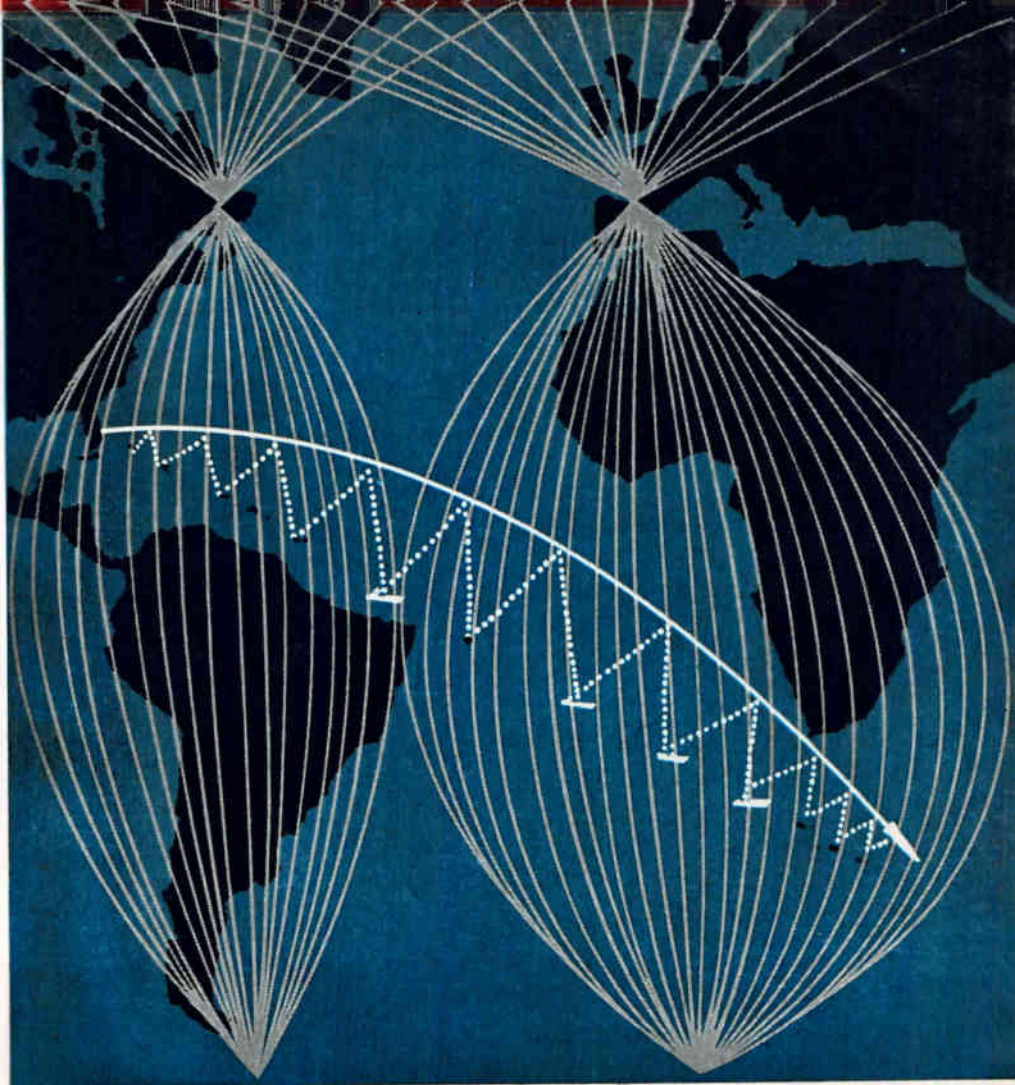
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of space instrumentation systems. A strong background of education and experience in scientific instrumentation is required.

Radar Development Engineers

BSEE with a minimum of 4 years' experience in the analysis, design and development of airborne radar systems. Should be capable of analyzing the radar system with the end view of integrating the equipment into a complex weapons system. Will fully participate in laboratory and flight development programs conducted in the finest facilities available in a professional atmosphere.

Data Processing Engineers

Background in digital data processing, logic circuit design, memory devices, R-F modulation techniques and related digital techniques required. Opportunity to participate in advanced design of systems concepts and hardware development. BSEE or BS in Physics with a minimum of 3 years' applicable experience is required.

