L-band klystron delivers 30-megawatts peak power
UTC stock hermetic units have been fully proved to MIL-T-27A, eliminating the costs and delays normally related to initial MIL-T-27A tests. These rugged, drawn case, units have safety factors far above MIL requirements, and are ideal for high reliability industrial applications. Listed below are a few of the hundred stock types available for every application. Industrial ratings in bold.

### Typical Miniature Audios
RC-25 Case 61/64 x 1-13/32 x 1-9/16 1.5 oz.

### Typical Subminiature Audios
SM Case 1/2 x 11/16 x 29/32 .8 oz.

### Typical Compact Audios
RC-50 Case 1-5/8 x 1-5/8 x 2-5/16 8 oz.

### Typical Power Transformers
Pric: 115V 50/60 Cyc. *Choke/Cond. inp.

### Typical Filament Transformers
Pric: 105/115/210/220V except H-130 (115) and H-131 (115/220) 50/60 Cyc.

### Typical Filter Reactors

### United Transformer Corporation
150 Varick Street, New York 13, N.Y.


Export Division: 12 East 40th Street, New York 16, N.Y. Cables: "Aralab"
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ENGINEERING

L-band klystron by Litton Industries delivers 30 megawatts peak, 100 Kw average. Tube is 39 percent efficient, was developed for MIT Lincoln Lab under USAF contract. It is used in long-range missile-detection research. See p 123

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Our instruments, 40 to 100,000 cycles, are used extensively by industry and on government projects where enduring accuracy and maximum durability are required. Your inquiries on related products are invited.

**Precision Frequency Standards and Fork Oscillator Units**

**Precision Fork Oscillator Units**

**TYPE 2003**
- Size: 1½" dia. x 4½" H.
- Weight: 8 oz.
- Frequencies: 200 to 4000 cycles
- Accuracies:
  - Type 2003 (±.02% at -65° to 85°C)
  - Type R2003 (±.002% at 15° to 35°C)
  - Type W2003 (±.005% at -65° to 85°C)
- Double triode and 5 pigtail parts required.
- Input: Tube heater voltage and B voltage
- Output: approx. 5V into 200,000 ohms

**TYPE 2007-6**
- TRANSISTORIZED, Silicon Type
- Size: 1½" dia. x 3½" H.
- Weight: 7 ozs.
- Frequencies: 300 to 1000 cycles
- Accuracies:
  - Type 2007-6 (±.02% at -50° to +85°C)
  - Type R2007-6 (±.002% at +15° to +35°C)
  - Type W2007-6 (±.005% at -65° to +85°C)
- Input: 10 to 30 Volts, D.C., at 6 ma.
- Output: Multitap, 75 to 100,000 ohms

**TYPE 2001-2**
- Size: 3¾" x 4½" x 6" H.
- Weight: 26 oz.
- Frequencies: 200 to 3000 cycles
- Accuracy: ±.001% at 20° to 30°C
- Output: 5V. at 250,000 ohms
- Input: Heater voltage, 6.3 - 12 - 28
- B voltage, 100 to 300 V., at 5 to 10 ma.

**Accessory Units for 2001-2**
- L—For low frequencies
- D—For low frequencies
- H—For high frequencies
- M—Power Amplifier, 2W output
- P—Power supply

**Precision Frequency Standards**

**TYPE 2005A**
- Size: 8" x 8" x 7¼" High
- Weight: 14 lbs.
- Frequencies: 50 to 400 cycles (Specify)
- Accuracy: ±.001% from 20° to 30°C
- Output: 10 Watts at 115V
- Input: 115V. (50 to 400 cy.)

**TYPE 2121A**
- Size: 8¾" x 19" panel
- Weight: 25 lbs.
- Output: 115V
- 60 cycles, 10 Watt
- Accuracy: ±.001% 20° to 30°C
- Input: 115V (50 to 400 cy.)

**TYPE 2111C**
- Size: with cover
- 10" x 17" x 9" H.
- Panel model
- 10" x 19" x 8¾" H.
- Weight: 25 lbs.
- Frequencies: 50 to 1000 cy.
- Accuracy: (±.002% at 15° to 35°C)
- Output: 115V, 75W.
- Input: 115V, 50 to 75 cy.

**American Time Products Inc.**
61-20 Woodside Avenue
Woodside 77, N. Y.
TAMING OF THE SCREW

Newest additions to the Burnell Adjustoroid® line, the microminiaturized Kernel ATE 34 and the miniatures ATE 11, ATE 0, ATE 4, represent an important contribution to printed circuit design.

These new Adjustoroids possess the exclusive advantage of flush-slotted heads which serve to eliminate adjusting screws — provide maximum economy of height — insure ease of adjustment. Besides high Q, they also offer high stability of inductance versus dc.

The new microminiature Kernel ATE 34 and the miniature ATE 11, ATE 0 and ATE 4 Adjustoroids are variable over a 10% range of their inductance. Fully encapsulated, they will withstand high acceleration and vibration environments. These Adjustoroids meet specifications MIL-T 27 Grade 4, Class R and MIL-E 13305 A as well as MIL-E 5272 for humidity and thermal shock. Write for Adjustoroid Bulletin ATE-7.

SEND NOW FOR HANDY 24" x 36" TOROIDAL INDUCTOR WALL REFERENCE CHART

Lists more than 100 types of toroidal inductors and adjustoroids. Gives performance characteristics, mechanical specifications, including case sizes, types of sealing, etc. Attach coupon to company letterhead. And if you haven’t already done so—send for your free membership in the Space Shrinkers Club.

Burnell & Co., Inc.
10 Pelham Parkway, Pelham, New York

Gentlemen:

☐ I am interested in your new universal toroidal reference chart.
☐ I am interested in a Space Shrinkers Club membership.

name

address

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Pioneers in Microminiaturization of Toroids, Filters and Related Networks.

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Pelham, N. Y.
Tel: Pelham 3-5000

Pacific Division
Dept. E-38
720 Mission St.
South Pasadena, Calif.
Tel: Murray 2-2841

August 12, 1960

CIRCLE 3 ON READER SERVICE CARD
CROSSTALK

CHALLENGE AT WESCON. As the world's second largest electronics show and convention gets underway a week from next Tuesday in Los Angeles, manufacturers will be learning to live in a changing economic climate. The changes affect largely the military part of our business, and this means the challenge to western industry is especially great.

The day of helter-skelter buying of all kinds of military electronics equipment is apparently coming to a close. There will no longer be funds for every gadget someone thinks is nice, nor will there be funds for every company with an idea. Manufacturers with proven capabilities in underside warfare, ballistic missile guidance, advanced communications, space exploration, countermeasures and reconnaissance will get substantial production business and considerable R&D work. Marginal operators will not be so lucky.

Already responding to the challenge, one West Coast company has brought out a new line of industrial and medical instruments to build its commercial business, another has gone heavily into digital process control. Many firms are actively working to develop an engineering capability more salable in today's defense market as well as commercially.

Throughout our industry, and particularly on the West Coast, the signs of the times are clear: develop new markets, learn how to satisfy present ones or be swallowed up by a company that can.

EDITOR

W. W. Mac Donald

WESTERN ELECTRONICS. When you are packing your bag for the Wesccon trip, take along this issue of ELECTRONICS. On the plane or train you'll be able to read our advance coverage of many papers being presented.

Pacific Coast Editor Hal Hood also brings you a synopsis of western R&D in our lead story. (see p 128). Included in Hood's coverage are: A cryogenic gyro scope being developed at the Jet Propulsion Laboratory — this gyro should provide one of the most accurate guidance instruments for spacecraft. Also, from Hughes Aircraft, an X-band solid state ruby maser amplifier developed by the same scientists who recently announced development of a ruby laser (optical-frequency amplifier). The 25-lb maser can extend the bandwidth of many Army electronics systems, can pick up radio beeps from millions of miles in space.

Western developments in communications with satellites and space probes are exemplified by: A compact uhf isolator from the Motorola Solid State Electronics department in Phoenix, an electro statically focused traveling-wave tube and feedback cavity by Watkins-Johnson for its microwave telemetry oscillator, and a high power L-band klystron by Litton Industries.

Other items include: Varian's electronic indicator that hunts metallic contamination in lubricating oil; Convair's Autotrack analyzer that can differentiate between vibrations one cps apart over a 5 to 2,500 -cps range; investigations by Stanford University's Radioscience Laboratory, bouncing radar signals off the sun's corona; and neuron research work being carried out by the Stanford Research Institute and Cornell Aeronautical Labs.

This week's complete editorial Wesccon fare also includes: Looking Ahead to Wesccon (p 44); New Look in Recruiting (p 49), What Wesccon Exhibitors Are Saying (p 51), Designers Vie for Wesccon Prizes (p 46), New On The Market at the Wesccon Show (p 160), Moore: At Wesccon, a numismatist and Exhibitors at the Show (p 254).
Here is another GIANT STEP toward optimum reliability...

Sprague Electric’s new COMPULYTIC Capacitors now permit digital computer power supply filtering at operating temperatures to 85 C as standard. This is a full 20 C higher than capacitors offered by other sources. COMPULYTICS will reduce your design headaches and cut down your cooling and ventilating problems.

New! compulytic capacitors are now designed for 85 C operation

Under normal 85 C operating conditions, Type 32D COMPULYTIC Capacitors display extremely low leakage current, low equivalent series resistance, and have higher permissible ripple current values. Extended shelf life of 3 years and more is another outstanding feature.

Ratings up to 130,000µF at 2.5 volts or 630µF at 450 volts are skillfully packed into the largest standard case size of 3" dia. by 4¾" high. Capacitor banks as large as 1 farad have been constructed, in relatively small space, using COMPULYTIC Capacitors.

Because of their extremely high stability, COMPULYTICS are ideally suited for use in continuously adjustable voltage power supplies since they will not “deform” when operated for long periods at lower than rated voltages.


SPRAGUE COMPONENTS:
CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES
In Trio Labs' new Standard Laboratory AC VTVM...the signal circuits are isolated from case and power circuits, to provide

- floating measurements previously impractical
- accurate voltage measurements to 5 cps
- shock safety: case isolated from circuit under test

The new Model 109-2 has 12 voltage ranges calibrated to RMS value of a sine wave: 0.001 to 300 VAC full scale, with frequency range of 5-200,000 cps. Accuracy is ±2% full scale. Can measure accurately to 20 microvolts. Input impedance 10 megohms. Low distortion amplifier output voltage can be externally shorted without internal damage. Power: 105-125 VAC, 50-420 cps, 25 watts. Price: $220.00


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**COMMENT**

Electronics Probes Nature

Congratulations on your July 29th issue. The special report "Electronics Probes Nature" was one of the all-time highlights of **Electronics**.

I have been a subscriber for a number of years but have never written you on any subject during these many years.

I am removing this special section intact and placing it alongside other outstanding scientific reports . . .

H. D. WESTBROOKS
GRiffin, GA.

. . . I found the July 29 issue extremely interesting, especially the portion dealing with the probing of nature . . .

ARThUR F. JOY
RAYTHEON CO.
WALTHAM, MASS.

Recruiting

I understand mass recruiting will be de-emphasized at this month's Wescon show. Is this report true?

DONALD ROMEO
GLOUCESTER, MASS.

It is. See p 49.

Labor Unions

I have always read **Electronics** with a great deal of interest, but I was most surprised to see the comments concerning the election among some professional engineers to determine their desire to be represented by a labor union. This appeared in the column Washington Outlook in the June 3 issue (p 14).

Far from being "dealt a blow," the results of the election would appear to be a major victory for labor unions, considering that approximately 40 percent of the voters favored representation by labor unions. I agree with your second observation, though, that the results could boost efforts of the production unions to increase professional membership; but not for the reason indicated in the article. In what other profession could an
affirmative vote of 40 percent be expected?
If the report is factual, the important observation would be: "Why did 40 percent of the professional engineers employed vote in favor of labor union representation?" One can only conclude that a great number of professional engineers see their only hope for recognition, self-respect and remuneration through the efforts of labor unions. Another possibility, of course, is a sense of indebtedness to unions for the professional engineer's present success.

As a Canadian professional engineer, I do not wish to be represented by a labor union. This is not to imply that a labor union is to be abhorred; it means that the professional engineer has a responsibility to the public and himself by virtue of the professional standing accorded him by law which could conflict with the aims, objectives and procedures of labor unions and laws governing them.

I am afraid that professional engineers often mistakenly identify the treatment afforded them in the course of their employment with the obligations demanded by their professional status. I also suspect the remarks in the column referred to may have been influenced by the intellectual anesthetic which often is a byproduct of the North American desire to keep in fashion.

M. J. McInroy

DON MILLS, ONTARIO

Since the majority rules, we naturally considered that the rejection of the union by a majority of the company's engineers in what was the largest election ever conducted among professional employees by the National Labor Relations Board was a blow to union organizing—which is what we said.

We agree with reader McInroy that the responsibilities of some professional engineers might conflict with aims and procedures of some unions. Our report was factual—and it was not influenced by any anesthetic, intellectual or otherwise. We still cannot agree that losing an election can be (as reader McInroy puts it) "a major victory for labor unions."

COMPACT, 3-OUNCE TIME DELAY RELAY
with silicone-controlled delay from 1/4 to 120 seconds

Worth a closer look . . . the Heinemann Type A Silic-O-Netic Relay. Despite its small overall size, the relay offers many big performance features.

For example, double-pole, double-throw switching . . . at fast snap-action contact speed.

The relay is a load carrier in itself: it may be energized continuously . . . does not require auxiliary lock-in circuits.

And it has a hermetically sealed time element that is forever free from the effects of aging or fatigue. The Type A Relay has proven itself in countless applications; it will give you reliable service over a long, long operational life.

For full details, refer to Bulletin T-5002. A copy will be sent on request.

BRIEF SPECS
Time Delays: from 1/4 to 120 seconds
Overall Dimensions: 2-1/16" x 2" x 1-9/16"
Contact Capacity: 3 amps at 120V AC, 1.5 amps at 240V AC (non-inductive load), 1 amp at 50V DC, 0.5 amp at 125V DC.

HEINEMANN ELECTRIC COMPANY
176 Plum St., Trenton 2, N. J.
SEE US AT WESCON BOOTH 445-455

CIRCLE 7 ON READER SERVICE CARD
Now, with one instrument, you can

1 mv at

hp 411A Voltmeter

Specifications

Voltage Range: 10 mv rms full scale to 10 volts rms full scale in seven ranges. Full scale readings of 0.01, 0.03, 0.1, 0.3, 1, 3 and 10 volts rms.

Frequency Range: 500 KC to 1,000 MC with accessory probe tips.

Accuracy: 1 MC to 50 MC, ±3% of full scale; 50 MC to 150 MC, ±6% of full scale; 500 KC to 1,000 MC, ±1 db.

Meter Scales: Two linear voltage scales, 0 to 1 and 0 to 3, calibrated in the rms value of a sine wave. Db scale, calibrated from +3 to -12 db, 0 db = 1 mw in 50 ohms.

Galvanometer Recorder Output: Proportional to meter deflection, 1 ma into 1000 ohms at full scale deflection.

Probe Tip Furnished: Pen type Probe Tip, 500 KC to 50 MC. Shunt capacity less than 3 picofarads at 1 volt, less than 4 picofarads at 10 mv. Shunt resistance depends on voltage and frequency.

Other Probe Tips Available at Additional Cost: VHF Probe Tip, 500 KC to 250 MC. Shunt capacity less than 1.5 picofarads at 1 volt, less than 2 picofarads at 10 mv. Shunt resistance depends on voltage and frequency.

Type N "Tee" Probe Tip, 500 KC to 1,000 MC. SWR less than 1.15 when terminated in 50 ohms.

BNC Open Circuit Probe Tip, 500 KC to 500 MC.

100:1 Divider Probe Tip, 500 KC to 250 MC. Division accuracy ±1%. Shunt capacity 2 picofarads. Shunt resistance depends on voltage and frequency.

Power: 115/230 volts ±10%, 60 cps, 35 watts.

Price: Model 411A $450.00.

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

1,000 mc!

or any rf voltage 1 mv to 10 v, over the very broad bandwidth of 500 KC to 1,000 MC. Accuracy is higher than any similar voltmeter known. Measuring is as simple as “touch and read” on the big, high resolution linear scale. Annoying thermal drift errors are eliminated.

Think of the times you would have liked to measure —with utmost accuracy—millivolts at rf frequencies.

Now you can do it, easily and dependably, with one compact instrument—the new @ 411A VTVM. This remarkable instrument has true linear operation—no correcting networks are required.

It has high temperature stability—negligible accuracy change from 10° to 40°C.

Such performance stems from a unique, @-developed circuit involving feedback applied to a diode-detector-dc amplifier arrangement; and further involving instantly replaceable, encapsulated, matched diodes!

Truly, this circuit has to be seen and operated to be believed. Write for a detailed description (ask for @ 411A Data Sheet) or better yet, call your @ rep for a bench demonstration.

And how about these extra features: (a) the matched diodes are protected against burnout (b) probe is temperature compensated for low drift (c) @-developed amplifier photochopper eliminates contact noise, guarantees high sensitivity, zero-drift freedom (d) extra probe tips include units for high frequency measurement, for measuring on as well as at termination of coax transmission lines, and a capacity divider increasing 411A voltage capability to 1,000 volts.

Why put up with complex, cumbersome instruments? Get a new 411A into action on your bench now!

HEWLETT-PACKARD COMPANY
1051A Page Mill Road, Palo Alto, California, U.S.A.
Cable “HEWPACK” DAvendorp 6-7000
Sales representatives in all principal areas

HEWLETT-PACKARD, S.A. Rue du Vieux Billard No. 1, Geneva, Switzerland
Cable “HEWPACKSA” Tel. No. (022) 26. 43. 36

August 12, 1960
UNIQUE NEW EIMAC 3CX10,000A3 CERAMIC TRIODE
OFFERS VHF POWER—UP TO 20 KW

Eimac expands its ceramic tube line with the introduction of the 3CX10,000A3—the only 10 kilowatt air-cooled ceramic triode in the field. This advanced power tube is intended for use at maximum ratings through 110 megacycles.

An outstanding feature of this clean, efficient ceramic triode is the large reserve of grid dissipation assured by platinum-clad tungsten grid wires. Overload protection has also been built into the 3CX10,000A3 to make it ideal for use in industrial heating—dielectric and induction.

This newly developed triode is also well suited for such applications as broadcast, FM and single-sideband transmitters, ultrasonic generators and sonar pulse amplifiers. It can also be used as a class-AB2 or class-B linear amplifier in audio or r-f service.

A companion air-system socket and chimney, as shown above, is available with the 3CX10,000A3 to meet your specific requirements. Watch for a low mu version of this high-power triode in the near future.

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<td>102 amp.</td>
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EITEL-McCULLOUGH, INC.
San Carlos, California

10 CIRCLE 10 ON READER SERVICE CARD
Silicon Power Unit

**Bids for Space Jobs**

**DEVELOPMENT** of a 1-Gc solid-state power generator promises to increase the range of space communications, prolong the life of satellite transmitters.

UHF power generator was designed by Pacific Semiconductors, uses advanced transistors and silicon high-Q voltage-variable capacitors. Unit is a combination of oscillator, amplifier and several stages of frequency multiplication. Rated output of one watt is substantially greater than that of commercially available uhf generators. The device will be described in detail at Wesccon.

**Japan Sets Quota**

**For "Toy" Radios**

**ADMITTING** that so-called toy transistor radios—containing only one or two transistors—are "confusing the U.S. market because they look almost like regular transistor radios," Japan's Ministry of International Trade & Industry last week suspended all exports of the small sets for the month of August. Beginning Sept. 1, an export quota for the hitherto exempt sets will be enforced. Quotas will be set in accordance with actual exports of individual trading firms. Exports of the toy sets to the U.S. alone exceeded 167,000 units during June, more than ten times the figure for June 1959.

Meanwhile, the British radio industry has reacted angrily to the quotas for radio and tv sets negotiated as part of a Japan-United Kingdom trade deal. For the fiscal year ending next March 31, Japan is given a quota of $560,000 for transistor radio exports to the U.K. and an additional $560,000 for other radios and tv sets, compared with a total quota of $56,000 for both categories in the previous fiscal year. British manufacturers argue that for $560,000, Japan can deliver over 50,000 transistor sets, about 4 percent of the overall British market and perhaps 7 or 8 percent of the market for transistor radios.