For your convenience, Mr. Henry C. Kilne, Avionics Staff Engineer, will be interviewing at the IRE show, March 20-23, in New York City at the Henry Hudson Hotel. To arrange an interview, call him at LT-1-1200 between 9:00 a.m. and 5:00 p.m. If this is not convenient, send your resume to Mr. W. Brown, Manager Engineering Employment, Dept. GR-76.



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INTERVIEWING
ENGINEERS IN N. Y.
MARCH 20-23**



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- *General Electric was the first to market a commercially successful tunnel diode.*
- *Dr. Vernon Ozarow, a member of the staff, holds patents on multielectrode field controlled germanium devices and fabrication methods for PN junctions. He is presently working in the area of silicon carbide devices and epitaxially grown films.*
- *Dr. Robert N. Hall, G.E. research physicist, developed indium-germanium junctions, and the "rate growing" process for making grown junction transistors.*

Current activities are concerned with virtually every aspect of the semiconductor industry—many of a highly sophisticated nature. Included are development of new materials, processes, and techniques; development of in-process measurements for diffusion, vacuum deposition and photolithographic techniques; new encapsulation methods; continued advanced studies in transistors, rectifiers, tunnel diodes, solar cells, micro-electronic components, etc.

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To apply, or obtain information on specific opportunities related to your background and interests, write in confidence to Mr. J. H. McKeehan, Dept. 69-WK.

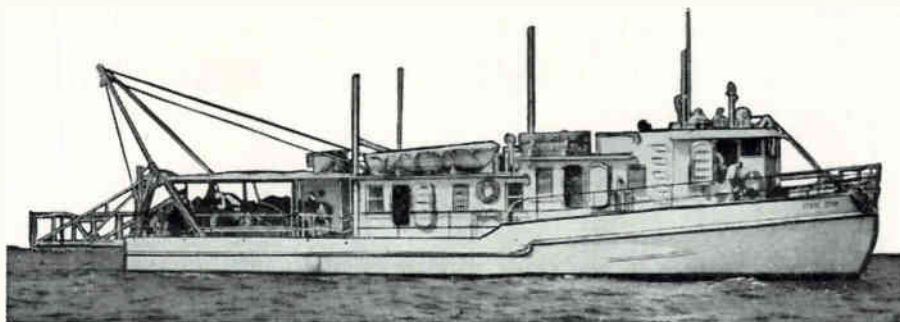
SEMICONDUCTOR PRODUCTS DEPARTMENT
GENERAL  ELECTRIC
Electronics Park Syracuse, New York

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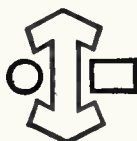
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if you are an **ELECTRICAL ENGINEER . . .**
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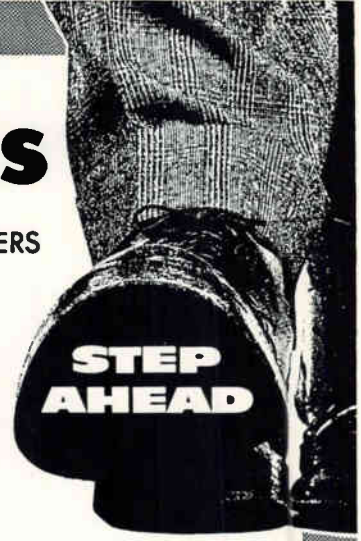
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 AT

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 PHONE: Eldorado 5-3000
 (for room number)

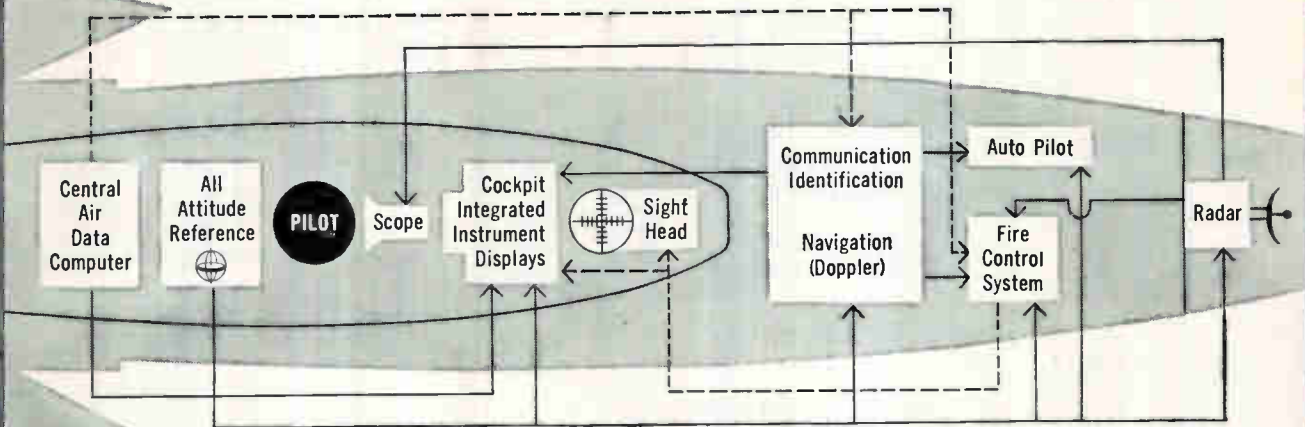
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SELLING OPPORTUNITY AVAILABLE

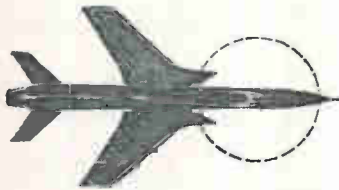
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To integrate the most complete electronic systems devised for flight

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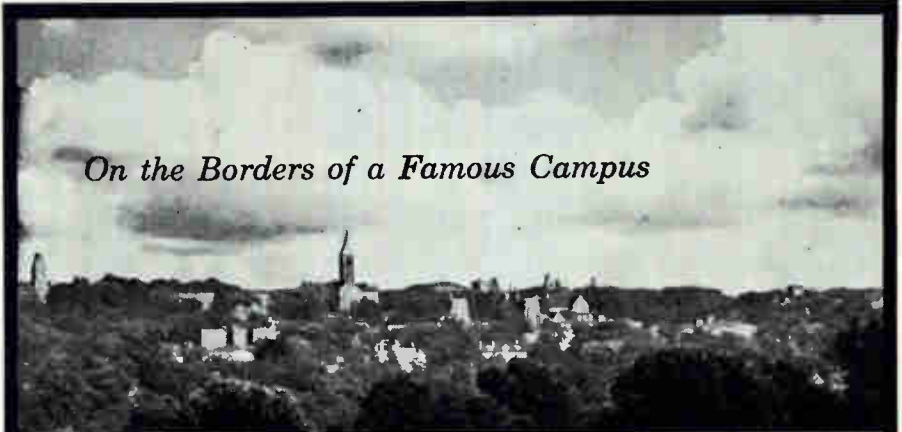
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Please write in full confidence to Mr. George Travers, Div 69-WJ
ADVANCED ELECTRONICS CENTER AT CORNELL UNIVERSITY
General Electric, Ithaca, New York

LIGHT MILITARY ELECTRONICS DEPARTMENT
A Department of the Defense Electronics Division



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The publisher cannot accept advertising in the Searchlight Section, which lists the names of the manufacturers of resistors, capacitors, rheostats, and potentiometers, or other names designed to describe such products.

Send NEW ADS or inquiries to Classified Adv Div. of Electronics P. O. Box 12, N. Y. 36, N. Y.

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Lots of 5, \$65.00 ea.
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 - PRD 650B Power Bridge..... 210.00
 - PRD 644 Thermistor Mount..... 62.50
 - PRD 645 Thermistor Mount..... 47.50
 - PRD 504 Heterodyne Frequency Meter.... 550.00
 - Winslow Model 5G-1000 Megohmmeter..... 129.50
 - AN/UPM-33 Spectrum Analyzer..... 995.00
 - AN/UPM-11 Range Calibrator..... 1250.00
 - Phaotron Model 777 VTVM (leather case) 52.50
 - Homelite Generator output 115 VAC 1
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PHONES — Market 7-6771-2-3

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.25	50KV	69.50	4	10KV	67.50
.25	80KV	109.00	5	10KV	70.50
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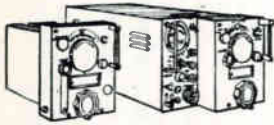
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NAME..... TITLE..... COMPANY.....