**British Setmakers are also worried by a direct market invasion from Sony Corp. The fast-moving Tokyo firm recently opened a new plant in Shannon, Ireland. New plant will produce 10,000 transistor radios a month, employ 200 Irish workers and a handful of Japanese technicians. Transistors will be shipped from the Sony plant in Tokyo, but everything else will be Irish. Since half the capital—$140,000—is Irish, and at least 51 percent of the total plant output will represent Irish parts and labor, the production can be certified as of Irish origin and receive the same preferential tariff and tax treatment in the sterling trading areas and the Common Market that are accorded British products.**

**German City Planning**

**Remote-Controlled Subway**

**ELECTRONIC COMPUTER will run the subway system in the German city of Hamburg starting in 1962.**

The Hamburger Verkehrsgesellschaft (transport company) is ordering a computer to handle traffic in the subsurface system. This will store timetable data, remember time each train should stop at each station, start and stop traffic accordingly. Special programs will account for unusual conditions, such as construction work requiring slowdowns or route switching.

The transport company hopes to improve operating economy 15 percent over present levels, figures on reduced error and consequently safer operation.

**EEs Discussing Solar-Cell Problems**

**ENGINEERS attending the Pacific general meeting of the American Institute of Electrical Engineers, being held this week in San Diego, Calif., are hearing several discussions of the problems of producing power by means of solar cells.**

Practical upper limit in solar cell efficiency, say two Lockheed engineers, is 15 percent of the available 130 w per sq in. Present cells are 10 percent efficient; theoretical limit of 19.6 percent has been calculated. The two engineers, A. B. Francis and W. E. Happ, call cadmium sulfide "a particularly promising material" with "strong voltaic effect." Large-scale production, improved fabrication methods resulting in higher reliability and lower cost, new materials with higher conversion efficiencies, and novel design techniques may drive the price of solar power down to $300 per watt or lower they say.

Convair engineer S. J. McCunney discusses the configuration of present solar voltaic collectors, says that present high costs indicate "careful consideration of panel design." He points out that present collector panels are formed from quantities of boron-coated silicon crystals on a structural backing, cost about $2,000 per sq ft. Cost per watt of average connected load varies from $700 to $6,000, depending on configuration and orientation (earth-oriented satellites use solar cells more efficiently than rotating vehicles do, for instance). McCunney says present low production rate of 150 sq ft a month is partly responsible for high costs.

**Reds to Supply Cuba**

**With 56 Factories**

**IRON CURTAIN countries will build 56 industrial plants for the production of everything from icepicks to chinaware in Fidel Castro's new Cuba. Havana's Communist mouthpiece Hoy (Today) provides no data on 13 plants, but cost of the other 43 will approach $76 million. Twelve facilities will produce electrical or electronic equipment.**

Included are generating stations, one each from USSR and Czechoslovakia, costing $11.5 million apiece. The Soviets will also build a plant for processing manganese at an unspecified cost. Poland's share includes an incandescent lightbulb works for $1.25 million.

East Germany's technical know-how will put up a $2-million refinery for producing kaolin, a $2.3-million facility to make wire and cable, and plants for the production of soldering electrodes, transformers, electric motors, photographic materials, radios and electrical appliances.
WASHINGTON OUTLOOK

ANOTHER INTER-SERVICE MISSILE RUMPS is shaping up over the issue of what medium-range missile the U. S. should supply to NATO. For the industrial contractors tied to the three services, the issue is a crucial one. At stake is a potential missile market of hundreds of millions of dollars.

NATO's requirements call for some 1,000 ballistic missiles to be deployed by some of the member nations starting about 1965. NATO planners envisage a missile with considerable mobility—capable of launching from fixed installations, tracked vehicles, trucks, barges, or trains. They want a solid-fueled missile with a self-contained all-inertial guidance system which could be used for both tactical and strategic missions. Its projected range: 200 to 1,200 miles.

Earlier this year, Defense Secy. Gates told NATO the U. S. was ready to meet the new missile requirement with a modified version of the Navy's Polaris (equipped with a GE-built guidance system).

But since then the Army has come up with a proposal that its Pershing missile be selected for NATO's use. The missile is still under development. Martin is the prime contractor, Bendix the guidance subcontractor.

Now the Air Force has gotten into the picture. For some time the Air Force has been clamoring for funds—unsuccessfully so far—to develop a small, mobile missile for its tactical air command as a follow-on to the jet-powered Mace. The project is still in the study stage. Aerospace Corp., the Air Force's new "braintrusting" contractor, is in charge of the project. The Air Force believes the Mace follow-on could be ready in time to meet NATO's requirements.

So far, it's still undecided whether the NATO missile would be manufactured by U. S. firms or whether western European companies would be licensed for production.

TEN ELECTRONICS EXECUTIVES recently attended an unprecedented, three-hour Pentagon conference on the delays in getting the first four Atlas ICBM bases combat ready. Top executives of the 40 other leading ICBM production and construction contractors also attended.

"Purpose was to outline causes of the delays, explain the Pentagon's new centralized management of the program, and to give contractors "a greater sense of urgency" about the program."

In the electronics field, there have been jurisdictional labor disputes between unions representing construction electricians and the installation men who work for electronics producers.

The electronics industry representatives at the meeting: Joseph A. Anderson, vice president, GM's AC div.; John L. Burns, president, and A. L. Malcarney, vice president, RCA; Lt. Gen. J. H. Doolittle, Board chairman, Space Technology Laboratories; Ray R. Eppert, president, Burroughs; Charles W. Perelle, president, American Bosch Arma; R. L. Shelter, general manager, GE; George A. Strichman, president, Kellogg Switchboard & Supply Co.; H. T. Engstrom, vice president, Remington Rand; W. H. C. Higgins, director of military electronics developments, Bell Telephone Laboratories.

THE GOVERNMENT WILL BE SPENDING close to $1.5 billion a year for the next 10 years or so for its space programs. That is what National Aeronautics and Space Administration's T. Keith Glennan told more than 1,300 industry representatives recently at a classified preview of the nation's projected space programs.

Glennan and other top NASA officials made it clear that a large chunk of the money will be going for electronics. As the space program moves into such projects as interplanetary flights, moon landings and orbiting space platforms, it calls for new requirements in such things as high-power telemetry, low-noise receivers, improved power supplies. The emphasis, NASA officials made it clear, will be on reliability and miniaturization of instruments going into the space vehicles.
BEST TEST
SET YET!

For fast, foolproof measurement of GAIN, LOSS, VSWR, Q, X, Xc, Z

Crystal Controlled Marker Generator
Model CM-10—A 10-crystal unit producing any selected fundamental and/or harmonic frequencies. Each oscillator has its own independent amplitude control. Features built-in scope pre-amplifier and VSWR filter.

Precision Sweep Generator
Model 707—The heart of the test set. Features an extremely flat RF output (±5/100 db) and variable rate, all electronic sweep with plug-in oscillators available covering 2 to 265 mcs. Provisioned for use with an X-Y plotter.

Accurate Voltage Comparator
Model VC-12—The unit that makes Measurement By Comparison possible. A 3-section instrument that contains regulated DC and RF voltage supplies and a wide band coaxial comparator for the simultaneous visual presentation of reference standards against which the test information is compared.

Model 1707 Price $1,570.00
(Oscilloscope, rack, or recorder not included)

Complete RF TEST SET employs the Measurement By Comparison technique

Interested in more than one frequency . . . an entire band, octave, or spectrum? Now it's no longer necessary to employ the slow, tedious, point-by-point method of measurement when working with a spectrum of frequencies. Jerrold's new 1707* test set will do the same measurement job Faster, more accurately, and with fool-proof results. Featuring the Measurement By Comparison technique, the model 1707 provides a continuous visual presentation and self calibration against precision standard attenuators (and/or accurate DC and RF voltage sources referenced against a standard cell). So, whatever your laboratory, production, or field needs—Jerrold's sweep frequency MBC method will serve them better.

Write today for complete catalog and technical newsletter series on MBC procedures.

*Similar test sets available for other ranges

Jerrold Electronics Corporation
Industrial Products Division, Dept. ITE-68, Philadelphia 32, Pa.
Jerrold Electronics (Canada) Ltd., Toronto • Export Representative: Rocke International, N.Y. 16, N. Y.

WESCON BOOTHS 426-427

August 12, 1960
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To meet the ever expanding demands of electronic technology, Cannon maintains 9 strategically located plants in 6 countries—has sales engineering representatives in 18 more! Whatever your requirements in plugs, wherever you are, delivery is never more than a few hours away. This is a continuation of our plan to give you Cannon service...Cannon quality—anywhere in the world. Another reason why you should consult the world’s most...
experienced plug manufacturer; why you should consult Cannon for all your plug requirements.

The Cannon Plug Guide "CPG-4," containing valuable information on our products, may be obtained by writing to:

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WHICH JOB WOULD YOU TAKE?

If you’re like most of us, you’d take the job with the more tempting salary and the brighter future.

Many college teachers are faced with this kind of decision year after year. In fact, many of them are virtually bombarded with tempting offers from business and industry. And each year many of them, dedicated but discouraged, leave the campus for jobs that pay fair, competitive salaries.

Can you blame them?

These men are not opportunists. Most of them would do anything in their power to continue to teach. But with families to feed and clothe and educate, they just can’t make a go of it. They are virtually forced into better paying fields.

In the face of this growing teacher shortage, college applications are expected to double within ten years.

At the rate we are going, we will soon have a very real crisis on our hands.

We must reverse this disastrous trend. You can help. Support the college of your choice today. Help it to expand its facilities and to pay teachers the salaries they deserve. Our whole future as a nation may depend on it.

It’s important for you to know more about what the impending college crisis means to you. Write for a free booklet to: HIGHER EDUCATION, Box 36, Times Square Station, New York 36, N.Y.

Sponsored as a public service, in cooperation with the Council for Financial Aid to Education
NEW! 58BA/58DA Frequency Doubler Sets
Extend your oscillator generator or sweep oscillator frequency to 40 KMC.

M-Band Components, 10 to 15 KMC
Tail used for users new to the general component band (for 10 to 15 KMC). Check this list, 58BA. Available from the nearest 58BA Particular Components, 58BA Pipefitting Components, Variance Adapter, 58BA Pipefitting Components, Variance Adapter, 58BA Pipefitting, Variance Adapter, 58BA Pipefitting Components, Variance Adapter, 58BA Pipefitting Components, Variance Adapter. All listed with the 58BA catalog for general description of microwave equipment as supplied for this band. Call our representative for details, prices.

NEW! 364AR Noise Figure Meter—Monitors noise figure of sweep oscillators automatically on operating radars. Simple front panel calibration. Gigohm resistance for reliability in extreme environments. High sensitivity permits detecting noise sources up to 20 dB from main transmitter output. Provision for automatic alarm: output may be controlled remotely on noise figure input, and when output efficiency is below predetermined limits. Approx. $1,100.00, depending on options, modifications.

NEW! 362A Sweep Oscillator, 1 to 2 KMC, featuring fast output.
Maximum simplicity, sensitivity, convenience for adding or sweep of frequencies, 1 to 2 KMC. Also upon the 362A Sweep Oscillator, an electronic circuit provides for tube replacement and miniaturizes output unit to within 1,000,000th of full frequency. Sweep Rate and Sweep Range metz to permit fast adjustment and full coverage of frequency range. Sweep rates are fixed by means of a four-step switch. The sweep oscillo normal (slow) or sweep (fast)

Data subject to change without notice. Price's Shub factors.
NEW! 772A 20 MHz Oscilloscope

Maximum reliability, versatility characterize this rugged, multirange 20 MHz instrument. For conventional controls, the general purpose 782A is simple to use, gives broad frequency presentation on a 10" CRT. Other features include the new beam finder and unique dual plug-in system (vertical and time base plug-ins), increasing versatility. 170A, $2,150.00.

NEW! 772B 20 MHz Oscilloscope

This plug-in (shown to right), is the most useful sweep delay available. Useful with 120B 18 MHz Scopes or 782A, the 772B delay main sweep for detailed study of a complex signal or pulse train. In addition, offers a unique signal-sweep feature to show an expanded segment of delayed waveform while still retaining a presentation of earlier portions of waveform. Precise time measurement—waveform analysis of waveforms to 100 ps, accuracy ±0.05%. Delay range is adjustable to 1000 ps. Delaying sweep 2 ps range. Delayed length 10 to 30 cm. Delaying sweep 10 ps range. Delayed length 0.1 to 0.5 cm. 772B, $255.00.

NEW! 1,000 MC Scope

Audio-video oscilloscope provides power supply, with 2 output amplifier. Now! Have new power output capability from this compact 0.5 lbs. chassis. For automatic frequency response amplifier, output power to 200 mW flat to 2000 Hz. 200 mW into 8 ohm speaker, 0.5 W into 8 ohm. Ideal for audio amplifier, linpack, transistorized frequencies, etc. No need for freedom from hum, noise interference. Use the 352A plug-in in as unstable as 452A or 452B Counters.

Model 160C in 160B Oscilloscope.

NEW! 160B 15 MHz Oscilloscope

Model 160B is a reliable, rugged unit, capable of performing all required, high-speed, transient measurements on small FET, 6000 -ohm signals. In addition, vertical for display, a second series of time axis reads to 200 ps. For vertical (also also the 160B) provides a great deal of additional flexibility and high-speed operation. It exhibited sweep times as a function of vertical sensitivity. When sweep time is greater than 1/10 second, a large minimum increases fall time, which may be decreased by increasing vertical sensitivity. 160B, $2,275.00.

NEW! 160C 30 MHz Oscilloscope

As shown in 160B, this small unit is the most useful delay available. Useful with 120B 18 MHz Scopes or 782A, the 160C delay main sweep for detailed study of a complex signal or pulse train. In addition, offers a unique signal-sweep feature to show an expanded segment of delayed waveform while still retaining a presentation of earlier portions of waveform. Precise time measurement—waveform analysis of waveforms to 100 ps, accuracy ±0.05%. Delay range is adjustable to 1000 ps. Delaying sweep 2 ps range. Delayed length 10 to 30 cm. Delaying sweep 10 ps range. Delayed length 0.1 to 0.5 cm. 160C, $2,950.00.
The important advances in environmental testing come from MB

NEW MB automatic spectrum equalizer
to revolutionize random vibration testing

Constituting a major breakthrough in applied electronics, MB's new automatic spectrum equalizer now means not only more accurate vibration testing... but tremendous savings as well in test time and money for missile and aircraft manufacturers.

The reason: set-up time has been completely eliminated. Using solid state magnetostrictive filters with correct phase properties plus servo systems on each of eighty channels in the 15 to 2000 cps spectrum, vibration shaker systems can be completely equalized within 5 seconds.

Savings in time and labor over previous equalization methods can easily mean thousands of dollars per missile tested. Still another advantage is the greatly increased accuracy of accumulated test data. The spectrum is continuously monitored in narrow bandpass channels and compensation automatically made during test run.

Automatic spectrum equalization is another of MB's important and continuing contributions in the field of environmental testing.

MB ELECTRONICS
A DIVISION OF TEXTRON ELECTRONICS, INC., 1082 State Street, New Haven 11, Conn.

Heart of the MB automatic equalization system is the multi-channel transistorized amplifier which provides amplitude control. The plug-in printed circuit assembly shown above contains four of these channels. Frequency control is provided by the 80-channel filter assembly in the compact metal box.
FINANCIAL ROUNDPUP

GE Six-Month Earnings $111 Million

Electronics Company earnings in general are still on the upgrade according to latest announcements on six-month and quarterly reports. Some exceptions, however, are noted.

General Electric Co. recorded earnings of $111,429,000 for the first six months of this year. This is a decline of 5 percent from the same period of 1960. Net sales billed this year are down 2 percent to $2,022,699,000, as compared with last year. Earnings for the period were equivalent to $1.26 this year, $1.34 in 1959.

Despite this, Ralph J. Cordiner, GE board chairman, says the trend of shipments of large producer goods is most encouraging, with sales billed for the second quarter of this year showing a marked increase over corresponding months of last year. "Sales of industrial components and materials also show strong gains over 1959," Cordiner adds.

P. R. Mallory, Indianapolis, reports increases for the first half of 1960 as compared with a year ago. Net sales this year were $43,707,226 up from $42,514,000. Net earnings before taxes were $4,927,961, an increase from $4,082,795. Preference dividends this year were $93,387, dipping from $98,387 in 1959.

Per-share earnings on 1,443,739 shares rose two cents from the $1.30 figure of a year ago.

Standard Kollsman, Melrose Park, Ill., announces gains for both the six-month period and the second quarter ended June 30, 1960, over comparable periods of 1959. For the six months, net rose 115 percent and sales were up 29 percent over comparable 1959 figures. For the half-year, net totalled $1,377,714 or 69 cents a share. Last year the figures were $939,703 or 34 cents a share. Consolidated net sales in the first six months were $45,329,044, compared with $35,221,567 in the comparable 1959 period.

Burroughs Corp., reports "significant increases" in both profits and revenue at this year's half-way mark. Net income after taxes rose 57 percent to $5,043,000, compared with $3,298,000 in the same period last year. Based on number of shares outstanding, earnings per share were 76 cents for the six months, compared with 49 cents in the same 1959 period. Also rising were provisions for income taxes for the period: $5,206,000 for 1960- $3,200,000 for 1959. New incoming orders rose 32 percent this year, going from $178,475,000 in 1959 to $236,018,000.

Tracerlab's semiannual report for the first six months of 1960 indicates a marked improvement in all phases of the company's operations. Profits for the period are the best since 1953 for the Wal- tham, Mass. firm, coming this year to a figure of $55,000. Sales this...
year are up 20 percent at $6,079,000, while sales backlog is up about $1 million from the same period in 1959.

Combined net earnings of ACF Industries and its wholly owned SHPX group of companies were $5,156,000, equivalent to $3.64 per share of common stock, for the year ended April 30, 1960. In fiscal 1959, combined earnings were $2,720,000 or $1.92 a share. Of fiscal 1960's earnings, ACF accounted for $2.77 a share, SHPX for 87 cents a share. Board chairman W. T. Taylor laid emphasis on the important role of Avien and Erco, elements of the newly-formed ACF Electronics division, which has a backlog in excess of $20 million.

Hewlett-Packard president David Packard announces a decision by the company's board of directors to ask shareholder approval for a 200-percent stock dividend. A special meeting slated for Aug. 19, a week from today, will be held for this purpose. Shareholders will be asked to approve an increase in authorized shares to cover the dividend. If approval for the move is granted by the California Commissioner of Corporations, the dividend will be paid to stockholders of record on Sept. 1, 1960, within 15 days of that date. Packard says the move will broaden his company's base of ownership and help it qualify for listing on the New York Stock Exchange. A preliminary review of the company's finances indicates a rise of 15 percent in earnings over last year.

National Research Corp., Cambridge, Mass., reports net profits of $99,290, equal to 19 cents a share, for the first half of 1960. This compares with a net loss of $100,554 after tax recovery of $87,000 in the corresponding period last year, and a net profit of $17,356 in the full year 1959.

Net sales in the first six months of this year were $4,496,427. This represents an increase of 43 percent over the same period in 1959.

NEW FROM WESTINGHOUSE:
STATIC POWER SUPPLIES FOR SPACE AGE PROJECTS

Westinghouse delivers rugged, reliable static power in any power range to meet your system requirement. High efficiencies of semi-conductors assure increased system performance. Name your static power conversion problem. Military or commercial? High Voltage or Low Voltage? 1 kw or 10,000 kw? Whatever the application, check first with your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 869, Pittsburgh 30, Pa. You can be sure...if it's Westinghouse.

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Voltage Regulator and Power Supply Users:

RAYTHEON ESTABLISHES PROGRAM 2020
Now, Raytheon provides 2,020 standard magnetic voltage regulator models for AC loads and DC power supply applications with easier selection, faster delivery, lower cost.

It's the easiest, most economical way yet devised to assure you of exactly the voltage regulator you need.

Raytheon's Regulator Selection Guide provides a simple, reliable means of selecting input and output voltages, volt-ampere rating and type of mounting. By using the Guide included in the new Raytheon voltage regulator catalog you can quickly determine size, weight and other pertinent data to aid you in selecting the unit that best suits your requirements. Your selection is made from 2,020 standard voltage regulator models, all available for prompt delivery.

In addition to their use in countless AC applications, these new regulators provide many significant advantages for the DC power supply designer. Using the Selection Guide, he can readily select the appropriate regulator model directly on the basis of DC output voltage and power requirements.

An extremely wide range of AC voltage ratings is available from 2.3 to 1,055 volts and up to 10,000 volt amperes. Regulation on all models is ±1% for line voltage variations of ±15%.

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Raytheon voltage regulators are also available from your local Raytheon distributor.
Capacitor Business Up 25% Over 1959

Capacitor dollar sales are running about 25 percent ahead of last year. If rate of increase is maintained for remainder of the year, sales total for 1960 will set a new record of about $330 million.

Ceramic and electrolytic types are showing strength with sales running 30 to 40 percent ahead of last year. (For further details on electrolytic tantalum capacitors see ELECTRONICS, p 24, June 10.)

Capacitor sales growth has been quite moderate in the period 1954 through 1958, with sales rising about 10 percent for the period—from $200 million to a peak of $225 million in 1957 and slipping slightly to $218 million in 1958. Picture started to brighten in 1959 when sales increased 22 percent to $267 million.

Bureau of Census reports shipments of electronic computing equipment in 1959 were valued at $314 million, including digital equipment worth $298 million and $16 million of general purpose analogs. This compares with total shipments of $319 million in 1958, comprising $298 million of digital and $21 million of analog equipment. Where equipment was leased estimates of sales value were used. Information comes from latest Office, Computing and Accounting Machines summary, part of Bureau’s Current Industrial Reports series.

United States imports of electronic products from Japan during first three months of 1960 amounted to $16 million, almost twice imports for first quarter last year. Comparison of 1960 shipments with corresponding three months of 1959 shows: Receiving tubes up 383 percent, speakers up 233 percent, sound equipment up 301 percent and transistors up 1,059 percent.

Report on Japanese imports was supplied by Business and Defense Services Administration, Electronics Division.
It's a non-Aristotelian world; few of us can take our syllogistics straight. Most of us chase them with a swig each of empirical data and educated hunch. Let's call it Heterogistics! Example: 

1. Premise: Giannini's systems capability is based on unsurpassed depth of component experience in Air Data Instruments, Inertial Instruments, Servo Components. 

2. Premise: From that depth comes a standard of performance best appreciated by those who already depend on Giannini for better measurement and control, everywhere on earth and above it. 

3. Add: Long experience in anticipating and solving complex systems problems; continuing research into changing requirements for component performance. 

Conclusion: Giannini is a Name to Plan With.
THESE AND DOZENS OF OTHER MEASUREMENT AND CONTROL SUBSYSTEMS IN DAILY OPERATION HAVE BUILT THE GIANNINI REPUTATION FOR FAST, KNOWLEDGEABLE DEVELOPMENT OF SYSTEMS

A "GUN BARREL" HALF-A-MILE LONG
The need was for a new inertial platform. Small and light enough for tactical missiles. Yet able to keep the boost trajectory gun-barrel-straight and the impact dispersion small. • First to answer the need was Giannini with a revolutionary new inertial system you can hold in your hand...and which costs one tenth as much as full guidance. • This startling development is made possible by Giannini's diversified capabilities and is based on two exclusive Giannini components. A miniature free gyro. And an ultra-miniaturized accelerometer which senses very small lateral accelerations, yet ignores the high g's of boost thrust.

PITCH TRIM COMPENSATOR FOR DC-8 JETLINER
Problem...As aircraft proceed into the transonic speed range, aerodynamic trim characteristics change. An adjustable Mach computer and power package were needed to deliver corrective force at the pilot's control column. • Solution...Giannini delivered a small, highly accurate servocomputer-controller with a pulse-modulated output. • Douglas now specifies the Giannini Trim Compensator system as standard equipment on every DC-8 delivered.

THREE-AXIS RATE GYRO SYSTEM FOR TITAN
Flight stabilization of the Martin Titan required a package gyro system—to provide the highest degree of performance stability, accuracy and reliability under severe environmental conditions. • Giannini met the requirement by designing a three-axis gyro system for flight control and for telemetering pitch, roll, and yaw rates. Two of these subsystems are used in every Titan.
CIRCLE 34 ON READER SERVICE CARD
THIS MAKES GOOD SENSE: HE WHO KNOWS MOST ABOUT ALL THE PARTS CAN BEST PUT THEM TOGETHER INTO A WHOLE THAT WORKS. ONLY GIANNINI HAS PROVEN EXPERIENCE IN SUPPLYING ALL OF THESE COMPONENTS

AIR DATA INSTRUMENTS

Giannini Air Data Instruments offer you the widest choice in the industry. For years they have set avionic standards and served as building blocks for control and flight test subsystems. The Air Data line includes: Absolute, Differential and Gage Pressure Transducers — Servoed Pressure and Pressure Ratio Instruments — Probe and Vane Sensors. All give evidence of a progressive engineering philosophy that emphasizes originality, simplicity, flexibility.

SERVO COMPONENTS

The Giannini line of precision potentiometers and special electromechanical devices meet standard and special needs for all types of high-performance servo systems. Included are: Precision Potentiometers. Linear and non-linear. Single-turn and multi-turn rotary. Low-torque models. Rectilinear units with or without spring loading. Unique Spiralpot® with infinite resolution from a wire-wound element. Stepping Motors — Segmented Torquers — MilliWatt Motors. More reasons why Giannini serves aerospace engineering/management fast and well... in design, liaison, production, field service.

INERTIAL INSTRUMENTS

Success in the design and production of inertial instruments puts a premium on the maker’s experience. For more than a decade, Giannini has been developing outstanding inertial components for the nation’s missiles and spacecraft. The line includes: Gyros, Rate and Free. High-level AC or DC output. AC and DC electrically powered rotor. Pyrotechnic rotor. High reliability in presence of unfriendly environments. Accelerometers, Linear and Statistical. Environments: normal, high-temperature, intense nuclear radiation. Integrating Acceleration Switches. Used by virtually all major prime contractors in scores of world-wide projects.
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Ask a Giannini representative to call for a friendly, informative talk about your system and component needs. You’ll find he has been selected for high technical competence and for his attitude of helpful service.

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The Electronics Man "buys" what he reads in...
Ultra high-speed, compact, rugged and completely reliable. These are the words to describe Cambion's new bistable multivibrators.

Available now in prototype quantities, these macromodule flip-flops have a superior frequency response — DC to 10 MC. They weigh only 9 grams, are .35 cubic inches in size and operate over a wide temperature range. The 12 volt logic provides a superior level output capable of driving many related circuits.

The standard 7-pin base design permits easy insertion into sockets for development work, dip-soldering in printed circuit boards and rapid assembly into finished computers. Fully guaranteed, these flip-flops are ideal for the designer developing the newest in digital computers.

For complete details on these exciting, new components, WRITE, WIRE, OR PHONE: Computer Components Division, Cambridge Thermionic Corporation, 427 Concord Avenue, Cambridge 38, Mass. TRowbridge 6-2800.

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Only MINCOM has the DC TOP PLATE

With all transport functions powered by DC, the Mincom Model C-100 Instrumentation Recorder Reproducer is a standout in reliability and mechanical simplicity. No belt changes—six speeds record frequencies from 50 cps to 120 kc with instant push-button control. Dynamic braking, no mechanical brakes. Only 12 moving parts with four easy adjustments. Three identical DC motors are used for take-up, rewind and capstan—and the converted AC to DC input means independence from power line frequency fluctuations. C-100's modular construction is completely transistorized; no cooling is necessary, operation is economical. Interested? Write for brochure today.
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Alpha offers a complete line of Mil-W-76A Wire from stock for immediate delivery from your local distributor or the factory.

Alpha Military Wire, produced to the highest standards, is used by every major manufacturer engaged in defense projects. Write for your free Alpha Wire catalog.

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### MIL-W-76A

<table>
<thead>
<tr>
<th>MIL-W-76A</th>
<th>DESCRIPTION (Single conductors)</th>
<th>VOLT RATING</th>
<th>CONDUCTOR SIZE</th>
<th>STOCK COLORS</th>
<th>ALPHA NUMBER</th>
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<tbody>
<tr>
<td>TYPE LW UNCOVERED PLASTIC</td>
<td>stranded tinned copper, light wall thermoplastic insulation. 80°C</td>
<td>300</td>
<td>20-30</td>
<td>*1-10 &amp; *14-22</td>
<td>1685-1690</td>
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<tr>
<td>TYPE LW NYLON JACKET</td>
<td>stranded tinned copper, light wall thermoplastic insulation, clear nylon jacket overall. 90°C</td>
<td>300</td>
<td>20-30</td>
<td>*1-10 &amp; *14-22</td>
<td>1675-1680</td>
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<tr>
<td>TYPE MW UNCOVERED PLASTIC</td>
<td>stranded or solid tinned copper, thermoplastic insulation. 80°C</td>
<td>1000</td>
<td>12-24 (stranded) &amp; 16-22 (solid)</td>
<td>*1-30</td>
<td>1550-1567</td>
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<tr>
<td>TYPE MW SHIELDED</td>
<td>stranded tinned copper insulation, tinned copper shield overall. 80°C</td>
<td>1000</td>
<td>12-24</td>
<td>Conductor 16-24 Colors *1-10 &amp; *14-22 &amp; Conductor 12-14 Colors *1-3</td>
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<td>TYPE MW NYLON JACKET (SHIELDED)</td>
<td>stranded tinned copper, thermoplastic insulation, tinned copper shield overall, jacket over shield. 90°C</td>
<td>1000</td>
<td>16-22</td>
<td>*1</td>
<td>1371-1374</td>
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<tr>
<td>TYPE MW NYLON JACKET</td>
<td>stranded tinned copper, medium wall thermoplastic insulation, clear nylon jacket overall. 90°C</td>
<td>1000</td>
<td>12-22</td>
<td>Conductor 16-22 Colors *1-10 &amp; *14-22 &amp; Conductor 12-14 Colors *1-6</td>
<td>1504-1509</td>
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<tr>
<td>TYPE MW GLASS BRAID</td>
<td>stranded tinned copper, thermoplastic insulation, lacquered glass braid overall. 80°C</td>
<td>1000</td>
<td>12-22</td>
<td>Conductor 16-22 Colors *1-10 &amp; *14-22 &amp; Conductor 12-14 Colors *1 &amp; *14-22</td>
<td>1590-1595</td>
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<td>TYPE MW GLASS BRAID SHIELDED</td>
<td>stranded tinned copper, white thermoplastic insulation, lacquered glass braid tinned copper shield overall. 80°C</td>
<td>1000</td>
<td>12-22</td>
<td>*1</td>
<td>1361-1366</td>
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<tr>
<td>TYPE HW UNCOVERED PLASTIC</td>
<td>stranded tinned copper, heavy wall thermoplastic insulation. 80°C</td>
<td>2500</td>
<td>6-22</td>
<td>Conductor 6-16 Colors *1-3 &amp; Conductor 18-22 Colors *1-10</td>
<td>1571-1579 &amp; 1561-1567</td>
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<tr>
<td>TYPE HW GLASS BRAID</td>
<td>stranded tinned copper, heavy wall thermoplastic insulation, lacquered glass braid overall. 80°C</td>
<td>600</td>
<td>6-10</td>
<td>*1, 14, 15</td>
<td>1598-1599/6</td>
</tr>
</tbody>
</table>

*Alpha can create for you over 40,000 military approved striped color combinations.

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**Colors**

1. White
2. Black
3. Red
4. Green
5. Yellow
6. Lt. Blue
7. Brown
8. Orange
9. Gray (slate)
10. Violet (purple)
11. Tan
12. Pink
13. Dark Blue
14. White/Black
15. White/Red
16. White/Green
17. White/Yellow
18. White/Blue
19. White/Brown
20. White/Orange
21. White/Gray
22. White/Violet
23. White/Black/Red
24. White/Black/Green
25. White/Black/Yellow
26. White/Black/Blue
27. White/Black/Brown
28. White/Black/Orange
29. White/Black/Violet
30. White/Black/Gray

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CIRCLE 38 ON READER SERVICE CARD
Transitron introduces an exciting new device for simpler, more reliable, more economical switching circuitry

The Silicon NPN Tetrode binistor is a new component and a new concept for the circuit designer! The key parameters of this bi-stable, negative resistance device are determined by external circuitry in contrast to existing devices. The significant reduction of peripheral circuitry results in outstanding savings in cost, space, weight and solder connections. For example, a typical flip-flop requires at least 13 components versus only 4 in an equivalent binistor stage. Very large current and voltage gains are realized in both on and off directions. Inputs and output are compatible in level with typical transistor and diode circuits. The tetrode binistor can operate from $-80^\circ C$ to $+200^\circ C$.

To learn more of this important new development — THE BINISTOR — and how it works — write for Bulletin No. TE-1360.

**CONDENSED SPECIFICATIONS TRANSITRON BINISTOR**

- Typical Turn-off Current Gain: $50 \@ 15\text{ma}$ Collector Current
- Operating Collector Current Range: $50\mu\text{a}$ to $15\text{ma}$
- $I_p$ critical: $0.5\text{ma} \@ 5\text{ma}$ Collector Current
- Operating Temperature Range without Temperature Compensation: $-65^\circ C$ to $150^\circ C$

**MEET US AT WESCON — BOOTH 2638-39**
Last year, traffic accidents killed 37,000, injured 1,400,000

...and they wasted Five Billion Dollars!
Traffic accidents’ human toll is so tragic we sometimes overlook their staggering economic waste. Five Billion Dollars in lost wages, medical expenses, insurance costs and property damage! Your business—every business—shares in this loss. So you have a double interest in helping reduce traffic accidents. And you can help! Drive safely and obey the law yourself . . . certainly. But go further. Use your influence to promote safe driving and urge strict law enforcement. To make your efforts more effective, join with others working actively to reduce traffic hazards in your community. Support your local Safety Council!

Published in an effort to save lives, in cooperation with the National Safety Council and The Advertising Council.
verify

events

permanently

in

milliseconds

Brush Operations Monitors' response to signals is virtually instantaneous—less than 4 milliseconds. Multiple high-speed events are clearly defined from start to stop, on a common time base—and at rates up to 500 per second. Portable 30 channel or rack-mounting 100 channel models record sharp reproducible traces with fixed-stylus electric writing that provides the utmost in reliability. "Built-in" transistor switching to eliminate relays is optional. No direct writing recording system can match the capabilities of Brush Operations Monitors for industrial and military analysis and control. Write for complete specifications and application data.
compact transistor switching for millisecond monitoring

The new Brush Trans-Switcher eliminates relays—greatly simplifies your problems of operations monitoring. Designed to take full advantage of the fast response and high resolution of Brush Operations Monitors, this compact, solid-state switching unit accepts up to 100 different “on-off” signals in a broad range of pulse shapes and amplitudes. Interchangeable, plug-in decade boards are designed to accept different voltage ranges and modes of operation. Avoid the “black box” approach—specify the standard Brush Trans-Switcher for the ultimate in precise, reliable monitoring. Write for complete details.
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from the family of the world's most nearly perfect insulation

helps to maintain peak gyro efficiency

Leading gyro producers design parts made of precision-molded SUPRAMICA 560 ceramoplastic, an exclusive formulation of MYCALEX CORPORATION OF AMERICA capable of retaining absolute dimensional stability at a maximum temperature endurance up to +932°F (unstressed) ... in complex but lightweight designs. These small parts function as vital components of miniature gyros ... critical applications where the highest standards for precision accuracy must be met.

SUPRAMICA 560 ceramoplastic having the same thermal expansion coefficient of many insert metals, can tightly bond and permanently anchor gold leads, stainless steel contacts and stainless steel threaded inserts ... in parts with wall thicknesses of only .010".

SUPRAMICA 560 ceramoplastic offers premium insulating properties with excellent economy in production scale runs. SUPRAMICA 560 ceramoplastic is but one of a family of versatile electrical and electronic insulating materials produced by MYCALEX CORPORATION OF AMERICA ...

- MYCALEX® glass-bonded mica,
  maximum temperature endurance (unstressed)—up to +700°F
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  maximum temperature endurance (unstressed)—up to +1550°F
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- SYNTHAMICA® synthetic mica,
  maximum temperature endurance (unstressed)—up to +2000°F

  * ASTM test method D 648 (modified) at stress of 264 psi.

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World's largest manufacturer of glass-bonded mica, ceramoplastic and synthetic mica products

See us at WESCON Booth 314-315, August 23-26, 1960
Looking Ahead to **WESCON**

**Big West Coast meet at Los Angeles Sports Arena features 200 papers and 989 booths—plus trips, contests and a technical session for ladies**

**Los Angeles—**"Definite departure from familiar technical convention formats" is promised by Richard G. Leitner, chairman of the 33-man technical program committee for this year's Western Electronics Show & Convention.

The 1960 Wescon, to convene at Los Angeles Memorial Sports Arena Aug. 23-26, will feature 200 technical papers in over 50 sessions. "A very aggressive steering committee," says Leitner, "has ferreted out regions of great technical interest and then solicited papers representative of noteworthy developments in these areas."

About a third of the program is made up of solicited papers. The steering committee has attempted to reduce the number of strictly tutorial papers, has interlarded the lecture sessions with debates, panels and special workshops. The complete convention record will be available to registrants on opening day, and speakers have been urged to use platform appearances for expanded discussions of their topics.

One session which promises to draw a full house is a discussion of preparation of military contract proposals, in which representatives of industry and government will probe ideas for reducing costs and saving time. Another session, aimed at management men, will be a panel discussion among authorities on finance, marketing and patents.

New industry products, and demonstrations of company capabilities and techniques, will be on display in 989 booths occupying 138,000 sq ft in the Sports Arena and 56,000 sq ft in a specially constructed air-conditioned building erected for supplementary exhibit space by Wescon. Combined area represents an increase of 14.5 percent over the total facilities of Pan Pacific Auditorium, used for previous shows.

Featured speaker at the All-Industry Luncheon will be Rear Admiral Joseph A. Jaap, director of development programs for the Chief of Naval Operations. Some interesting views on how the Navy looks at the transition to missile warfare should be forthcoming. Speaker at the Western Electronics Manufacturers Association luncheon will be announced later.

Importance of distributors and manufacturers reps will be stressed in an all-day session the day before the convention opens. Following a breakfast at the Ambassador Hotel on Aug. 22, 20 work sessions will provide an opportunity for factory people and reps to put their heads together to plan sales strategy and review product lines.

Wives of conventiongoers will be entertained during a carefully planned four-day "Polynesian holiday." But it won't be all play for the ladies at Wescon this year. For the first time there will be a technical session dedicated to the woman's role in engineering, in which discussions are scheduled by a woman engineer, an engineering secretary (who is also the wife of an engineer), and a nontechnical woman who works in a support function to engineers.

For the fourth time in Wescon history, promising student scientists will vie for awards in the Future Engineers competition. Thirty-five youngsters will display the products of their design ingenuity in an exhibit area near Wescon's annex. Each will be given a $25 defense bond; the winners will split $2,500 in scholarships.

Items on exhibit range in size from large computers and an 8-ft radar antenna to microminiaturized components that you'll need a magnifying glass to see.

Five meeting rooms in the Arena will house technical sessions. Transportation between the Arena and
Sports Arena's 138,000 sq ft will be augmented by 58,000 sq ft in a specially constructed air-conditioned annex.

four downtown Los Angeles hotels will be handled by chartered buses, running every 10 minutes.

Electronic products, fittingly enough, will be used to expedite registration at this year's meeting. Digital computers will keep tabs on all registrants and will produce a running total of the expected 35,000-plus as they sign up. A closed-circuit tv system will permit coordination between registration areas set aside for exhibitors and for visitors.

Field trip committee has scheduled eight tours, highlighted by a trip to Rocketdyne's rocket-engine testing facility in the Santa Susana mountains. Local companies which are opening their doors to conventioners include Packard-Bell, Telemeter Magnetics, Thompson-Ramo-Wooldridge, ITT Labs, Librascope and Hughes Research Labs. Other organizations hosting field trips are Jet Propulsion Lab and its parent California Institute of Technology, Space Technology Labs, and System Development Corp.

Industrial Design Awards program last month selected 25 products from the drawingboards of companies throughout the nation. Five of these will be selected for prizes prior to the opening of the show; the entire group will be on display in an exhibition hall on the arena's glass-walled concourse.

Field trips include this Rocketdyne rocket-engine test facility in the mountains behind Los Angeles.

August 12, 1960
Designers Vie for WESCON Prizes

Industrial arts in electronics are highlighted by second Wescon design contest. Twenty-five competitors line up for try at five awards.

FIVE WINNERS will be chosen this month from among 25 entries in the second Wescon Industrial Design contest. The contest, introduced in the Wescon proceedings for the first time last year, aims to show the relationship of good design to the eventual success of an electronic product.

Products from electronics drawingboards throughout the nation have been carefully considered. Among the jurors for the final decisions will be George Walker, styling v-p for Ford Motor Co.; Henry Keck of Keck Associates; Bert Gastenau of Aerojet General, and George Jergenson and Strother MacMinn of the Los Angeles Art Center.

The 25 items selected will be on display throughout the convention, with the five top designs bearing the "Wescon Award of Excellence." The remaining 20 will be given a "Wescon Award of Merit."

Wescon program chairman K. J. Slees told ELECTRONICS that the Industrial Design Institute and the American Society of Industrial Designers have both lent their official support to this portion of the Wes-
Entry by Minnesota Mining & Mfg. is this model CM-100 video-band recorder/reproducer.

con program. The contest will be a permanent part of the Wescon agenda from now on.