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TS51	Battery Tester & Power Meter	35.00
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2J55	27.50	
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OA2WA	2.00	4AP10	10.00	244A	1.25	808	.75	5844	.60
OA3	.85	4B31	12.50	245A	2.50	809	4.75	5845	4.50
OB2	.50	4B32	7.50	249B	10.00	810	12.50	5852	2.25
OB2WA	2.00	4C33	100.00	249C	5.00	811	2.00	5854	1.00
OB3	.70	4C35	15.00	250R	10.00	811A	4.50	5879	1.25
OC3	.50	4E27	7.50	250TH	20.00	812	3.25	5881/6L6WGB	2.00
OD3	.30	4J30-61	PUR	252A	4.75	813	9.50	5886	3.00
C1A	6.50	4J52	25.00	254A	2.00	814	2.50	5896	1.50
1AD4	1.50	4PR60A	50.00	257A	2.50	815	1.00	5899A	2.50
C1B	1.50	4X150A	15.00	FG-258A	75.00	816	1.85	5915	.90
1B24A	10.00	4X250B	22.50	259A	2.50	828	8.50	5930/2A3W	2.00
1B35	1.85	5B1A	9.50	262B	2.50	829B	9.50	5932/6L6WGA	2.00
1B35A	3.00	5C22	10.00	FP-265	5.00	832	2.50	5933/807W	1.25
1B58	25.00	5C1A	9.50	267B	5.00	832A	6.75	5933WA	5.00
1B59/R1130B	7.50	5CP7A	9.50	271A	8.50	836	1.00	5948/1754	75.00
1B63A	12.50	5CP11A	9.50	272A	2.75	837	.80	5956/E36A	9.00
1C/3B22	2.00	5J26	25.00	274A	2.00	838	1.00	5962/B510L	3.00
C1K/B	7.50	5L1	7.50	275A	3.00	842	5.00	5963	1.00
1P21	30.00	5R4GY	90	276A	4.00	845	7.50	5964	.75
1P22	7.00	5R4WGB	5.00	283A	2.50	850	12.50	5965	1.00
1P25	8.00	5R4WGY	3.00	287A	1.85	866A	1.60	5975	1.00
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1Q22	8.50	5R7A	75.00	HF-300	25.00	872A	2.50	5979/BS1	4.00
2-01C	10.00	5R11A	25.00	300B	5.00	884	1.00	5980/BS2	6.00
1AD4	1.50	5SP1	25.00	304TH	30.00	885	.65	5987	7.50
2BP1	5.00	5SP7	25.00	304TL	30.00	913	8.50	5992	2.00
2C36	18.85	6AC7W	.35	310A	2.50	918	.65	5993	4.00
2C39	3.50	6AG7Y	.75	311A	2.25	927	.85	6004	.50
2C39A	9.50	6AK5W	1.00	313C	1.00	931A	3.00	6005/6AQ5W	1.00
2C39B	18.75	6AN5	1.85	323A	5.00	954-58	.25	6011/710	8.75
2C40	7.00	6AR6	.75	328A	2.25	959	.50	6012	4.00
2C42	3.00	6A5E	.85	329A	3.50	1000T	90.00	6021A	2.00
2C43	7.50	6A5G	2.50	336A	2.00	CK-1006	2.00	6032	10.00
2C50	4.00	6B4G	2.50	337A	2.25	1237	2.00	6037/QK-243	15.00
2C51	1.50	6B6L	30.00	347A	1.00	HY-1269	3.00	6044	3.50
2C52	1.50	6B6M	30.00	348A	2.00	1500T	125.00	6045	1.15
2D21	1.00	6B86A	30.00	349A	1.50	1614	2.50	6050	1.00
2D21W	1.00	6C4W	2.50	350A	3.50	1616	.50	6072	1.50
2E22	2.50	6C21	10.00	350B	1.00	1619	.20	6073	.75
2E24	2.50	6CJ	11.50	352A	6.00	1620	3.50	6074	1.50
2E26	2.50	6GJ/A	15.00	354A	7.50	1624	.75	6080	3.00
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2J42	50.00	6J6W	.75	393A	5.00	1846	50.00	6080WB	10.00
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2K26	30.00	6L6WGB	2.00	401A/5590	1.00	5545	12.50	6099	.75
2K28	30.00	6Q5G	2.50	403A/6AK5	.65	5550	30.00	6100/6C4WA	1.25
2K29	25.00	65C7GTY	1.00	403B/5591	3.00	5636	1.00	6101/6J6WA	1.00
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2K50	75.00	10K7P	15.00	429A	6.50	5678	1.25	6161	50.00
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3B24	.35	FG-17	2.00	576	12.50	5693	3.75	6211	.75
3B24W	3.00	HK-24	1.00	577	12.50	5696	1.00	6216	2.50
3B24WA	5.00	25T	10.00	578	5.00	5702	1.50	6236	150.00
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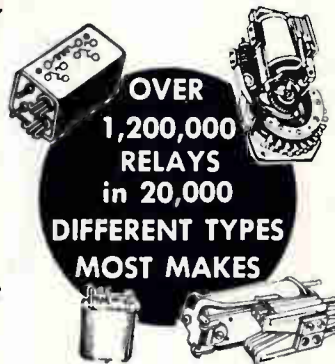
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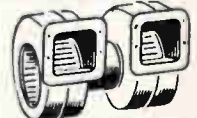
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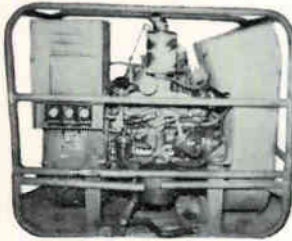
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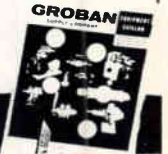
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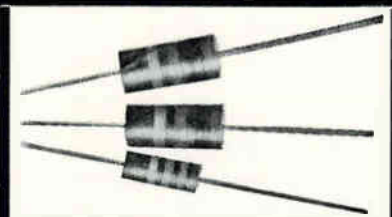
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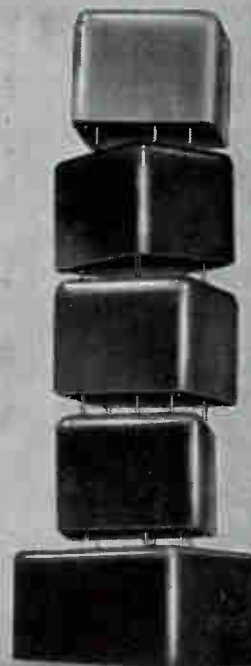


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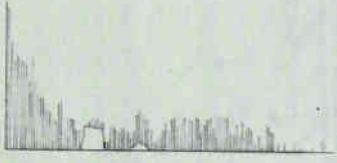
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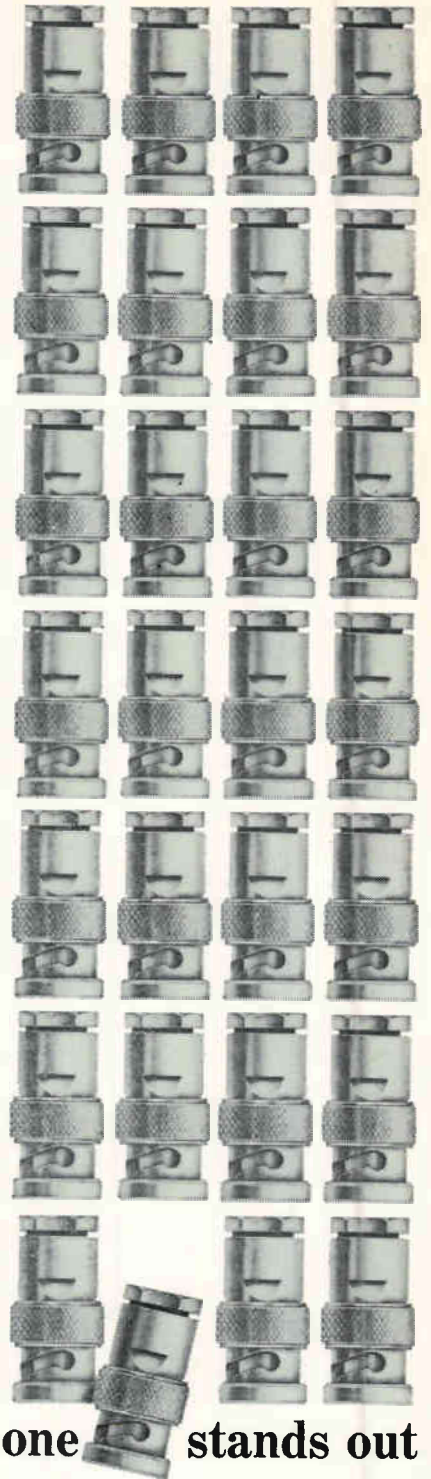
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MPT-4	TF4RX35YY	0.5/0.5	250
MPT-5	TF4RX35YY	0.5/0.5/0.5	500
MPT-6	TF4RX35YY	0.5/0.5	500
MPT-7	TF4RX35YY	0.7/0.7/0.7	200
MPT-8	TF4RX35YY	0.7/0.7	200
MPT-9	TF4RX35YY	1.0/1.0/1.0	200
MPT-10	TF4RX35YY	1.0/1.0	200
MPT-11	TF4RX35YY	1.0/1.0/1.0	500
MPT-12	TF4RX35YY	0.15/0.15/0.3/0.3	700