Among the entrants are: a precision standing-wave detector by DeMornay-Bonardi; a high-speed data-processing system by Beckman Instruments; a signal generator from Southwestern Industrial Electronics; Rendix G-20 data processor; the model 312 digital control system of General Electric; the GM-100 video-band recorder by Minnesota Mining & Manufacturing; a cabinet design from Thompson-Ramo-Wooldridge; Librascope’s 210-XY plotter; P. R. Mallory’s voltage reference battery; a Voltcon Products voltmeter; a traveling-wave tube by Huggins Laboratories; a variable attenuator from Hewlett-Packard.

Other contenders will be: an Amphenol Micromod connector, an XY plotter by Electro-Instruments; a Corning Glass NF fusion-sealed resistor; an Ampex TM-1 digital tape handler and an Eitel-McCullough X762B power triode.

These and other components and systems will be shown at the Sports Arena.

August 12, 1960

**ELECTRONIC CORP.**

CChurchill 8-1200

30303 Aurora Road, Cleveland 39, Ohio

Western Representative:

VAN GROOS COMPANY, Woodland Hills, Calif.

CIRCLE 47 ON READER SERVICE CARD 47
Advanced missile systems, space-probing research vehicles, high performance avionic and ground support equipment, industrial controls... these are some of the areas where the vital need for accurate, ultra-reliable timing is being met by Tempo Instrument Incorporated. Tempo's highly developed research and engineering skills, together with modern manufacturing techniques, represent the State-of-the-Art in the field of electronic timing devices and controls. Lending strong support to these advanced technologies is Tempo's exacting Quality Assurance Program, a company-wide function culminating with temperature and voltage testing of each production line unit. If the performance and reliability requirements of your timing needs are of a high order...and if you regard considerate customer service, with the emphasis on cooperation, as equally important...you are invited to write, phone or TWX for complete engineering and catalog data. Tempo Instrument Incorporated, Box 338, Hicksville, N.Y. • OVerbrook 1-2280 • TWX Hicksville 429

PULSE TRAIN GENERATORS. For control of various loads in a single system. Provide output signals and pulses of specified characteristics.

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INTERVALOMETERS. Typical operation: 300 seconds after application of 28 vdc, output relay energizes; 3 seconds later, relay de-energizes. Cycle repeats itself until supply voltage is removed.

ELECTRONIC TIME DELAY RELAYS. No moving parts except relay contacts, 2PDT-2 amp or 3PDT-10 amp ratings; fixed or adjustable time delays from .02 to 300 seconds.

SOLID STATE TIMING MODULES. Subminiature "building block" components, with timing sequence control; may be used to develop a wide range of timing and programming devices. Fixed or adjustable time periods from .00005 to 300 seconds.

PROGRAMMERS. Designed to meet particular system requirements. Typical unit may control complete timing and sequence program covering more than 5000 seconds.

REPEAT CYCLE TIMERS. Provide multi-channel control signals, each with a timing pulse of predetermined magnitude. Sequencing of output pulses is synchronized.

SEQUENCE TIMERS. Typical operation: Delivers sixty-four sequential pulses each of 100 milliseconds duration, starting immediately upon application of 28 vdc. Automatically stops after last pulse.

FLASHERS. Typical operation: Flashing rate of 40 cycles per minute, with a one-to-one ratio of on time to off time.

Booth 2419

48 CIRCLE 48 ON READER SERVICE CARD
New Look in Recruiting at Wescon

Managers persuade showgoers to soft-pedal recruiting activity this year.
Gentleman's agreement will undo impression that show is a "body exchange"

DURING WESCON WEEK last year a leading San Francisco newspaper carried a front-page story which detailed a recruiting gimmick for shanghaing engineers who were attending the convention. A national wire service picked up the story; it appeared ultimately in some fifty newspapers across the country, in many cases giving readers their only coverage of this high-level technical meeting.

This year, in an effort to correct the impression that Wescon is just one big body exchange, Wescon has clamped down on recruiting. Show management has asked participants to accept a gentleman's agreement to refrain from hard-sell proselytizing activities.

ELECTRONICS interviewed Hugh Moore, chairman of the executive committee, and Don Larson, Wescon manager, to find out why.

**Q. What prompted the clampdown on recruiting activities this year?**

MOORE: The board of directors of Western Electronic Manufacturers Association requested that we do what we could to limit recruiting efforts, feeling that these had become too dominant a force, not just at Wescon, but at electronics conventions throughout the country. They felt, as we do, that high-handed methods of recruitment distract from the prime purpose of Wescon: dissemination of technical information and the useful exchange of ideas between industry members.

**Q. How did you go about getting the idea across that recruiting should be soft-pedaled?**

LARSON: We mailed out a form letter specifically requesting participating companies to "join in a gentleman's agreement to rule out recruiting at Wescon functions." Obviously, we can't lay down rules as to what one can and cannot do in the way of recruiting, and there's no sense making rules if there is no police force to enforce them. Our idea from the very beginning was to appeal to participants' good-neighbor sense.

**Q. What reaction did you get from the recipients of the letter?**

LARSON: Almost unanimously they agreed to comply with the request, and for the most part welcomed a slowdown in recruiting activity. The electronics division of one leading manufacturer of computers and associated equipment said, "We are enjoying an expanding situation which includes the immediate need for a number of capable computer engineers. We agree, however, that the prime importance of the convention is the technical effort, and we are pleased to join in the gentleman's agreement that will exclude recruiting." Another told us "We are more than happy to enter into a gentleman's agreement, and feel that as a result Wescon can be a more useful trade show and technical meeting." A somewhat more cautious consent voiced by one company expressed willingness "to discuss the matter of refraining from hard-sell recruiting and advertising in the convention city, providing—of course—that other companies can agree on the approach."

**Q. It has been said that in the past some companies have engaged in recruiting solely as a defensive measure. Is this true?**

MOORE: Yes. Some companies have reported that they actually didn't need additional engineers, but as insurance against the inevitable sniping away at their engineering force they engaged in recruiting to assure replacements when such were necessary.

**Q. What would you say are some of the specific deleterious effects from too vigorous recruiting at shows such as Wescon?**

LARSON: For one thing, some firms restrict the number of engineers which they send to conventions, fearing that they will get involved in recruiting activities rather than attending technical sessions. Personnel who come to a show to enter into technical discussions and see the new developments within the industry, but who are exposed to high-handed recruiting efforts, are bound to be somewhat distracted.

**Q. What about the overall effect on the industry?**

MOORE: This high-powered recruiting has the effect of a game of musical chairs, with everyone stealing everyone else's people. It stimulates the growth of a class of what you might call vagabond engineers, jumping from one job to another at each offer of a slightly increased salary. Some industry economists feel that it tends to increase salary levels at an inflationary rate, putting us in an adverse competitive position with foreign industry.

Radar Guards Bridge

Raytheon radar atop vertical lift bridge at Duluth, Minn., warns of approaching ships in heavy weather
New HUGHES® nanosecond diodes switch 50 times faster than standard germanium diodes. If your circuits require faster response, faster recovery, with greater accuracy, you can solve your problem with Hughes nanosecond diodes.

Hughes nanosecond germanium diodes are designed to make today's circuits better—and tomorrow's possible. They combine the most wanted parameters into one subminiature component. They switch 50 times faster than the usual germanium diode; they have conductances 50% higher; and they have rectification efficiencies greater than 70%. They have higher Q and faster recovery (both forward and reverse), which give your circuits greater accuracy and extremely low transient losses.

These new semiconductors were created especially for high-speed computer logic, high-frequency transistor circuits, extremely fast reference switching, and low-noise, low-level RF modulation and demodulation. If you're working with sophisticated circuitry with exacting requirements, the Hughes Semiconductor sales engineer in your area is a good man to know. Call him.

Or write Hughes Semiconductor Division, Marketing Department, 500 Superior Avenue, Newport Beach, California.

**Typical Parameter Ranges**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Voltage (IF = 100 mA)</td>
<td>3.5V to 25V</td>
</tr>
<tr>
<td>Reverse Current (IF = 25V)</td>
<td>5mA</td>
</tr>
<tr>
<td>Peak Reverse Voltage</td>
<td>12V</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>1.5 ns (max)</td>
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<tr>
<td>Shunt Conductance (IF = 600 A)</td>
<td>100 mhos</td>
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<tr>
<td>Rectification Efficiency (IF = 100 mA)</td>
<td>70%</td>
</tr>
<tr>
<td>Q @ 250 mA</td>
<td>10</td>
</tr>
<tr>
<td>Maximum Power Dissipation</td>
<td>150W</td>
</tr>
</tbody>
</table>

*Some parts listed above, AVVs and ISVs to 100 volts.

**Switching (0mA to 100 mA) and rectification to 750 mA with a load resistance of 180Ω. A sampling scope is used for measuring rise and recovery.
What WESCON Exhibitors are Saying

H. L. HOFFMAN
President
Hoffman Electronics Corp.

ROBERT ERICKSON
Executive vice president
Beckman Instruments Inc.

As one of the exhibitors in the first Wescon and in each succeeding show, we have been gratified to see the growth both in size and impact of this event. Wescon gives industry members an opportunity to show and to see what's new in components and end equipment. It serves as a vital link in communications between the supplier and the customer.

While it's a place for exhibitors to take orders, the real value of the show is the opportunity it affords for exchange of information. The supplier can discuss applications of products with the customer. The latter, in turn, can explain his further needs to the supplier and can make helpful suggestions for modifying existing devices or developing entirely new products to meet specific requirements. This feedback is important.

This year's show should be not only the biggest but the most interesting and most significant Wescon yet. One of the reasons will be the many new semiconductor devices that will be on display. Our semiconductor division will be showing more new products than at any previous trade show, and our industrial products division will be represented for the first time.

Judging from growth and advances made during the past decade, the 60s should see the electronics industry occupy the top industrial spot in the U. S.

To achieve this pinnacle, an aggressive sales and engineering program must be undertaken, and one top method of implementation is a meeting such as Wescon.

On the engineering side, we are planning heavy participation in the technical sessions. Few actual sales will be consummated during Wescon, but many contracts for future business will be made. For the most part, the show draws serious individuals who are seeking new items and have a genuine interest in determining the most up-to-date methods and merchandise available.

Although there is a trend toward an economic plateau, I doubt that any indications of austerity will be felt at Wescon. The market potential for electronics has never been greater. More and more applications for electronic instrumentation are being discovered and it is up to the developer or maker to educate buyers on uses of new devices.

(Continued on next page)
What Exhibitors are Saying (cont.)

CROSBY M. KELLY
Assistant to the President
Litton Industries

WE FEEL THAT WESCON will continue to reflect the transition taking place in the electronics industry.

Some R&D activity in 1950-53 led to limited production of proprietary products, and these began to appear at Wescon and other shows. As more of the industrial activity began expressing itself in production, off-the-shelf hardware was deemphasized and capabilities were deemphasized. Now Wescon is beginning to acquire the characteristics of the historical trade show, where the sale of products is stimulated by new things, personal contacts.

A great deal of innovation is still required in the sale of electronics, so there will be little order taking in the booths; but there will be many leads for follow-up sales.

FRANK P. Deluca JR.
President
Acoustic Associates Inc.

HAVING RECENTLY MOVED our corporate headquarters from New York to Los Angeles, we are taking more than a casual interest in the Wescon show.

We at Acoustic are interested in seeing what other companies are doing in electronics. The Wescon show gives us a marvelous opportunity to look at all the electronic product lines at one time with the view of possible acquisitions. Semi-
conductors, as in recent years, probably will get the big play at the show.

We are exhibiting new transistor-ized ultrasonic cleaning equipment, and also a new line of ferroelectric ceramics. These are in addition to a display of the type of sensing and gauging equipment that we provide for the Atlas missile program.

In our business, we are not affected by foreign competition; in fact, we visualize foreign markets for much of our equipment. The labor-saving aspects of ultrasonics tend to increase in proportion to the amount of education we are able to provide.

MILITARY ELECTRONICS can lead the way in increasing our standard of living. Technological advances made in military electronics could result in an explosion of new and improved products and techniques for civilian and industrial use. Specific requirements of military systems, however, are of such an unusual nature that it is rare when they can be put to immediate use by industry.

Increasing use of scientific computers by industry is one example of how original military developments can be translated into non-military use. Autonetics industrial products has an operating Recomp general-purpose computer on display at this year's Wescon.

In order successfully to solve the complex technical industrial problems of today, a systems approach (Continued on p 56)

E. A. HOLMES III
Vice president, Autonetics division
North American Aviation

These "3 Steps to Excellence" — Funnel Flange Eyelets, Automatic Eyeleting Machine, and Component Inserting Machines... can provide that vital extra margin of dependability and value in your PW or Etched Boards. And the investment is surprisingly small. Call or write for complete details.

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"PANCAKE" TRANSISTORS

Now... a new dimension in packaging that offers...

* exceptional volumetric efficiency
* correct pin-circle geometry for 100-mil automation grid-system
* performance equal to that of prototypes
* increased ruggedness
**PANCAKE TRANSISTORS** — a Sylvania development — herald a new era in the art of designing subminiaturized electronic equipment. PANCAKE TRANSISTORS are 85% smaller, 85% lighter in weight than their larger electrical counterparts. PANCAKE TRANSISTORS are shorter in height than the diameter of conventional ½-watt resistors, flatter than conventional silvered-mica capacitors.

**PANCAKE TRANSISTORS** are equipped with leads spaced to fit the 100-mil grid-system for automated installation. PANCAKE TRANSISTORS feature clear-glass stress-free matched seals, true chemical bonds that offer exceptional hermetic reliability and strength, excellent resistance to thermal shock. PANCAKE TRANSISTORS withstand atmospheric pressure as high as 200 p.s.i., enabling high-pressure leakage tests for military and industrial quality-assurance.

SYLVANIA launches its PANCAKE program with two germanium alloy switching types: PNP type SYL-1986 (electrically similar to 2N404) and NPN type SYL-1987 (electrically similar to 2N388). Many other types utilizing drift, mesa, and alloy-junction techniques are under development at Sylvania.

**FOR CONSULTATION** on PANCAKE transistor value to your circuit developments, contact your Sylvania Representative. For technical data, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 198, Woburn, Mass. Sylvania PANCAKE TRANSISTORS also available through Sylvania franchised Semiconductor Distributors.
What Exhibitors are Saying (cont.)

similar to that used by a military weapons-system manager is needed. The world has become more technically complex and we need to use all the most advanced knowhow to create better, more reliable products and at the same time to keep the price economically stable for the user.

DONALD E. ROOT
General manager, industrial division
Cubic Corp.

WECON OFFERS our sales staff at Cubic an effective evaluation of our marketing program. At the convention, interested participants, many of them experts in the rapidly expanding electronics industry, offer comments on future requirements in various fields while making constructive suggestions on our product designs.

Wecon provides us with an indication, in one location and at one time, of the overall size and nature of our industry. At this meeting we can obtain a broader picture, and hence a better feeling for the changing vista of our markets—something which is not so easily determined in day-to-day sales calls. Wecon is like a great department store; it provides us with an on-the-spot comparative analysis of competitive instrumentation.

In addition, it is an ideal place for introducing new products and new techniques. The responses to such new ideas have, in the past, proved to be indicative of the potential sales success which those ideas and products will enjoy.

In 1960 we anticipate that Wecon will be visited by a greater percentage of management people with broad viewpoints, by more marketing men trained to recognize the trends of the industry, and by more purchasing people whose importance in making technical procurement decisions is ever increasing.

Lab Reveals Lunar Reflection Results

LUNAR REFLECTION STUDIES made by the propagation sciences laboratory of the Air Force Research Division at Hanscom AFB, Mass., reveal characteristics relevant to the use of the moon as a passive relay station for communication systems.

At 915-Mc, the moon presents a random scattering surface, with relatively little specular (mirror) reflection. This indicates a greater roughness, or irregularity, in the surface than was previously suspected. From the standpoint of communications, it means that at 915-Mc, usable bandwidth will be limited. At lower frequencies the random scattering may be less serious.

"One of the most interesting results to date," says the Laboratory's Russell Corkum, "is that the 915-Mc signals exhibit propagation characteristics remarkably similar to those of a 400-mi tropospheric scatter path. Because of this, it is speculated that diversity techniques presently used for tropo scatter circuits to overcome bandwidth limitations can also be used for lunar circuits."

Two lunar propagation paths are being used for AFRD's study. For both paths, transmissions at 915-Mc with a 10-Kw transmitter are being made from Bedford, Mass., using the laboratory's 28-ft radar telescope. One receiving terminal is operated by General Electric at Schenectady, and the second by Cornell Aeronautical Laboratories, at Buffalo.

The Schenectady path is used to investigate fading rates, power requirements, and effective bandwidth and frequency dispersion. The Buffalo path is used for more general propagation studies.
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August 12, 1960
Airborne Tv Plans Take Form

$2.2-million educational tv contract covers planes, television gear, airborne antennas

LATEST DEVELOPMENT in plans to transmit educational tv from airplanes is announcement of a $2,200,000 contract covering planes, tv equipment and airborne antennas.

Funds will be used by Westinghouse which was awarded the order by the Midwest Council on Airborne Television instruction, to equip two DC-6 A/B aircraft to transmit programming over a six-state area encompassing thousands of schools and colleges.

The Stratovision program, working on a $7½ million budget, was announced last October by MCAT. Of these funds, $4½ million are being provided by the Ford Foundation. A spokesman for the Council tells ELECTRONICS the remaining funds will be solicited from industry as goods and services, or direct cash contributions.

Assisting in the project is the Purdue Research Foundation and Purdue University, where instruction courses are being planned. Operation of Stratovision will be in the uhf band on channels 72 and 76. These frequencies have already been allocated to the project by Federal Communications Commission.

Slated to get underway on Jan. 20, 1961, programming will reach most of Illinois, Indiana, Kentucky, Ohio, Michigan and Wisconsin. There will initially be a four-month demonstration and shakedown period during which three hours of programming will be transmitted four days a week. In September, 1961, with the start of the academic year, telecasts will be made six hours a day Monday through Friday.

Plans call for the broadcast planes to circle at 23,000 ft around Montpelier, Ind. By multiplexing, the Council expects to have each transmitter broadcasting two programs at once.

Future modifications in the airborne equipment will allow the planes to broadcast live or taped fare from ground stations such as those now operating at Purdue.

Three broadcast engineers will go on each flight to operate broadcast equipment, monitoring gear, tape recorders. Their jobs will be to place the equipment on the air, change tapes and monitor audio and video output. Tape changes will be made every half hour, the duration of the classroom period.

Planes will carry a two or three day supply of taped program fare in case bad weather should cause landings at airports other than home base. According to meteorological surveys of the region, lost broadcast time due to bad weather is expected to average less than two days out of the school year.

The broadcast antenna, designed by Douglas Aircraft, projects 24 feet below the fuselage of the airplane. For take-off and landing, the antenna will be retracted along the length of the plane’s underside. Hydraulically operated, the antenna will be kept vertical gyroscopically, independent of aircraft motion or banking up to 20 degrees.

Ampex tape recorders will be used and CBS Laboratories will provide test equipment as well as multiplex gear for the narrow band (3 Mc) transmissions.

**Electron Tube Ager**

Tube aging bank at Boeing-Wichita stabilizes new tubes, locates weak units prior to installation.
SYLVANIA
GOLD BRAND
SUBMINIATURE TUBES
add a high degree of reliability to your critical designs
...new tests prove it!

New manufacturing techniques build reliability into Sylvania Gold Brand Subminiature Tubes.
New survival rate criteria provide quantitative definition of Subminiature Tube reliability, aid designer compute reliability of end-equipment.
New—four Gold Brand Subminiature types—featuring rugged-design heater for 26.5V applications—increase versatility of line, widen designer's choice.
Sylvania increases shock test levels!
- 750g for Gold Brand Premium Subminiature Types
- 1000g for Gold Brand Guided Missile Subminiature Types

Sylvania has significantly improved the design and manufacture of subminiature type tubes. Now, Gold Brand Subminiature Tubes are capable of withstanding greatly increased impact acceleration tests. For example, newly designed micas provide tight 6-point contact with the cathode. A reducing welding method produces an exceptionally sturdy, clean weld area. Special flared-lip envelopes assure that mica points are not damaged in insertion, maintain the tube structure rigidly within the bulb.

In addition to the increased shock of 1000g applied to Guided Missile Subminiature Tubes, the shock intensity pattern has been changed by eliminating the usual ½" synthetic rubber pad between the hammer and striking plate of the high impact machine. Although shock tests are increased, rigid control of end points has not been relaxed.

Too, low-frequency vibration tests assure low signal to noise ratio. Vibration tests for "random" or "white" noise are made over a frequency range of 100 to 5000 cps and read up to 10,000 cps to control harmonics. Additional checks include tests for low voltage stability and fatigue.

Sylvania increases life tests to 1000 hours!
New controls added to 100-hour test!

Now, Sylvania Gold Brand Subminiature Tubes are tested for 1000 as well as 500 hours. They must meet the same tight limits at 500 and 1000 hours for such end points as: inoperatives, grid current, filament current, Gm, heater-to-cathode leakage, electrical insulation, and cathode interface impedance.

These end points are controlled during manufacture by such operations as: chemically etching the cathode sleeve to provide a good bonding surface for the cathode coating which helps reduce interface impedance, provides improved electrical levels, especially at reduced voltage conditions; use of isolation micas to increase insulation resistance; coating the inside of the cathode sleeve with a nonconductive material to minimize heater-to-cathode leakage.

Further controls are included in the 100-hour life test to assure early-hour stability. For example, new specifications are added for grid current, heater-to-cathode leakage and insulation resistance. The 100-hour life test is performed at room temperature—a critical level for cathode sublimation and resultant leakage paths—and on concurrent samples at various operating temperatures.

Sylvania tightens glass AQL limits!

Sylvania has lowered the Acceptance Quality Level from 6.5% to 4% for combined glass defects. Individual glass defects must now meet a 1.5% AQL. This is made possible by increased manufacturing controls to maintain strain-free glass envelopes. Strains that may occur in manufacture are eliminated by annealing glass of Gold Brand Subminiature Tubes after envelopes are sealed. "After-manufacture" annealing is made possible by a special process that keeps the tube structure relatively cool during the annealing. Gold Brand Guided Missile Subminiature types utilize high-resistivity glass. Tubes are capable of withstand ing operating temperatures of 250°C, electrolysis caused by heat is virtually eliminated.
Sylvania Gold Brand Subminiature Tubes with 6-volt heaters are sample-tested at a heater voltage of 10 volts and a peak heater-to-cathode voltage of 150 volts—cycled 10 seconds “on” and 4 minutes “off” for a total of 300 cycles. In addition, all Gold Brand Subminiature types are tested at normal heater voltages cycled 1 minute “on,” 4 minutes “off” for 2000 cycles. To more closely correspond to equipment variations, heaters are designed to operate in a wider voltage range. Ratings for heater voltage variations have been increased from ±5% to ±10%.

Gold Brand Subminiature Tubes are capable of withstanding radiation dose rates (fast neutrons) of $10^{19}$ NV and accumulated radiation of $10^{16}$ NVT—further proof of Gold Brand reliability under the most severe environmental conditions.

Initiated 15 years ago, “Gleam” is contributing to Gold Brand Subminiature Tube reliability by—welding in a reducing atmosphere to eliminate weld splatter and oxidation • use of special flared-lip bulbs to allow easy insertion of tube structure into bulb without damaging and flaking mica points • ultrasonic cleaning of critical parts • specially processed getter material which resists flaking • air-conditioning in factories • lint-free clothing, enclosed cloakrooms • individual hooded worktables • lint-free parts containers • microscopic examination of completed tubes for loose particles.

Sylvania rigorous acceptance criteria is based on the average number of cumulative failures for a five-lot moving average—instead of one—tested for 1000 hours. The first five lots are tested and the cumulative number of inoperatives and combined failures are plotted with their respective bogey rates. Inoperatives and failures for the sixth lot are added to the cumulative figure and the first lot figures deleted. Sampling consists of 40 tubes per lot. The result is a more stringent control over a wide range of production as well as giving the customary lot by lot results. Too, percent failure rate in 1000 tube hours can be statistically predicted with a high degree of accuracy and provide a quantitative measure of reliability.
SYLVANIA ANNOUNCES 4 NEW GOLD BRAND SUBMINIATURE TYPES FOR 26.5 VOLT APPLICATIONS

These remarkable new Gold Brand Subminiature Tubes utilize a rugged-design heater that combines very low heater power with excellent mechanical strength. A heavy mandrel coated with a high-temperature insulator forms the base of the heater. A fine heater wire is wound over the coating and the entire assembly recoated to form a sturdy, efficient, folded coil heater. Your Sylvania Sales Engineer has complete technical data on all four types.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>7759 (Each Section)</th>
<th>7760 (Each Section)</th>
<th>7761 Class A Video Amplifier</th>
<th>7762 Class A (Single Tube)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Voltage</td>
<td>100</td>
<td>26.5</td>
<td>110</td>
<td>Vdc</td>
<td></td>
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<tr>
<td>Plate Supply Voltage</td>
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<td>0.1</td>
<td>0.27</td>
<td>Megohms</td>
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<tr>
<td>Cathode Resistor</td>
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<td>2.0</td>
<td>2.2</td>
<td>2.4</td>
<td>Megohms</td>
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<tr>
<td>Grid Resistor</td>
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<td>2.0</td>
<td>2.2</td>
<td>2.4</td>
<td>Megohms</td>
</tr>
<tr>
<td>Plate Current</td>
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<td>6.5</td>
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<td>5000</td>
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<td>100</td>
<td>110</td>
<td>Vdc</td>
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<td>Signal Voltage  (rms)</td>
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<td>Max. Signal Grid 22 Current</td>
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GOLD BRAND PREMIUM SUBMINIATURE TYPES

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>5903</td>
<td>UHF Double Diode</td>
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<tr>
<td>5904*</td>
<td>UHF Medium-Mu Triode</td>
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<tr>
<td>5905*</td>
<td>UHF Sharp Cutoff Pentode</td>
</tr>
<tr>
<td>5906</td>
<td>UHF Sharp Cutoff Pentode</td>
</tr>
<tr>
<td>5907*</td>
<td>UHF Pentode</td>
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<tr>
<td>5916</td>
<td>Dual-Cutoff</td>
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<tr>
<td>7728</td>
<td>Medium-Mu Double Triode</td>
</tr>
<tr>
<td>7730</td>
<td>Medium-Mu Double Triode</td>
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<tr>
<td>7761</td>
<td>High-E Video Pentode</td>
</tr>
<tr>
<td>7762</td>
<td>Beam Power Pentode</td>
</tr>
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</table>

GOLD BRAND PREMIUM SUBMINIATURE GUIDED MISSILE TYPES

<table>
<thead>
<tr>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>6543</td>
<td>Sharp Cutoff RF Pentode</td>
</tr>
<tr>
<td>6544</td>
<td>Semi-Remote Cutoff RF Pentode</td>
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<tr>
<td>6545</td>
<td>AF Beam Power Pentode</td>
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<tr>
<td>6546</td>
<td>Medium-Mu Triode</td>
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<tr>
<td>6547</td>
<td>Medium-Mu Double Triode</td>
</tr>
<tr>
<td>6548</td>
<td>High-Mu Double Triode</td>
</tr>
<tr>
<td>6768</td>
<td>Sharp Cutoff RF Pentode</td>
</tr>
</tbody>
</table>

Sylvania-7760—medium-mu double triode—for service as an RC coupled amplifier, mixer. All elements are 26.5 volts.

Sylvania-7761—high-Gm pentode—well-suited for use as a video amplifier.

Sylvania-7762—beam power pentode—especially for Class A audio amplifier, series regulator, servo-amplifier applications.

Gain the benefits of Gold Brand Subminiature Tubes in your military and industrial designs. Call your nearest Sylvania Field Office for the new specifications and delivery information. For data on individual types, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. H, 1100 Main St., Buffalo, N. Y.

See the Sylvania Exhibit at Wescon—Booth #2009-2011, 2058-2061, 2108-2111.
Compact cryogenic cooling systems for infrared, electronics or optics

New AiResearch system delivers nitrogen in liquid form from storage system to cooling area

Now units requiring cryogenic cooling no longer need be designed with allowances made for bulky expanders or adjacent storage tanks.

The new AiResearch system transfers the coolant in liquid form to a point of use 25 feet or more away. The liquefied gas passes through an uninsulated, small, flexible tube which can be bent over and around obstructions. Because the storage system can be placed anywhere, space limitations are overcome and vehicle installation problems are simplified.

The complete system includes the cryogenic liquid container, pressure and flow controls, the liquid transfer tube and cooling adapter. The system can be operated without external power. It can be used with missile, aircraft, space or ground based units and can be converted to a closed-cycle system with the addition of a small gas liquefer.

AiResearch has pioneered many new developments in the cryogenic field. It is presently engaged in work on systems utilizing helium, hydrogen or neon as coolants, and cryogenic systems for zero G operation.

* Please direct inquiries to Los Angeles Division.

THE GARRETT CORPORATION
AiResearch Manufacturing Divisions
Los Angeles 45, California • Phoenix, Arizona
Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

August 12, 1960

CIRCLE 63 ON READER SERVICE CARD 63
Exclusive

AUTOMATIC

OVERVOLTAGE

PROTECTION

Prevents damage to power supply load under any conditions. Unique electronic circuitry monitors output voltage at all times and reduces output voltage and current to nominal zero if output attempts to rise above operating voltage. Of course turn-on and turn-off transients are also eliminated.

OVERVOLTAGE PROTECTION: Voltage excursions above operating voltage in case of internal fault condition is less than 5% or 1/2 volt for less than 5 milliseconds.

TURN-ON/OFF TRANSIENT ELIMINATION: Transient less than 1% or 1/2 volt for less than 5 milliseconds.

<table>
<thead>
<tr>
<th>MODEL</th>
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<tbody>
<tr>
<td>DC OUTPUT</td>
</tr>
<tr>
<td>VOLTS</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>S36-2.5</td>
</tr>
<tr>
<td>S36-10</td>
</tr>
<tr>
<td>S36-15</td>
</tr>
<tr>
<td>S60-2.5</td>
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<tr>
<td>S50-5</td>
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<tr>
<td>S60-10</td>
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<td>S72-15</td>
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<td>S300-400</td>
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<td>S300-800</td>
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<td>S300-1500</td>
</tr>
<tr>
<td>T5-600</td>
</tr>
<tr>
<td>T20-1</td>
</tr>
</tbody>
</table>

All units available with remote programming.

TRYGON ELECTRONICS, INC.
111 Pleasant Ave. Roosevelt, L.I., N.Y.
Freeport 6-2800

MEETINGS AHEAD


Aug. 23-26: Western Electronic Show and Convention, WESCON, Memorial Sports Arena, Los Angeles.


Aug. 29-31: Metallurgy of Elemental and Compound Semiconductors, AIME, Statler Hotel, Boston.

Sept. 7-8: Value Engineering, EIA, Disneyland Hotel, Anaheim, Calif.


Sept. 8-9: Conference on Technical Communications, Society of Technical Writers and Editors, Univ. of Dayton, Dayton, O.

Sept. 9-10: Communications: Tomorrow's Techniques—A Survey, IRE, Roosevelt Hotel, Cedar Rapids, Iowa.

Sept. 11-16: American Chemical Society, Annual, Statler Hilton, New York City.


DC TO 2000 Mc
BANDWIDTH

0.2 Mu sec
RISE TIME

Unquestionably the most advanced traveling wave oscilloscope available, EG&G's new milli-mike is the only scope capable of many types of basic research. Its phenomenal performance gives it both single transient and repetitive signal capability. Yet its simplicity and ease of operation make it a highly versatile production-evaluation instrument.

For precise photographic recording, EG&G's Model 850 integrated camera system is recommended. For less accurate requirements, however, any standard camera can be used to record pulse displays through an illuminated reticle attachment which completely eliminates parallax. Single transient displays can be recorded directly from the screen. .0015" spot size ensures maximum resolution. This, in combination with the fact that signals as low as 5.5 mv will deflect the beam a full trace width, gives you an idea of this instrument's extreme sensitivity.

For full details, write for Data Sheet 7070.

Edgerton, Germeshausen & Grier, Inc.
162 Brookline Avenue, Boston 15, Massachusetts

August 12, 1960
Lockheed's interest in developing the science of communications extends from the depths of the oceans to deep space. Its Missiles and Space Division research programs deal with the development and application of statistical communication and decision theory in such areas as countermeasures; telemetry multiplexing and modulation; scatter communications; multiple vehicle tracking; millimeter wave generation and utilization; sonic signal detection and processing; avoidance of multipath degradation; and interference avoidance.

Associated research and development efforts are directed toward propagation studies and advanced antenna design; low noise amplifiers; vehicle borne signal transmission and reception, data storage and processing; solid state materials and devices.

The scope of such activities extends from advanced studies of naval communication problems on and under the oceans; the many applications to satellite vehicles; on to the specialized communication problems of deep space explorations. Latter needs are exemplified by high frequencies, low weight and power, high stability, low effective bandwidth, extreme reliability and basic simplicity requirements.

**Engineers and Scientists:** Investigating the entire spectrum of communications is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; communications; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetohydrodynamics; man in space; materials and processes; applied mathematics; oceanography; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space medicine; space navigation; and space physics.

If you are experienced in work related to any of the above areas, you are invited to inquire into the interesting programs being conducted and planned at Lockheed. Write: Research and Development Staff, Dept. H-22, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

**Lockheed Missiles and Space Division**

*Systems Manager for the Navy POLARIS FBM;*  
*the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER*  
*SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA*  
*CAPE CANAVERAL, FLORIDA • HAWAII*
NEW from MELABS-
seasoned microwave designers and builders

Swept Signal Generators offering Constant Power Output over Entire Band

A common power and sweep supply can be used with any of the new Melabs electronically tuned signal generators covering, respectively, L, S, C, X and K band frequencies.

All five units are compatible with Melabs' radiometer and panoramic display unit. Addition of a receiver box creates a swept receiver or panoramic analyzer. TWT amplifiers with power outputs up to 1 watt can be supplied.

SPECIFICATIONS
Model SGS-2, S Band, with SGO-2 Power Supply
Power output: Regulated, 10 mw ± 1 db; unregulated, 10 mw at 2 KMC; rising to 300 mw at 4 KMC; manual adjustment range, 30 db.

Internal modulation: For regulated power, pulse, 1-10 μsec; square wave, Rep rate, 100-5000 cps.
External modulation: Any type, unregulated only.

Sweep: 0.3 to 30 cps; cw through 100% of band.

Price: \$2,300.00; \$900.00.

Specifications similar to Model SGX-2, \$2,600.00; Model SGK-2, \$4,500.00.

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

Employment opportunities at Melabs are exceptional for ambitious engineers and physicists; write in confidence.

Melabs
(pronounced MEL-LABS) · Dept. M7, 3300 Hillview Ave. PAlo Alto, California · DAvenport 6-9500
WURLITZER DR-5 RESONANT REED RELAY

A reliable miniaturized relay featuring anti-vibration design and application flexibility

This new Wurlitzer Reed Relay incorporates shock and vibration resistance, zero mechanical coupling to support, and closely controlled response and hold regions.

Twin reed configuration based on tuning fork concepts makes the Wurlitzer Reed Relay highly resistant to false operation from shock or vibration.

Sensitivity is less than 1.0 milliwatt.

32 channels at 4% increments between 300 to 1000 cps.

Frequency variation is less than ½% from —60°F to +150°F.

Has application in: • Frequency Sensing and Measurement
                    • Selective Tone Communication and Control Systems
                    • Frequency Generation
                    • Controlled Sequence Contacting Applications
                    • Speed Control
                    • Ground Station Telemetering

Available in uncased, hermetically sealed, and plug-in models for frequency range of 300 to 1000 cps. Other frequencies available on special order.

Inquiries Invited
ELECTRONICS AND DEFENSE PRODUCTS DIVISION
THE WURLITZER COMPANY
North Tonawanda
New York

CIRCLE 69 ON READER SERVICE CARD 69
If you're at all concerned with electronics, here is the biggest circuit component story of the year. The seven AMP lines listed below will all be designed into tomorrow's electronic products.

**AMP-MAD**
*SHIFT REGISTER*
The first commercial all magnetic register/counter using only multiaperture ferrite cores and wire. Available with any serial/parallel input/output combination and featuring non-destructive dynamic and static readout.

**AMP-MECA**
(Maintainable Electronic Component Assembly) is a three-dimensional packaging concept that will change your thinking. Components, or functions are assembled and encapsulated, if necessary, in AMP-Cells then plugged between programmed AMP side rails.

**AMPin-cert CONNECTORS**
Series A, D, M and W meet or exceed all applicable mil-specs. Pins and sockets are crimp-type for uniform reliability.

**AMP DOUBLE THROW SWITCH**
From 80 to 1500 pole for instrumentation and related applications requiring a compact, rugged programming unit.

**AMP PATCHCORD PROGRAMMING SYSTEMS**
In universal and shielded types, this line offers more unusual features than any other system made including positive wiping action and unbeatable reliability.

**AMP PINBOARDS**
For matrix programming. No moving parts, top reliability and low cost, range of sizes.

**AMP GENERAL LINE**
One of the greatest continuing stories in modern industry, the AMP solderless crimp technique each year produces a host of new items and new applications.

*Trademark*
1960 PRODUCT STORY BEING TOLD BY MP INCORPORATED

Harrisburg, Pennsylvania

BOOTH 2001-2003, AUGUST 23-26, 1960

August 12, 1960
WHY GAMBLE?

RELIABILITY

is a NATURAL...

WITH CIC PRECISION FILM POTS!

HERE'S WHY!

WIRE-WOUNDED...

THE HARD WAY

- All current carried by a single fragile hair-like wire. Cutting any one turn causes no-warning, catastrophic failure—for 2,000 turns, 2,000 chances for element failure!
- Single bar contact wiper—one microscopic dust particle can cause an open—1:1 odds on failure!
- In one traverse wiper must make switch-like contact to each turn for continuity—for 2,000 turns, 2,000 chances for opens!

FILM POT...

THE EASY WAY

- Current carried by broad band of hard carbon film with an infinite number of current paths—ZERO probability of element failure!
- Multiple fingered wiper—each finger with different natural frequency—odds on opens 1:16!
- Wiper rides on continuous film, glass smooth, self-lubricating carbon—ZERO probability of opens!

Precision film potentiometers are inherently four million times more reliable than wire-wound types!
Write for our Tech Note “Reliability Factors in Precision Potentiometers” for the whole story.

FIRST IN FILM POTS

92 MADISON AVENUE, HEMPSTEAD, L.I., N.Y.

Hear The Film Pot Story at WESCON TECHNICAL SESSION
NEW! ...NJE Again Advances the State of the Art!

...The MOST

Power Supply in a 3½" Panel

This fully transistorized power supply delivers maximum power and performance in minimum panel size at surprisingly low cost. It is NJE's ultimate answer to power supply requirements. Complete with meters, it is fully capable of remote sensing and remote programming. It is the only unit that can be used easily for series or parallel operation. No fans or blowers utilized.

<table>
<thead>
<tr>
<th>Output Volts Amps</th>
<th>Model No.</th>
<th>Input Volts</th>
<th>Power Freq. **</th>
<th>Max. Ripple In RMS</th>
<th>Static Regulation</th>
<th>Dimensions H x W x D</th>
<th>Approx. Weight Pounds</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td>0-10 0-10</td>
<td>QR-10-10</td>
<td>105-125</td>
<td>55-65</td>
<td>1</td>
<td>±0.01% or ±1 mv</td>
<td>±0.3% or ±3 mv</td>
<td>3½&quot; x 19&quot; x 16½&quot;</td>
<td>41</td>
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<td>55-65</td>
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<td>±0.3% or ±3 mv</td>
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<td>55-65</td>
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<td>±0.3% or ±3 mv</td>
<td>3½&quot; x 19&quot; x 16½&quot;</td>
<td>41</td>
</tr>
</tbody>
</table>

* Whichever is greater.
** Available for 400 cycle operation.

60 and 400 cycle from stock subject to prior sale.

WRITE TODAY FOR COMPLETE TECHNICAL INFORMATION AND A COPY OF OUR NEW CATALOG.

NJE CORPORATION
20 Boright Avenue - Kenilworth, New Jersey
BR. 2-6000 - TWX Cranford, NJ 51 - FAX FFP

August 12, 1960
Vitramon® Capacitors adapt easily to the printed circuit boards used in VERDAN. Note how square configuration and axial-radial design of capacitors permits flush mounting and easy insertion. Solid-state construction — fine silver electrodes molecularly fused with dense porcelain dielectric — give Vitramon® Capacitors outstanding stability, extremely low loss, and high pulse rate.

Autonetics’ air-borne VERDAN is an extremely high speed computer with relatively high capacity, great flexibility of application, and extensive input-output provisions. Occupying less than 1½ cubic feet of space, VERDAN is designed with a general purpose section and a digital differential section, both of which share a common magnetic disk memory and have complete intercommunication. VERDAN was developed by Autonetics for its air-to-ground “Hound Dog” guidance control and REINS nav-bomb systems.

* a division of North American Aviation, Inc.

See us at WESCON, Booth No. 625

VITRAMON INCORPORATED
BOX 544 • BRIDGEPORT 1, CONN.
FOR PRECISION WELDING
OF TRANSISTORS AND COMPONENTS

RAYTHEON'S
MODEL "M"
WELDING HEAD

Newest development
in precision welding
of miniature parts.