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Primary 105/115/125 V 50-60~

Cat. No.	Appl.	MIL Std.	MIL Type
MGP 1	Plate & Fil.	90026	TF4RX03HA001
MGP 2	Plate & Fil.	90027	TF4RX03JB002
MGP 3	Plate & Fil.	90028	TF4RX03KB006
MGP 4	Plate & Fil.	90029	TF4RX03LB003
MGP 5	Plate & Fil.	90030	TF4RX03MB004
MGP 6	Plate	90031	TF4RX02KB001
MGP 7	Plate	90032	TF4RX02LB002
MGP 8	Plate	90036	TF4RX02NB003
MGF 1	Filament	90016	TF4RX01EB002
MGF 2	Filament	90017	TF4RX01GB003
MGF 3	Filament	90018	TF4RX01FB004
MGF 4	Filament	90019	TF4RX01HB005
MGF 5	Filament	90020	TF4RX01FB006
MGF 6	Filament	90021	TF4RX01GB007
MGF 7	Filament	90022	TF4RX01JB008
MGF 8	Filament	90023	TF4RX01KB009
MGF 9	Filament	90024	TF4RX01JB012
MGF 10	Filament	90025	TF4RX01KB013



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AUDIO TRANSFORMERS**

Cat. No.	Imped. level—ohms	Appl.	MIL Std.	MIL Type
MGA 1	Pri. 10,000 C.T. Sec. 90,000 Split & C.T.	Interstage	90000	TF4RX15AJ001
MGA 2	Pri. 600 Split Sec. 4, 8, 16	Matching	90001	TF4RX16AJ002
MGA 3	Pri. 600 Split Sec. 135,000 C.T.	Input	90002	TF4RX10AJ001
MGA 4	Pri. 600 Split Sec. 600 Split	Matching	90003	TF4RX16AJ001
MGA 5	Pri. 7,600 Tap @ 4,800 Sec. 600 Split	Output	90004	TF4RX13AJ001
MGA 6	Pri. 7,600 Tap @ 4,800 Sec. 4, 8, 16	Output	90005	TF4RX13AJ002
MGA 7	Pri. 15,000 C.T. Sec. 600 Split	Output	90006	TF4RX13AJ003
MGA 8	Pri. 24,000 C.T. Sec. 600 Split	Output	90007	TF4RX13AJ004
MGA 9	Pri. 60,000 C.T. Sec. 600 Split	Output	90008	TF4RX13AJ005