The "M" head—Raytheon's completely
new precision welding device—assures
consistent welding performance even
when joining miniature parts. The
secret is the advanced design that
achieves relatively low welding currents
and electrode pressures.

The new head has extremely fast action
and a new low-impact anti-hammer
arrangement that extends electrode life
many times. It has an air chamber that
provides for a deflection of less than
.0001 inch under full pressure.

The "M" head—thoroughly tested in
transistor production—can be mounted
horizontally or vertically and is adap-
able to dial feed or in-line feed for
automated production.

THE UNIQUE ADVANTAGES
of an "M" head installation will be ob-
vious to you after reading the latest
technical bulletins. Write for them
today at the address below.

FEATURES
• Can be used with any welder
• Horizontal or vertical operation
• Fits dry box without
modifications
• Quick, easy servicing,
electrode changing
• Adjustable linear bushing
and electrode alignment
• Long electrode life
• Minimum deflection

See our new automated welding systems and ultrasonic joining unit at WESCON—Booth 210

August 12, 1960

CIRCLE 75 ON READER SERVICE CARD 75
In the complete BUSS line...

you can quickly find the right fuse and fuseholder to meet every demand!

Dual-element "slow-blowing", single-element "quick-acting" and signal or visual indicating type fuses... plus a companion line of fuse clips, blocks and holders... are available from one source — BUSS. You'll save time and trouble by turning first to BUSS when you need fuses and fuseholders.

To safeguard against 'kicks' or complaints, every BUSS fuse is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected to assure dependable protection under all service conditions.

Save engineering time on special problems in electrical protection. At your request, the BUSS fuse engineers are at your service to help you determine the fuse or fuse mounting best suited to your needs.

In many cases it is possible to find, in the complete BUSS line, a fuse and fuse mounting already available in local wholesalers' stocks, so that your device can be easily serviced.

For more information on BUSS and FUSETRON small dimension fuses and fuseholders... Write for bulletin SFB.

BUSSMANN MFG. DIVISION, McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.
For close capacity tolerance and capacitance stability

Gudeman Polystyrene Capacitors are wound with

NATVAR Styroflex®

Gudeman capacitors are made in a wide range of capacitance values, voltages, and cases. Natvar Styroflex film is used in all Gudeman polystyrene capacitors.

The Gudeman Company, Chicago, one of the principal capacitor manufacturers, uses Natvar Styroflex film in their new series X-727 and X-728 capacitors. These polystyrene capacitors are used in such exacting applications as: critical timing circuits requiring capacitance stability, and low dielectric absorption; tuned circuits; laboratory standards; analog and digital computing circuits; circuits requiring storage capacitors with long time constant; and radiation counters.

Natvar Styroflex film is used as the dielectric because it has all of the outstanding properties of polystyrene plus toughness, uniformity, and complete flexibility due to bi-axial orientation during the manufacturing process.

Natvar Styroflex is available in standard thicknesses from .00033" to .006" in rolls from ½" to approximately 10" in width, or in special put ups to meet manufacturing requirements.
Converting power to your specific requirements is the specialty of the Precision Power Division of American Electronics. Through its years of experience devoted exclusively to solving power conversion problems, have come many new rotary and solid state power conversion developments. Thousands of these dependable AEI products today serve the aircraft, missile, electronics and industrial fields. For all of your precision power needs, depend on one reliable source—American Electronics’ Precision Power Division. Please call on our field representative and engineering staff to discuss your specific power requirements.

- **Brushless Inductor Type Motor-Alternator Sets** • 300 watts to 30 KVA, 100 cycles to 10,000 cycles, fixed or variable, single or 3 phase.
- **Revolving Field Motor-Alternator Sets** • 3 KVA to 125 KVA, 50 cycles to 10,000 cycles fixed or variable, single or 3 phase.
- **Filament Line Voltage Regulators, Magnetic Servo Amplifiers, Magnetic Amplifiers, Line Voltage Regulators.**
- **Amstat Solid State Devices** • Inverters, Converters, Regulator and Filter Packs and Frequency Changers.

**AMERICAN ELECTRONICS, INC.**

**PRECISION POWER DIVISION**

9705 KLINGERMAN STREET, EL MONTE, CALIFORNIA, CUMBERLAND 3-7721
THERE IS NO ROOM FOR SMALL MINDS where men fathom the laws and create the vehicles of space. Nor is there any limit to what these minds can accomplish in a total celestial climate like Martin-Denver. If you seek the stimulation of projects, associates, tools, accomplishments far beyond the ordinary, write: N. M. Pagan, Director of Technical and Scientific Staffing, Martin-Denver, P.O. Box 179Z, Denver, Colorado.
There’s now a new meaning to “The Name That Counts” on the West Coast. Veeder-Root has expanded its operations to include engineering, manufacturing, and service facilities from a new plant at Glendale, California.

Veeder-Root/Western represents your best single source for the latest in counting technology and counting devices for all functional designs and applications. Coupled with other Veeder-Root facilities, and the Research and Development headquarters at Hartford, a complete selection, as well as modification of all types of mechanical and electromechanical counters, will now be available to West Coast industry.

**See us at Wescon — Booth 956**

The staff of Veeder-Root/Western will be on hand to show you the complete line of Veeder-Root Counters. And whatever your Counting and Control requirements, wherever you are, make sure you contact . . . The Name That Counts!
AlSiMag®

offers...

the widest variety
of technical ceramics
from any single source

Specialized engineering talent in depth • 
The quantity you need ... deliveries and quality as agreed • Special speedy service on prototypes • Specialized equipment for smaller quantity production • Unequaled facilities for volume production when you really need volume.

from one source...

These are typical samples picked up in our Inspection Department over a week end. They illustrate the great variety of technical ceramics constantly flowing through our ultra-modern plants.

Parts are shown approximately 1/2 size.

Property Chart Sent on Request.
Accurate Q Measurements

1 KC to 260 MC

PRODUCTS OF 25 YEARS SPECIALIZED EXPERIENCE IN Q METER DESIGN!

Model 260-A Q Meter
Model 190-A Q Meter

These BRC instruments incorporate many exclusive design features resulting in improved accuracy and reliability—

- Low Q scales permit direct measurement down to a Q of 5 (190-A) or 10 (260-A)
- Extremely wide direct reading Q range: 5-1200 (190-A), 10-625 (260-A)
- \( \Delta \) Q Scales permit accurate measurement of capacitors, dielectrics, and resistors
- Mirror meter scales eliminate parallax
- Electronically regulated power supplies provide maximum stability
- Extremely low injection impedance provides maximum Q accuracy

BRC Q Meters are versatile, general-purpose instruments with a broad field of application in the laboratory and on the production line. They are designed to measure coils, capacitors, resistors, transformers, dielectrics, networks and filters through either series or parallel connection to a calibrated resonant tank circuit.

To Users of Earlier Models of BRC Q Meters!

While older models of the world-famous BRC Q Meters are still performing satisfactorily after many years of continuous service, users of these instruments are invited to investigate the greatly improved accuracy and convenience of the Types 190-A and 260-A.

SEE OUR EXHIBIT AT THE WESCON SHOW—BOOTH 751-752

Boonton Radio Corporation
BOONTON, NEW JERSEY
Precision Electronic Instruments since 1934

82 CIRCLE 82 ON READER SERVICE CARD
"Then," as it refers to the electronics industry, means... "just a very few years ago." The radically swift advances made in those few years have changed the whole concept of component design and performance.

Capacitor users will find the new capacitors which modern circuitry demands at Pyramid Electric Company, where miniaturization with highest reliability are among our proven engineering and production accomplishments. A few of the modern capacitor products are shown here.

**Type TAD**... solid tantalum high reliability capacitors. They are available in a wide range of sizes and values, are hermetically sealed, and have a long shelf and operating life.

- temperature range: $-80^\circ C$ to $+85^\circ C$
- Write for bulletin ET-7

**Type MLE**... true miniature electrolytic capacitors. They are metal clad of all-welded construction, made to last ten years or longer.

- temperature range: $-40^\circ C$ to $+85^\circ C$
- Write for bulletin EL-6

**Type TAK-H**... wet electrolyte tantalum capacitors with built-in rugged construction, seep and vibration proof, and made to meet specifications MIL-C-3965.

- Write for bulletin ET-8

**Type 107**... Mylar dielectric capacitors— the smallest film capacitors made. Non-hydroscopic polyester dielectric and wrapper with thermosetting resin end seals.

- temperature range: $-55^\circ C$ to $+125^\circ C$
- Write for bulletin MY-2

For full details write or call: Sales Department S-100

**Pyramid Electric Company**

Orange Street, Darlington, South Carolina • In Canada: Wm. Cohen, Ltd., 8900 Tanguay Street, Montreal • Export: Morhan Exporting Company, 485 Broadway, New York 13, N. Y.
SAVE SPACE, WEIGHT AND MAINTENANCE with Versatile Compact MIL Spec Modules

For your electronic/electromechanical packaging problems, consult Oster specialists. Compact, transistorized, MIL spec, hermetically sealed, plug-in modules are available for numerous applications. Typical building block basic units are illustrated. Temperature range is -55°C to +105°C. Basic units can be modified easily or completely redesigned to your specific requirement. Oster engineers are specialists in creating densely packaged black boxes. These boxes can help you design more compactness and less weight into your systems. Phone or write your nearest John Oster office today.

### GENERAL ENVIRONMENTAL CONDITIONS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Temperature</td>
<td>-55°C to +75°C</td>
</tr>
<tr>
<td>B. Altitude</td>
<td>1000 Feet to +80,000 feet</td>
</tr>
<tr>
<td>C. Humidity</td>
<td>Section 4.4.3 of MIL-E-5272</td>
</tr>
<tr>
<td>D. Vibration</td>
<td>0.30 inch double excursion from 3 to 18 cycles per second and ± 2 g. acceleration from 18 to 500 cycles. (Without vibration isolators)</td>
</tr>
<tr>
<td>E. Crash Safety</td>
<td>Repeated shocks of 30 g. with durations of 11 milliseconds</td>
</tr>
<tr>
<td>F. Salt Atmosphere</td>
<td>Section 4.8.1 of MIL-E-5272</td>
</tr>
<tr>
<td>G. Fungus Growth</td>
<td>Section 4.8.1 of MIL-E-5272</td>
</tr>
<tr>
<td>H. Sand and Dust</td>
<td>Section 4.11.1 of MIL-E-5272</td>
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</table>

### GENERAL PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Gain Variation</td>
<td>Less than 10% due to any given parameter extreme variation.</td>
</tr>
<tr>
<td>B. Linearity</td>
<td>Better than 10% through the range of 3% to 80% of full output.</td>
</tr>
<tr>
<td>C. Noise</td>
<td>Less than 6% of maximum output.</td>
</tr>
<tr>
<td>D. Phase Shift</td>
<td>Less than 8 degrees.</td>
</tr>
</tbody>
</table>

### TYPE 9805-19—SYNCHRONIZER

**Generator Output**
- 0.3 volts/1000 R.N.M. Min.
- Control Transformer Speed: 100 degrees/second-Min.
- Control Transformer: John Oster Mfg. Co. 4053-19
- Motor Generator: John Oster Mfg. Co. 6232-17

### TYPE 9816-06—SUMMING AMPLIFIER (DUAL)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summing Inputs</td>
<td>10 (per channel)</td>
</tr>
<tr>
<td>Gain</td>
<td>Nominal 1.0; variable from 0.1 to 10.0</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>Dependent on Summing Channel. (50,000 ohms—500,000 ohms)</td>
</tr>
<tr>
<td>Load Impedance</td>
<td>Greater than 10,000 ohms</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>28 V. D.C.</td>
</tr>
</tbody>
</table>

### OTHER PRODUCTS INCLUDE:

- Computers
- Indicators
- Servo Mechanisms
- Servo Torque Units

### MANUFACTURING CO.

- Specialists in Instrumentation and Display
- Avionic Division
- Racine, Wisconsin

### EASTERN OFFICE

310 Northern Blvd.
Great Neck, Long Island, New York
Phone: Hunter 7-9330
TWX: Great Neck N.Y. 2980

### WESTERN OFFICE

5333 South Sepulveda Blvd.
Culver City, California
Phone: Exmoor 1-5742 • Upton 0-1194
TWX S. Mon. 7671

Engineers For Advanced Projects: Interesting varied work on designing transistor circuits and servo mechanisms. Contact Mr. Dallas Nielsen, Personnel Manager, in confidence.
FAST SWITCHING plus
HIGH CONDUCTANCE in
SILICON JUNCTION DIODES

SWITCHING TYPES

New circuit possibilities for low impedance, high current applications are opened up by Clevite's switching diodes. Type CSD-2512, for example, switches from 30 ma to -35 v. in 0.5 microseconds in a modified IBM Y circuit and has a forward conductance of 100 ma min@1 volt.

Combining high reverse voltage, high forward conductance, fast switching and high temperature operation, these diodes approach the ideal multi-purpose device sought by designers.

GENERAL PURPOSE TYPES

Optimum rectification efficiency rather than rate of switching has been built into these silicon diodes. They feature very high forward conductance and low reverse current. These diodes find their principal use in various instrumentation applications where the accuracy or reproducibility of performance of the circuit requires a diode of negligible reverse current. In this line of general purpose types Clevite has available, in addition to the JAN types listed below, commercial diodes of the 1N482 series.

MILITARY TYPES

<table>
<thead>
<tr>
<th>JAN</th>
<th>SIGNAL CORPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N457</td>
<td>MIL-E-1/1026</td>
</tr>
<tr>
<td>1N458</td>
<td>MIL-E-1/1027</td>
</tr>
<tr>
<td>1N459</td>
<td>MIL-E-1/1028</td>
</tr>
<tr>
<td>1N562</td>
<td>MIL-E-1/1139</td>
</tr>
<tr>
<td>1N563</td>
<td>MIL-E-1/1140</td>
</tr>
<tr>
<td>1N564</td>
<td>MIL-E-1/1160</td>
</tr>
<tr>
<td>1N563</td>
<td>MIL-E-1/1171</td>
</tr>
</tbody>
</table>

All these diodes are available for immediate delivery. Write now for Bulletins B217A-1, B217A-2 and B217-4.

Reliability In Volume...

CLEVITE TRANSISTOR
254 Crescent Street Waltham 54, Mass. Tel: T'Winbrook 4-9330

August 12, 1960

CIRCLE 85 ON READER SERVICE CARD 85
Build In Reliability

Seal Out Moisture and Humidity with Silastic RTV

Reliability of equipment starts with materials. Dow Corning Silicones have physical and electrical properties that mean extra reliability for electronic components, assemblies, systems.

For example: Silastic® RTV, the room temperature vulcanizing Dow Corning silicone rubber, is highly resistant to ozone, corona, weathering and oxidation. Heat-stable, Silastic RTV remains operable from —60 to 250°C; has good dielectric and physical properties.

Major uses for Silastic RTV include potting, filling, and encapsulation of electronic components and assemblies. Since it is a liquid, Silastic RTV pours easily to form a void free, rubbery mass around components. Available in several grades, Silastic RTV has set-up times ranging from several minutes to hours. Encapsulated parts can be handled in 24 hours, filled parts in even less time.

As a seal against humidity and salt water spray, Silastic RTV is used by Automatic Power, Inc., Houston, Texas to embed all tube sockets, connections, electronic components and wiring in the chassis of the control panel for their Dies-L-Air Automatic Warning Signal. This interchangeable control panel monitors operation of the entire warning signal system — including a diesel engine driving an integral air compressor, an air system, the control circuitry and air blast horns. Used to alert sea traffic to the presence of off-shore drilling equipment, reliability requirements for Dies-L-Air are continuous — and most critical during storms when the unit is being whipped by corrosive salt water spray and lashed by wind-driven rain. By sealing the control chassis with Silastic RTV, Automatic Power, Inc., has assured the reliability of electronic components.
Laminates Give Extra Strength

Silicone-glass laminates, made with Dow Corning resins, have dielectric properties at high temperatures that are superior to those of other laminate materials. They resist ozone, arcing, corona, fungus — even the combination of high humidity and high voltage. Mechanical strength is good — permitting thin, rigid coil bobbin walls; more winding space and better resistance to winding pressure. These are the reasons why Foster Transformer Company, Cincinnati, Ohio, specifies coil bobbins of silicone-glass laminates for transformers they manufacture for airborne guidance control systems. The one-piece coil bobbins, like those shown, are used in continuous operation at 250°C... tested for 1000 hours at 400°C.

Improve Transistor, Diode Performance

Used in mounting diodes to heat-sink or to chassis, Dow Corning Compound forms an excellent heat-sink seal... is easy to apply and never dries out. Its good thermal conductivity improves the heat transfer between diode-and-washer, washer-and-chassis.

Dow Corning silicone compounds don't melt, lose their grease-like consistency or dielectric properties from -70 to 200°C. Dow Corning silicone compounds have been found ideal for potting transistors. They cushion junctions against shock and vibration... improve heat dissipation because of their good thermal conductivity. Transistor junctions are not contaminated by Dow Corning's transistor potting compound... rejects from metal splatter are reduced when welding on transistor caps.

New Gel for "See Through" Protection

Poured as a liquid, transparent Dow Corning Dielectric Gel fills all voids, then sets up to form a heat-stable gel. Dielectric strength is excellent; stress on components almost nil. Potted components and circuitry remain clearly visible... can be checked by eye. Probes can be inserted for instrument checks... the gel re-seals itself when probes are removed. Individual components can be replaced. Dielectric Gel enabled CBS Laboratories to meet stringent reliability requirements on its Photoscan power supplies. Despite high temperatures, high voltages, and high vibration levels in this remarkably small unit, Dielectric Gel prevents arcing. Components are spaced less than ¼" apart, yet output voltages run from 1,000 to 25,000 volts!

Visit Our Booth 215-216 At Wescon Show

...Specify Silicones

CORPORATION

MIDLAND, MICHIGAN

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

August 12, 1960
Good electrical properties at H.D.T.'s above 500°F now possible in epoxy resin potting systems

Turn an appraising eye on the chart above. These data were assembled in tests of epoxy resin systems which had been cured with Du Pont’s pyromellitic dianhydride (PMDA).

Note the unusual stability of electrical properties at elevated temperatures.

Had we the space, we could also display equally exciting graphs showing excellent thermal resistance.

PMDA is now available in commercial quantities, to help you add these exceptional thermal characteristics to your epoxy resin potting, encapsulating, and laminating systems.

Other advantages

There’s more. PMDA provides several advantages in addition to high heat resistance.

You get all the usual benefits of an anhydride curing agent, including low toxicity and good chemical stability.

If you wish, you can get long pot life—up to 2 days at room temperature or 6 hours at 165°F. On the other hand, if you want a quick cure—say, 15 minutes at 355°F—you can get it by simply changing the formulation.

Now available

You can turn these test results into product improvements now, because PMDA is being delivered in quantity from Du Pont’s new multimillion-pound plant. Recent price reduction to only $1 per pound also makes this a practical means of improving your epoxy resin systems.

For more details or for samples of PMDA, write to Du Pont, Explosives Department, 6539 Nemours Bldg., Wilmington 98, Delaware.

*(H.D.T.—Heat Distortion Temperature)*
The Offner Type \textbf{R} All Transistor Dynograph

provides greatest versatility

**RP TWO CHANNEL**
Compact, economical, convenient where only one or two channels are desired.

**BMM/B CONSOLE**
Features horizontal paper travel. Available as Type R or RC.

**R SIXTEEN CHANNEL**
Assemblies with 16 channels. 24 inch paper permits up to 24 channels on one inch centers.

**RC DESK-TYPE CONSOLE**
Medium gain assembly for computer write-out, telemetering, applications with input signal above 10 millivolts.

VERSATILITY of assemblies—select the mounting best suited for your use.

VERSATILITY of application—one set of amplifiers covers all uses, microvolt to volts dc or ac, strain gages, reluctance gages, etc.

VERSATILITY of writing media—use ink, heat, electric interchangeably on one assembly—select the one most suited for the application.

The Offner Type R Dynograph Assembly is unmatched for sensitivity, accuracy, versatility—we invite you to compare it with any other high speed direct writing oscillograph.

Write on your company letterhead for Bulletin 891, a 20 page, 2 color brochure giving you complete specifications, application data, etc.

OFFNER ELECTRONICS INC.
3906 River Road, Schiller Park, Illinois (Suburb of Chicago)
Announcing a new series of size 8 servo components designed for today's high performance systems

**hi-T** or **lo-J**

**HIGH TORQUE** or **LOW INERTIA**

EAD's new line of Size 8 servo components are designed to meet the extreme environmental conditions and the reliability required by today's advanced control systems. From a family of six basic units, the design engineer has the selection of servo motors, inertially damped servo motors or servo motors with tachometer generators for "hi-T" or "lo-J" system needs.

As with all EAD components, these motors can be modified, if necessary, and can be supplied with a wide variety of integral gear reductions.

**TYPICAL CHARACTERISTICS**

- 26 volts per phase, 400 cycles
- Stall power per phase (watts):
  - hi-T 3.0
  - lo-J 2.8
- Max. power output (watts):
  - hi-T .40
  - lo-J .28
- Size 8 diameter: .750"
- Meets MIL-E-5272, MIL-E-5400.
- Ambient temperature: −55°C to +125°C.

Construction features: precision ball bearings, housing and hardened shaft all of stainless steel.

**SERVO MOTORS**

**hi-T**

Embraces high torque/watt ratio and adequate acceleration characteristics. Stall Torque, .35 oz-in.; Rotor Inertia, .72 gm-cm²; Acceleration, 34,400 rad./sec²; No load speed, 6,200 rpm; Damping coefficient, 38 dyne-cm-sec/rad.; 3.0 watts/phase @ stall.

**lo-J**

For low time constant and fast response to input signals in systems requiring max. torque/inertia. Rotor Inertia, .17 gm-cm²; Acceleration, 104,000 rad./sec²; No load speed, 6,500 rpm; Damping coefficient, 26 dyne-cm-sec/rad. Stall torque, .25 oz-in.

**SERVO MOTORS with TACHOMETER GENERATORS**

**hi-T**

Stall Torque, .35 oz-in.; Rotor Inertia, .72 gm-cm²; Acceleration, 34,400 rad./sec²; No load speed, 6,200 rpm; Damping coefficient, 38 dyne-cm-sec/rad.; Stall torque, 3.0 watts/phase @ stall; Flywheel, .250 v/1000 rpm; Phase shift, ±10°; Null voltage, 10 mv; Gen. input, 1.7 watts.

**lo-J**

Rotor Inertia, .23 gm-cm²; Acceleration, 77,000 rad./sec²; No load speed, 6,200 rpm; Damping coefficient, 27 dyne-cm-sec/rad.; Gen. output, .250 v/1000 rpm; Phase shift, ±10°; Null voltage, 10 mv; Gen. input, 1.7 watts. Stall torque, .25 oz-in.

**SERVO MOTORS with INERTIAL DAMPERS**

**hi-T**

Stall torque, .35 oz-in.; Rotor Inertia, 1.0 gm-cm²; Acceleration, 74,700 rad./sec²; No load speed, 6,000 rpm; Damping coefficient, 39 dyne-cm-sec/rad.; 3.0 watts/phase @ stall; Flywheel damping, 60 dyne-cm-sec/rad. Stall torque, .25 oz-in.

**lo-J**

Rotor Inertia, .34 gm-cm²; Acceleration, 32,700 rad./sec²; No load speed, 6,000 rpm; Damping coefficient, 28 dyne-cm-sec/rad.; Flywheel damping, 60 dyne-cm-sec/rad.; Corner freq., .77, 2.8 and 16.4 cps. Stall torque, .25 oz-in.

**SEND FOR COMPLETE TECHNICAL DATA**

**EASTERN AIR DEVICES, INC.**

SUBSIDIARY OF NORBUTE CORPORATION

397 CENTRAL AVENUE, DOVER, NEW HAMPSHIRE

electronics 90 CIRCLE 90 ON READER SERVICE CARD
NEW DIFFUSED SILICON DIODES

featured in more efficient economical switching block

New CBS high back-resistance diffused silicon diodes for positive switching now join CBS high-conductance and fast-recovery types. Efficient and flexible switching is made possible (see circuit). CBS diffusion techniques offer three major advantages over the alloying method: Close process control of all parameters, great uniformity, and high reverse voltage through the graded junction.

The new CBS 1N456, 1N457, 1N458, 1N459 are particularly designed for efficient computer operation in missiles, rockets, airborne and industrial equipment. Typical applications include: switching, pulse, flip-flop, modulator, demodulator, discriminator, clamping, gating, and detector circuits. Write for data sheet E-387. Order direct, from your local sales office, or MWD distributor.

ADVANTAGES OF CBS 1N456, 1N457, 1N458 AND 1N459
Efficient computer switching
High back resistance
Sharp back-voltage characteristic
Excellent forward conductance
Low current saturation
Wide storage and operating temperature ranges

More Reliable Products through Advanced Engineering

This single building block for computer switching achieves increased efficiency, flexible cascading, and simple maintenance. New CBS high back-resistance diffused silicon diodes used in the "And" gate assure positive switching. The relatively large voltage drop developed by these current switching devices drives the phase inverter transistor efficiently at high switching speeds, and minimizes cooling problems.

Check These Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. Reverse Voltage (volts)</th>
<th>Min. Forward Current (mA)</th>
<th>Maximum Reverse Current (volts) @ 25°C</th>
<th>Avg. Rect. Current</th>
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</thead>
<tbody>
<tr>
<td>1N456</td>
<td>30</td>
<td>40</td>
<td>0.025</td>
<td>5</td>
</tr>
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<td>1N457</td>
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<td>1N458</td>
<td>200</td>
<td>3</td>
<td>0.025</td>
<td>5</td>
</tr>
</tbody>
</table>

Other CBS DIFFUSED Silicon Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. Reverse Voltage (volts)</th>
<th>Min. Avg. Forward I (mA) @ 25°C</th>
<th>Bulletin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N482</td>
<td>40</td>
<td>100</td>
<td>E-373</td>
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<td>1N483</td>
<td>65</td>
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</tr>
</tbody>
</table>

CBS ELECTRONICS
A Division of Columbia Broadcasting System, Inc.

Sales Offices: Lowell, Mass. 960 Chelmsford St. (413) 455-4844 • Beverly, MA 111 Sumner Ave., Tewksbury 2-2449 • Medford 3-2440 • Newton, MA 17-1751 • Tewksbury 2-4540 • Medford 3-2440 • Newton 2-4540 • Hubbell, 438 W. Broadway, San Francisco, Calif., 2120 S. Garfield Ave., Raymond 6-3051 • Atlanta, Ga., Cary Chapman & Co., 679 Whitley St., Jackson 4-7365 • Algonquin, Minn., The NILMANS Co., 11401 Hawthorne Ave., Fillmore 2-9427 • Toronto, Ont., Canadian General Electric Co., Ltd., 4303-4-6321

CIRCLE 91 ON READER SERVICE CARD 91

August 12, 1960
NEW!
WESTINGHOUSE
HIGH VACUUM SWITCH TUBES

THE TUBES... New Westinghouse High Power Pulse Modulator Tubes (High Vacuum Switch Tubes).

THE APPLICATION... For use in radar systems, to replace hydrogen-thyratron type modulators.

THE ADVANTAGES...
- Successive staggering of power levels gives you a complete driving chain of switch tubes for systems use
- Power range 100 kilowatts to 10 megawatts
- Operation at higher D.C. voltage levels frequently eliminates the need for pulse-transformer coupling to the RF generator
- Eliminates the jitter problem inherently associated with soft-tube modulators
- Uses thoriated-tungsten filaments for long, reliable, trouble-free life
- Air and liquid-cooled versions available from a single source

THE PLACE TO WRITE... For more information, contact Westinghouse Electronic Tube Division, Elmira, N. Y., or your local Westinghouse Electronic Tube Sales Office.

YOU CAN BE SURE... IF IT'S Westinghouse
A New Galaxy in Electronics and Aerospace Activity

Ling-Altec Electronics, Inc.

and

Temco Aircraft Corporation

Join Forces as

LING TEMCO
Electronics INC.

Ling-Altec has attained remarkable growth in super-power electronic communications (radio, radar and sonar), vibration and environmental testing equipment for missiles and high-performance aircraft, closed-circuit television, stereo and other sound systems.

Temco has won an enviable position among the nation's first 500 corporations as a producer of aircraft, missile and propellant systems and components, many varied electronic devices and the Iconorama visual 2- and 3-dimensional radar plotting display installations.

We take pleasure in announcing this new force in the electronics and aerospace industry. The combined skills, facilities, management talent, financial capability and research programs establish Ling-Temco Electronics, Inc. as a strong, integrated corporation whose primary interest is the development and production of electronic and aerospace systems.

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Electronics INC.
P. O. Box 5003 • Dallas 22, Texas
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UNITED ELECTRONICS COMPANY
THE ELECTRON CORPORATION
UNIVERSITY LOUDSPEAKERS, INC., DIVISION
LING ELECTRONICS DIVISION
PEERLESS ELECTRICAL PRODUCTS DIVISION

TEMCO ELECTRONICS & MISSILES CO.
TEMCO Missiles & Aircraft Division
TEMCO Electronics Division
TEMCO Overhaul & Aerosystems Division
TEMCO Industrial Division
Fenske, Fedrick & Miller, Inc., Subsidiary

August 12, 1960
CIRCLE 93 ON READER SERVICE CARD 93
Eliminate all connector soldering operations with Continental Connector’s new, improved removable contact with crimp terminations. Extra wide, three-tine spring clutch on pin and socket provides maximum holding area between contact and molded block. Contacts are supplied separately and are wired independently. This permits mounting of plug and socket connector units at any convenient time without waiting for completion of wiring operation.

Wire crimping is fast and easy with hand or automatic power crimping tools readily available for small or quantity production. Contacts are quickly removed and replaced with a simple, low cost hand tool.

These removable contacts are designed for use with Continental Series 25 Miniature Rectangular connectors in sizes of 14, 26, 34, 50, 75 and 104 contacts. Both socket and pin contacts are made of phosphor bronze with gold plate over silver plate. Terminations accommodate any #16 to #22 AWG wire. Removable contact connectors are interchangeable with existing fixed contact types.

For complete technical data bulletin on Continental Removable Contact Connectors, write to Electronics Division, DeJUR-AMSCO CORPORATION, 45-01 Northern Boulevard, Long Island City 1, N. Y. (Exclusive Sales Agent.)

**EASY 3-STEP PROCEDURE FOR WIRING AND INSERTION OF CONTACTS**

1—CRIMPING . . . One motion with crimping tool quickly crimps contact securely to wire

2—INSERTION . . . Simple hand held insertion tool inserts crimped contact into molding

3—REMOVAL . . . Special spring-loaded removal tool removes contact and wire with one motion

**See us at the Wescon Show—Booths 855-856**
NOW... from VICKERS

2 NEW SILICON POWER RECTIFIERS

18 and 35 amperes

SILICON POWER RECTIFIERS
CATALOG NUMBERS

<table>
<thead>
<tr>
<th>Peak Inverse Voltage</th>
<th>LOW POWER</th>
<th>MEDIUM POWER</th>
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<tbody>
<tr>
<td></td>
<td>2 Amperes</td>
<td>5 Amperes</td>
</tr>
<tr>
<td>50V</td>
<td></td>
<td>DA05</td>
</tr>
<tr>
<td>100V</td>
<td></td>
<td>DA10</td>
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<td>DA50</td>
</tr>
<tr>
<td>600V</td>
<td>AA60</td>
<td>DA60</td>
</tr>
</tbody>
</table>

QUALITY
RELIABILITY
UNIFORMITY
IMMEDIATE DELIVERY

SILICON RECTIFIER STACKS of all cell sizes available in all popular circuits and voltage ratings with current ratings from 2 to 100 amperes.

Write for new 3300 Series Bulletins or contact the nearest Vickers Sales Representative.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION

ELECTRIC PRODUCTS DIVISION
1801 LOCUST STREET / SAINT LOUIS 3, MISSOURI

August 12, 1960
INTRODUCING THE ONLY SELF TUNING ULTRASONIC CLEANERS

Powertron's new line of self tuning ultrasonic cleaners CUT CLEANING TIME 300% over outmoded ultrasonic systems. Case histories on file show up to 900% faster cleaning consistently, and savings of $3,000 a month in labor costs — details on request.

The Autosonic by Powertron is the world's only full line of ultrasonic cleaners with the self tuning feature that assures you of consistent peak performance cleaning regardless of load changes, solution level, liquid temperature, solvent contamination, or operator inattention.

Powertron's unique feedback transducer senses the energy level in the cleaning tank and automatically tunes itself for maximum cleaning efficiency. Every change in operating conditions is sensed by the Autosonic transducer and is immediately compensated for to keep cleaning performance at its peak continuously without operator attention.

Powertron Autosonic cleaning systems are high power, heavy duty units, ruggedly constructed for continuous operation on any cleaning job—even those that other ultrasonic systems can't handle.

A single switch is the Autosonic's only control, so careless operation can't affect the rate or degree of cleaning. Because Powertron's advanced design has eliminated knobs, meters and moving parts, even mishandling, such as no-load operation, won't damage the Autosonic. Every Autosonic cleaner is unconditionally guaranteed.

Powertron will be glad to show you how your cleaning problem can be solved Autosonically. Simply describe your application, or send a sample of the item you want to clean, and Powertron will send you proof that the Autosonic can increase your output, cut production time, and increase your profits. If you prefer, send for details on Powertron's free trial offer.

WRITE FOR FREE BULLETIN 60-1 "HOW TO CLEAN ULTRASONICALLY WITH SELF TUNING"

POWERTRON ULTRASONICS CORP.
DEPT. E-8 PATTERSON PLACE • ROOSEVELT FIELD • GARDEN CITY, L.I., NEW YORK • PIONEER 1-3220
Thousands of Compatibility Tests help show why—

EPOXY MAGNET WIRE HELPS SIMPLIFY DESIGN AND INVENTORY PROBLEMS

Thousands of chemical and thermal stability tests in the laboratory at temperatures above 130°C—plus over four years of field experience—show that Anaconda Epoxy Magnet Wire is compatible with virtually every varnish, encapsulating and potting compound currently in use.

This outstanding high-temperature compatibility alone is reason enough to consider Epoxy practically an "all-around" magnet wire. But this Anaconda-developed magnet wire has outstanding dielectric strength, heat shock, adherence, and flexibility properties as well. And test results show Epoxy performs well in transformer oils and exhibits excellent resistance to attack from acids, alkalis and moisture conditions.

Anaconda Epoxy is a 130°C (AIEE Class B) enameled magnet wire, but it costs no more than most 105°C Class A magnet wires. This means you can often thermally upgrade your components to Class B at no additional cost. It's readily available, too—in a full range of round, square and rectangular sizes. It can also be furnished in combination with Vitrotex (glass served) for positive thermal overload protection.

You can see how Epoxy offers many interesting possibilities for cutting costs and simplifying production through standardization in many totally enclosed as well as open applications.

Our technical staff and our Research and Development Laboratory facilities are available to give you assistance in your compatibility and other magnet wire problems. See the man from Anaconda. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

ASK THE MAN FROM ANACONDA® FOR EPOXY MAGNET WIRE

ANATHERM 155°C (AIEE Class B) high temperature resistance
NYFORM 155°C (AIEE Class B) superior windability
PLAIN ENAMEL 105°C (AIEE Class A) low-cost enameled magnet wire
FORMVAR 105°C (AIEE Class A) proven dependability
ANALAC 105°C (AIEE Class A) solderable magnet wire
NEW DRIVER TRANSISTORS
SWEEPING THE FIELD

Extra-VERSATILE Bendix units beat high costs, design limitations over wide front

Called the “workhorse of the transistor industry,” the new Bendix Driver Transistor series is winning the nod from more and more engineers daily. These men find it the answer to audio frequency and switching applications requiring extra performance without extra cost.

Here is a special device for use where reliability, versatility, and low cost are primary requirements. The Bendix units combine higher voltage rating and high current gain with more linear current gain characteristics for low distortion and more efficient switching. They’re now in high production for rapid delivery in JEDEC TO-9 packages.

NEW BENDIX SEMICONDUCTOR CATALOG: on our complete line of power transistors, power rectifiers, and driver transistors available on request. Write SEMICONDUCTOR PRODUCTS, THE BENDIX CORPORATION, LONG BRANCH, N.J. for information about employment opportunities write personnel manager.

ENGINEERS KNOW the new Bendix Driver Transistor line-up meets an unusually wide range of circuitry applications. Bendix Applications Engineering Department suggestions on circuitry problems are helpful, too.

**APPLICATION, PERFORMANCE DATA INDICATE BROAD USAGE**

<table>
<thead>
<tr>
<th>TYPE NUMBERS</th>
<th>MAXIMUM RATINGS</th>
<th>TYPICAL OPERATION</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Vcc</td>
<td>Ic</td>
</tr>
<tr>
<td>2N1008</td>
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<td>300</td>
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<tr>
<td>2N1008B</td>
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</tr>
<tr>
<td>2N1176B</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Ideal for such applications as:

- TRANSISTOR DRIVER
- AUDIO AMPLIFIER (CLASS A OR B)
- POWER SUPPLY
- SERVO CONTROL
- AUDIO OSCILLATOR
- MOTOR CONTROL
- RELAY DRIVER
- POWER SWITCH

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Red Bank Division
LONG BRANCH, N.J.

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Midwest Sales Office:
2N563 York Road, Elmhurst, Illinois
New England Sales Office:
4 Lloyd Road, Tewksbury, Massachusetts
Export Sales Office: Bendix International Division,
205 E. 42nd Street, New York 17, New York
Canadian Affiliate: Computing Devices of Canada, Ltd.,
P.O. Box 508, Ottawa 4, Ontario, Canada

electronics
No ground support system (like the message center above) is a system at all — regardless of the ultimate reliability of its individual components — until it is packaged and operational.

This is the obvious and compelling reason for the indispensability of the systems packaging specialist in today's missile program. Among the best qualified and most reliable of these specialists are the engineers at Craig.

To the complex field of system engineering, Craig brings a wealth of specialized knowledge, plus more than a decade of experience with over 180 different types of mobile installations. Craig offers a complete system packaging capability — from initial study, to installation, to final operational checkout.

Whatever your system packaging problems, we can wrap them up for you, either in whole or in part, as a supporting service to your plan of operations.

CRAIG SKILLS AND SERVICES
- Systems housings — lightweight, high-strength aluminum shelters, vans and trailers for mobile, transportable ground support and electronic systems.
- Systems components — including telescoping antenna masts, transit cases, spare parts boxes, equipment racks, and cabinets.
- Systems installation service — layout and installation of complete systems, through final checkout for maximum mobility and reliability. Includes all cabling, shock & vibration isolation,
New temperature controlled MICROSTACK® meets

-55°C to +85°C

MILITARY REQUIREMENT

The General Ceramics MICROSTACK, one of the most important advances in memory core packaging, now operates in a temperature range of from -55°C to +85°C. Core characteristics remain constant. By maintaining temperature stability inside the MICROSTACK unit, General Ceramics engineers have developed a memory core package that is smaller, more rugged, requires no external cooling or heating, and meets MIL shock and vibration specifications.

For additional information, please write on company letterhead. Address inquiries to Section E.
human engineering, environmental control, testing, and repackaging.

- Systems packaging research — engineering design and development for ground support and electronic equipment protection.

- Complete production facilities — all the manpower, all the tools, all the space required to handle the complete packaging assignment.

- A unique “aluminum-chemical research” service — a highly versatile “brainpower pool” for solving virtually any problem in aluminum and foamed plastic fabrication.

Craig’s capabilities brochure will be sent on request. Write to Dept. E-4.
KOVAR is an iron-nickel-cobalt alloy with thermal expansion characteristics essentially matching those of several hard glasses. It is the ideal material for making high-quality drawn shapes required for vacuum- or pressure-tight glass-to-metal seals in equipment such as electron tubes and semi-conductors.

KOVAR has deep drawing qualities similar to cold-rolled steel. Satisfactory results are assured by observing a few simple precautions:

1. On the initial draw, punch radius should be a minimum of four times the material thickness. Reduce successively on re-draws.
2. Inside radii at the corners on the final draw should be not less than the thickness of the metal.
3. Sharper radii, if absolutely essential, should be produced by a subsequent coining operation.
4. Hold-down pressures in drawing should be kept to a minimum to insure metal flow from the outside rather than stretching.

For permanent vacuum and pressure-tight sealing . . . count on KOVAR.

Obviously, to prolong tool life and simplify production, maximum permissible tolerances should be allowed. More detailed information on deep drawing of KOVAR alloy is supplied in Technical Data Bulletin 100 EB11.

Carborundum maintains large stocks of KOVAR alloy in a wide variety of sizes and forms. This alloy can be welded, brazed, soldered and plated with other metals. It can be either oxide bonded to hard glass or brazed to metatized-ceramic insulators. Technical service is available to help you solve processing and application problems. Contact The Carborundum Company, Refractories Division, Dept. E-80, Latrobe Plant, Latrobe, Pa.