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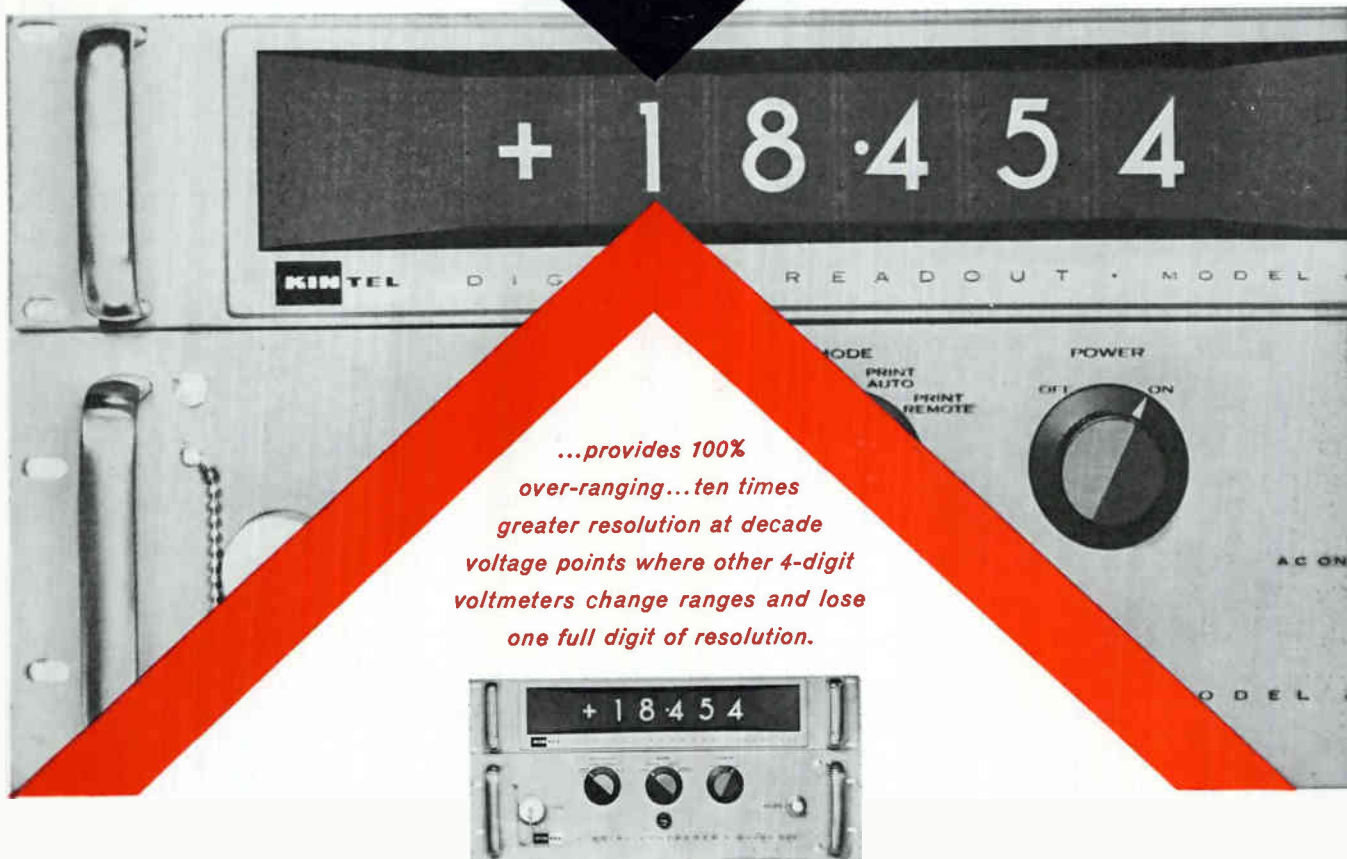
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*This unique "extra"
fifth digit...*



*...provides 100%
over-ranging...ten times
greater resolution at decade
voltage points where other 4-digit
voltmeters change ranges and lose
one full digit of resolution.*

The KIN TEL Model 501B 4-digit, over-ranging digital voltmeter measures DC from ± 0.0001 to ± 1000.0 volts to an accuracy within 0.01% of reading ± 1 digit. An extra fifth digit in the left decade indicates "0" or "1" to provide ten times greater resolution at decade (1, 10, 100) voltage points than standard 4-digit voltmeters. Ranging and polarity indication are entirely automatic. The measured voltage, decimal point and polarity symbol are displayed on an in-line readout in a single plane—no superimposed outlines of "off" digits.

An adjustable sensitivity control permits decreasing sensitivity to allow measurement of noisy signals. Ten-line, parallel input printers can be driven directly, and converters are available for driving other types of printers, typewriters, and card or tape punches. The input may be floated up to ± 300 volts DC without affecting accuracy, up to ± 500 volts DC and keep an accuracy within 1 digit of that specified. Stepping switches are energized by DC as in telephone service to provide long, trouble-free operation (covered by warranty for two years).

The 501B is one of a complete line of KIN TEL digital instruments. Others include AC converters, AC and DC preamplifiers, ratiometers, comparators, and multi-channel input scanners.

IMPORTANT SPECIFICATIONS

Display... Six decades display 5 digits (Left digit "0" or "1" only), decimal point, polarity symbol. Ranging and polarity indication are automatic. Projection system readout employs bayonet-base lamps with 3000-hour minimum life rating. Readout contains no electronic circuitry and can be remotely mounted.

Automatic Ranges... ± 0.0001 to ± 1000.0 volts DC in four ranges: 0.0001 to 1.9999; 02.000 to 19.999; 020.00 to 199.99; 0200.0 to 1000.0

Accuracy... 0.01% ± 1 digit (of reading).

Input Impedance... 10 megohms on all ranges at null.

Reference Voltage... Chopper-stabilized supply, continually and automatically referenced to standard cell.

Stepping-Switch Drive... DC voltage within stepping-switch manufacturers rating applied by transistor drive circuit at rate of approximately 20 steps per second.

Controls... Three: on-off; sensitivity; and mode of operation (standby, normal, print auto, print remote).

Printer Drive... Built-in for parallel input printers. Automatic or remote.

Dimensions and Net Weights... Control unit: 45 lbs, 5 1/4" H x 19" W x 16" D.
Readout: 10 lbs, 3 1/2" H x 19" W x 9" D.

Price: \$2995

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CW APPLICATION

Type	Prototype	Description	Power Output at Frequency	Max. Freq. (Mc)	Power Gain	Typical Plate Kilo-volts	Typical Pulse Plate Kilo-volts	Typical Duty Factor	Typical Pulse Width μ Sec
6448	—	Beam Power Tetrode	14Kw/400Mc	1000	35	6.5	—	—	—
6806	6448	Beam Power Tetrode	25Kw/400Mc	1000	85	8.5	—	—	—
2029	6806	Beam Power Tetrode	25Kw/400Mc	1000	85	8.5	—	—	—
A-2548*	2041	Beam Power Tetrode	50Kw/425Mc	575	50	10.0	—	—	—
A-2690*	6952	Beam Power Tetrode	70Kw/450Mc	900	50	10.0	—	—	—
6949	—	Shielded-Grid Triode	500Kw/425 Kc	75	250	17.5	—	—	—
A-15157*	A-2342*	Shielded-Grid Triode	500Kw/110Mc	150	25	17.0	—	—	—
A-2335-C*	—	Double-Ended Triode	75Kw/550Mc	1000	15	9.0	—	—	—
A-15161*	A-15037*	Double-Ended Triode	300Kw/425Mc	600	10	9.0	—	—	—

PULSED RF APPLICATION

2041	A-2515-H*	Beam Power Tetrode	180Kw/450Mc	575	100	24**	—	0.06	2000
4605	6952	Beam Power Tetrode	2Mw/425Mc	575	100	—	50	0.004	13
6952	—	Beam Power Tetrode	2Mw/425Mc	575	100	—	50	0.004	13
A-2589*	2041	Beam Power Tetrode	180Kw/575Mc	1000	90	—	26	0.06	2000
A-2590*	6952	Beam Power Tetrode	1Mw/940Mc 200Kw/940Mc	1000 1000	40 40	— —	40 25	0.005 0.05	20 200
A-2606*	2041	Beam Power Tetrode	1.25Mw/425Mc	900	100	—	50	0.003	13
A-2645*	6952	Beam Power Tetrode	275Kw/425Mc	900	100	25**	—	0.06	2000
A-2669-A*	6952	Beam Power Tetrode	275Kw/425Mc	900	100	20**	—	0.06	2000
4603	6949	Shielded-Grid Triode	1.5Mw/50Mc	100	125	—	32	0.09	2000
6950/2039	A-2342*	Double-Ended, Shielded-Grid Triode	1.5Mw/200Mc	250	30	—	30	0.05	2000
2054	A-2346-N*	Double-Ended Triode	5Mw/440Mc	600	25	—	33	0.06	2000
7835	A-2346-f*	Double-Ended Triode	5Mw/250Mc	300	35	—	34	0.006	25
A-15025-A*	A-2346-f*	Double-Ended Triode	5Mw/250Mc	300	35	—	34	0.02	20
A-15040*	A-15037*	Double-Ended Triode	5Mw/425Mc	600	30	—	30	0.008	20
A-15038*	—	Coaxitron	5Mw	Broadband 385-465	20	—	25	0.008	30
A-2344*	A-2335*	Double-Ended Triode	5Mw/900Mc	200-1300	20	—	50	0.01	10

HARD-TUBE MODULATOR APPLICATION

A-15034-C*	6949	Shielded-Grid Triode	11Mw	—	—	40	—	0.05	2000
A-15042	5831	Beam Triode	44Mw	—	—	40	—	0.005	20

*Developmental Type Number **Screen-and-Grid-Pulsed Amplifier Service

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