FIND OUT ABOUT KOVAR WHERE IT IS USED AND WHY
Bulletin 5134 gives data on composition, fabrication techniques and applications. Send for your free copy today.
Dr. F. W. Reichelderfer, chief of the Weather Bureau, calls this "the best weather radar in the world."*

Raytheon STORMFINDER shows a composite picture of the entire weather front over a 200,000 square mile area. The "weather eye" pinpoints and tracks storms 250 miles away, distinguishes hail, rain, and snow, probes the heart of a hurricane. It is ground-based... and designed, developed and produced specifically for weather detection and analysis.

<table>
<thead>
<tr>
<th>EQUIPMENT CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iso-echo feature. Sensitivity Time Control of 20 db between 10-100 miles. Triple display indicator unit: (1) 7&quot; RHI (range height indicator), (2) 12&quot; PPI (plan-position indicator), (3) 7&quot; A/R Scope for storm intensity measurement.</td>
</tr>
<tr>
<td>Power output</td>
</tr>
<tr>
<td>Frequency</td>
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<tr>
<td>Beamwidth</td>
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<tr>
<td>Elevation</td>
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<tr>
<td>Azimuth</td>
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</table>

*from testimony before a House Appropriations subcommittee, January 18, 1960.
NEW PHOTOMULTIPLIERS FROM CBS LABORATORIES

CBS LABORATORIES new line of photomultipliers are specially designed for counting or scanning applications.

Unique photocathode geometry and improved linear dynode structure are combined to provide excellent uniformity of response across the face of the tube and extremely short transit time spread.

The rugged photomultipliers made by CBS LABORATORIES are available as illustrated above in 2", 3" and 5" diameter cathodes with visible (S-11) or infra-red (S-1) response and 10 stages of multiplication; or with quartz windows in 2" and 3" diameters with ultra-violet response (S-13, Rb, Te or Cs, Te cathodes). Special modifications or entirely new structures can be developed to order.

For technical bulletins describing specific tube types, write to CBS LABORATORIES, Electron Tube Department.

CBS LABORATORIES
HIGH RIDGE ROAD, STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

You are invited to visit CBS Laboratories Booth #2523
at Wescon Show, August 23-26, Los Angeles

electronics
See our new products at WESCON—Booths 2250, 2251

Bourns Trimpot® Instead of a Fixed Resistor?

Yes, these units meet the same Mil-Specs that fixed resistors meet and give you the added advantage of adjustability! Because of their design and construction, Trimpot potentiometers are virtually unaffected by the most severe shock and environmental conditions—a fact proven repeatedly in major missile and space programs.

Trimpot units offer several kinds of savings. They minimize the need to maintain stocks of close-tolerance resistors—you can adjust to compensate for the variances of fixed components. Production labor costs are cut, too, for Trimpot units eliminate trial-and-error matching of fixed units to the system. Savings also carry over to maintenance because the technician can adjust equipment quickly in the field—no time and dollars spent to replace components.

Before you specify fixed units, investigate all the advantages offered by Trimpot potentiometers. Over 20 basic models (wire-wound and carbon)—in four terminal types and three mounting styles—are available on short notice from stocking distributors or factory. Get the facts...write for the new Trimpot brochure and list of distributors.

Exclusive manufacturers of Trimpot®, Trimit® and E-Z-Trim®. Pioneers in transducers for position, pressure and acceleration.
all your eggs in from one basket...

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INDUSTRIAL ELECTRONIC DISTRIBUTOR

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460 WEST 34TH ST., NEW YORK 1, N.Y.
LONGACRE 4-8550

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VARIAN presents the VA-839

HIGH EFFICIENCY KLYSTRON with BANDWIDTH RIVALING TWTs.

- 43% efficiency
- 140 megacycles bandwidth
- 5 megawatts peak
- 10 kilowatts average
- 40 db gain
- No tuning

Coherent radar systems with frequency agility and of exotic concept can be designed around the VA-839 amplifier klystron. You can use programmed frequencies, pulse-to-pulse frequency changes, phase coding or frequency variations within the pulse—all with the low spurious noise and high stability of Varian Klystrons.

Varian Associates also builds pulse power klystrons of 12% bandwidth and pulse power traveling wave tubes for even greater bandwidths. These demonstrate Varian's unmatched capability in advanced microwave tube development and manufacture. May we supply further data or an answer to a particular microwave need of yours?
In research...
The analog record at upper right, made by a Model 906A Honeywell Visicorder oscillograph, gave U. S. Weather Bureau scientists immediate readout of thunderstorm data at Mt. Washburn in Yellowstone National Park. As the storm system passed, the Visicorder measured and recorded positive and negative air conductivity, rate of ionization of air, raindrop charge, corona discharge current from an insulated tree and a 4' x 6' grass plot, times of camera exposure photographing droplet size and electrical charge, atmospheric potential gradient, and time. In any research field where high-speed variables are under study, the direct-recording Visicorder is providing instantly-readable, high-sensitivity data at frequencies from DC to 5000 cps. Models are available with 8, 14, or 36 channel capacities.

these are records of leadership

In industrial use...
The Visicorder record at lower right, made by design engineers at Westinghouse, measured oil film thicknesses on the bearing pads of a 67,500 KW water wheel generator supplied for Chief Joseph Dam at Bridgeport, Wash. In these tests, oil thickness encountered by the leading edge of the bearing (trace #6), center (#5) and trailing edge (#4) were found to be within the limits of safety as predicted by engineering assumptions. In this and hundreds of other scientific and industrial applications, Visicorders are pointing the way to new advances in product design, rocketry, computing, control, nucleonics, and production testing.

For information on applying the unlimited usefulness of the Visicorder to your specific problems, phone your nearest Honeywell Industrial Sales Office.

The Honeywell Visicorder provides instantly-readable, high-sensitivity data at frequencies from DC to 5000 CPS. There are models with 8, 14, 24, or 36-channel capacities.

Honeywell Industrial Products Group

Reference Data: Write for specifications on Visicorders 906B, 1108 and 1012.

Minneapolis-Honeywell Regulator Co., Industrial Products Group, Heiland Division, 5200 E. Evans Ave., Denver 22, Colorado

108 CIRCLE 108 ON READER SERVICE CARD CIRCLE 109 ON READER SERVICE CARD
BETTER SERVICE on Stampings

"ONE PLUS"—
If you require just a few pieces for experimentation, specify our "One Plus" Method. Special equipment and "know-how" produce these small quantities at lowest cost. No tooling charges.

SHORT RUNS—
To produce something more than a few but less than high production quantities, use our temporary tooling Short Run Method utilizing simple contour dies and special equipment that keep costs at a minimum.

PRODUCTION RUNS—
Here is where our regular Production Method tooling works to your advantage. Die charges are modest and cost per unit is the very lowest consistent with tolerances specified.

"WATCH DOG" SERVICE—
Our Order Department maintains a "watch dog" check on the quantity of each order in relation to the quantities on all your previous orders... then selects the appropriate Method to deliver the fastest, most efficient, lowest cost Service on Stampings.

Send this for this!
Here's why the NEW AO TRACE-MASTER
World's finest 8-channel direct writing

American Optical Company, famous for precision instrumentation for 138 years, introduces an electronic direct-writing recorder of unique design, in which ultra-precise electromechanics has been combined with advanced electronics to achieve truly superior performance.

Finest Writing Method Ever
TRACE-MASTER uses unique direct-carbon-transfer writing method. Trace is uniformly black and up to four times thinner than that made by any other recorder. Minute variations in phenomena measured are more faithful, more meaningful. Carbon trace is permanent...cannot fade as ink and electric traces do ...may be reproduced by all conventional methods.

Finest Frequency-Amplitude Performance
TRACE-MASTER'S multiple-feedback wide-range Driver circuitry, combined with the advanced pen-motor design, produces wider frequency response at larger amplitudes than any other recorder. TRACE-MASTER response is flat—within 1%—from dc to 110 cps at 40 mm!

Band Amplitude Product (i.e. Bandwidth times Amplitude) is 5600...140 cps (3 db point) x 40mm! TRACE-MASTER can provide meaningful signal information in areas never before possible with direct-writing recorders!

Finest Chart-Drive Facilities
TRACE-MASTER provides widest chart-speed range...0.1 to 500 mm/sec...of any direct-writing recorder! Convenient push-button selection...new speed is accurately established before finger can leave the button. Unique take-up reel automatically stores full 1000 ft. record. Writing table tilts to convenient angle for close examination and easy chart annotations. Guide rails permit quick, easy paper-roll changes. Chart paper is low in cost...makes it practical to do continuous recording at high speeds for protracted periods.

Entire channel easily accessible and completely interchangeable as single unit.
Compact panel contains all signal input and conditioning facilities.
Platen tilts to convenient writing angle.
is the recorder!

**Finest Resolution, Linearity, Stability**
Thin carbon trace (thinner by 4 to 1 over most recorders) and high Band Amplitude Product (higher by 6 to 1 over other recorders) provide up to 24 times the resolving power or ability to detect short, sharp variations in the record. The superior linearity (+1%) and stability in rectilinear presentation permit full use of this unexcelled resolution.

**Finest Systems Oriented Compatibility**
Fully transistorized circuitry...generous performance margins...conservative derating...application of combined dc level and signal multiple feedback...complete interchangeability of modular signal-conditioning elements...are only some of the outstanding features that combine to make the AO TRACE-MASTER the world's finest general purpose, 8-channel direct writing recorder.

See it...
Try it...
at WESCON,
ISA, NEC,
NEREM

Complete
TRACE-MASTER systems will be operating at the American Optical booth at all four shows...don't miss this opportunity to examine the newest, finest recorder on the market.

Write for Complete Information
Engineering bulletins are now available on the complete AO TRACE-MASTER line of recording modules and systems. Write, wire, or telephone today for a complete file! TRACE-MASTER Field Sales Engineers are at your service everywhere.
NEW

TRANSISTOR-REGULATED

• Five-Year Warranty
• Transient-Free Output
• Exclusive Regulator Circuit

Two new lines of power supplies — one high and one low voltage line — are available now from POWER SOURCES, INC. Both lines feature the exclusive POWER SOURCES regulator circuit that provides full protection for the transistors without DC fuses or circuit breakers. Both lines are warranted for five full years. Warranty includes all semiconductor components. Cooling systems of advanced design insure long life and trouble-free operation.

For complete specifications on POWER SOURCES high and low voltage solid state power supplies, write or phone today.

See a Demonstration at WESCON • Booth No. 831-A
1. Series 42—Over 2,000,000 produced since 1942—The standard of reliability.


3. Series 55—10 turn potentiometer—available in 3 sizes—½" dia., 1½" dia., and 2" dia.—winding molded to housing—shock-proof construction.

4. Series 54—The ultimate in precision—available in 5 sizes: ⅞" dia., 1¼" dia., 1¾" dia., 2" dia., and 3" dia.

5. Series 57—½" precision trimming potentiometer—⅜" dia.—available with glass seal back cover.

6. Series 56—Padding potentiometer—⅜" wide x ¾" high x 1¾" long. Available in many variations including various terminations.

Precision Potentiometer Competence

For quality, with practicability, count on Clarostat competence. Unsurpassed experience and historical performance is your assurance that you get the most in Clarostat Precision Potentiometers.

Write for complete potentiometer catalog and technical specifications...

CLAROSTAT MFG. CO., INC.
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In Canada: CANADIAN MARCONI CO., LTD., TORONTO 17, ONT.

Wescon Booth #2630

August 12, 1960
The Baird-Atomic NC-I is the only direct reading, variable duty cycle, medium and high-power transistor test set on the market. This instrument applies suitable pulse drive signals to the transistor under test and then peak detects the resulting current pulses so that they have the same measuring value as steady state DC. The average power in the pulse signals is considerably lower than would be required if steady state DC biases were applied. Thus, measurements can be made at power levels higher than the transistor could survive if normal DC measurement methods were used. At the same time, less stress is put on the transistor itself. Under optimum conditions, the power fed into the transistor is but 6/10ths of 1% of the power used with conventional DC currents.

With the NC-I, tests are conducted under pulse conditions in the common emitter configuration — the meters present DC readings of \( V_{BE}, I_e, V_{CE} \) and \( I_c \). The instrument also measures leakage current and floating potential by standard techniques.

**EXAMPLE**

Here is how the variable duty cycle tests may be used to advantage. Shown below is a typical power transistor C-E set of collector characteristics.

Suppose that we desire to measure the DC current gain at point X. A steady state voltage of 10V and a current of 5A would be required. If conventional DC biases were used, 50W of input power would have to be dissipated by a very large heat sink or auxiliary cooling, such as forced air.

Consider now testing this transistor by the pulse method. We can apply a peak collector voltage of 10V and suitable base drive to produce collector current pulses 5A peak. For the current pulses 100 usec. wide at 1/60 Sec. repetition, the average power is:

\[
P = V_e I_e T / T_{sec} = 100 \times 10^{-6} \times 0.3 = 0.3 \text{ Watt}
\]

The Baird-Atomic NC-I is the only direct reading, variable duty cycle, medium and high-power transistor test set on the market. This instrument applies suitable pulse drive signals to the transistor under test and then peak detects the resulting current pulses so that they have the same measuring value as steady state DC. The average power in the pulse signals is considerably lower than would be required if steady state DC biases were applied. Thus, measurements can be made at power levels higher than the transistor could survive if normal DC measurement methods were used. At the same time, less stress is put on the transistor itself. Under optimum conditions, the power fed into the transistor is but 6/10ths of 1% of the power used with conventional DC currents.

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**CURVE TRACER MODEL MW-1**

- Designed to display families of characteristic curves for PNP and NPN transistors — either common base or common emitter configurations.
- Both input and/or output current or voltage may be selected as components of the curves displayed.
- Operational range includes the highest maximum current (30 amp collector current continuous duty — 50 amp intermittent, 450 watts maximum available power) and the lowest observable impedance (.001 ohms) now available.
- Maximum input current is 5 amp.
- Automatic overload protection.
- Users say this is the finest, most versatile instrument on the market. (Illustration shows instrument with tube adaptor.)
HIPERNAS!

It can pinpoint a long-range missile on target. Guide a satellite or space ship to any point in the universe. Regulate the predetermined course of a surface vessel or submarine to any spot on the seven seas — by any route, however circuitous.

In manned vehicles, it will give exact position — even without an atmosphere — independent of gravity, sea, wind, and weather conditions — without fixes on horizon or stars — after days and weeks of travel.

This is Hipernas, a self-compensating, pure inertial guidance system developed by Bell's Avionics Division. Designed for the U.S. Air Force, Hipernas is so versatile that a whole family of related systems has been engineered for application in any environment — sea, sky, or space.

The system introduces new Bell BRIG gyros. Its accelerometers and digital velocity meters are already operational in missile and space guidance systems.

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Avionics Division

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A Division of Philips Electronics & Pharmaceutical Industries Corp.

CIRCLE 117 ON READER SERVICE CARD 117
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Collins is one of the nation's leading electronic growth companies. Balanced government and commercial business assures stable employment. Present military and commercial backlogs are approximately $200 million. Commercial sales are heavy in airline, business aircraft, amateur, broadcast and ground communication areas. And Collins is an engineer-minded company... with 20% of the more than 13,000 employees working in engineering.

Collins Radio Company is interviewing at the Wescon Show. Could you contribute new ideas to these fields?

CEDAR RAPIDS — E.E.'s and M.E.'s are needed for assignments in Airborne communication and navigation R&D. Communication design engineers, and field service men for Doppler installations are also needed. If unable to interview at the Wescon Show, send your resume to: Mr. L. R. Nuss, Manager of Professional Employment, Collins Radio Company, Cedar Rapids, Iowa.

DALLAS — Qualified E.E.'s and M.E.'s with 5-10 years experience are needed in Collins Texas Division for R&D work in Data System Engineering. If unable to interview at the Wescon Show, send your resume to: B. E. Jeffries, Manager of Technical Employment, Collins Radio Company, 1930 Hi-Line Drive, Dallas 7, Texas.

BURBANK — E.E.'s and M.E.'s with 2 to 8 years experience are needed for research and development work in the expanding field of high speed data transmission equipment and systems. If unable to interview at the Wescon Show, send your resume to: Al Peachey, Collins Radio Company, 2700 West Olive Avenue, Burbank, California.

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L. R. Nuss, Al Peachey and F. I. Aiken will be located at the Career's Inc. area in the Shrine Exposition Hall during the show. For a personal, confidential interview phone Richmond 6-1211 between 9 am and 9 pm.
Come see us at Booth Number 431-432 and get complete information on how these and other Belden wire and cable developments can be applied to your design requirements.

Miniature Microphone Cables—Rubber, Plastic

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No. 8420 Plastic

Miniature in size with low capacitance, extreme flexibility, and long flex life. Cadmium bronze stranded conductors.

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No. 8879

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No. 8765

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August 12, 1960

CIRCLE 119 ON READER SERVICE CARD 119
INTEGRAL-INTERLACE
(2000) SERIES:
Two inline head stacks (with interlaced channels) mounted on integral "H" block record more channels per inch of tape width, while maintaining high output per channel and strong shielding against channel crosstalk. Patented "gap-mounted" feature ensures accurate location of each stack. IRIG telemetering standard available (exclusive design maintains IRIG time relationship despite normal head wear). Identical (non-interlaced) stacks can be used in redundant analog applications.

INLINE (4000) SERIES: Records or reproduces simultaneously on many channels of a single tape or drum. Precise perpendicularity and colinearity of gaps and accurate track width and location with reference to other tracks and base assures reliable data transfer to and from media. Base and full metal-face machined for correct azimuth and contact angle (standard and special base mountings available).

GAP-MOUNTED (5000) SERIES:
Unique head stack mounting permits quick interchangeability without critical adjustment of head azimuth, contact angle or gap perpendicularity. Adjoining faces of head and mounting structure are lapped with reference to the gap line. Mounting structure is adjusted permanently and four set screws hold head in precise location.

REDUNDANT (6000) SERIES:
Two identical head stacks are mounted opposite each other in a single structure, with closely spaced gap lines (down to .150 inch). Digital data recorded by first stack is read for reliability check by the second stack. Close spacing between gaps reduces storage capacity required in checking register.
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CLEVITE

"optional characteristic" magnetic heads

An analysis of present usage and future trends in magnetic recording heads, transports, media, and associated electronics indicates areas for partial standardization of these interdependent components. Within the framework of these partial standards, Clevite offers "optional characteristic" magnetic heads to simplify the design of reliable analog and digital recording systems.

These new designs provide a choice of electrical characteristics. Four basic mechanical configurations are available in six compatible tape formats with track widths from .020 inch to .050 inch, and spacings of .050 inch to .140 inch. These provide from 7 to 20 inline channels per inch.

Detailed mechanical drawings and specifications plus actual electrical performance data are available before the fact. This allows the design engineer to predict reliably the overall recording system performance.

Clevite continually produces beneficial design improvements in such areas as high resolution and flux-responsive readout, and high-efficiency record structures. As these developments are field-proved they are adopted in Clevite "optional characteristic" designs. These dynamic standards thus offer recording system designers magnetic heads that include up-to-date advances in recording technology.

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**ELECTRICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
<th>Inductance (maximum)</th>
<th>Gap Length</th>
<th>Bias Current</th>
<th>Record Current**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANALOG</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ARL</td>
<td>Low impedance record head. Used with transistor driver.</td>
<td>1.38 MH</td>
<td>.005&quot;*</td>
<td>6 to 20 MA, up to 1 mc</td>
<td>0.7 MA 8db below saturation</td>
</tr>
<tr>
<td>ARH</td>
<td>High impedance record head. Used with vacuum tube driver.</td>
<td>10 MH</td>
<td>.005&quot;*</td>
<td>2 to 4 MA, up to 500 kc</td>
<td>0.2 MA 8db below saturation</td>
</tr>
<tr>
<td>APH-ACH</td>
<td>High impedance playback head or combination record/playback head.</td>
<td>80 MH</td>
<td>.0025&quot;*</td>
<td>1 MA up to 60 kc</td>
<td>.09 MA</td>
</tr>
<tr>
<td>ACL</td>
<td>Low impedance combination record/playback head for use up to 100 kc at 60 ips with 400 kc bias, or to 206 kc at 120 ips with 1 mc bias on half winding.</td>
<td>15 MH</td>
<td>.0025&quot;*</td>
<td>2.5 MA</td>
<td>0.1 MA</td>
</tr>
<tr>
<td><strong>DIGITAL</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DRL</td>
<td>Low impedance record head. Used with transistor driver. 12 volts single ended, or 8 volts double ended.</td>
<td>4.5 MH</td>
<td>.005&quot;*</td>
<td>1.5 MA</td>
<td>9 MA peak</td>
</tr>
<tr>
<td>DRH</td>
<td>High impedance record head. Used with vacuum tube driver. Used as playback with DRL head.</td>
<td>55 MH</td>
<td>.005&quot;*</td>
<td>3.0 MA peak</td>
<td>3.5 MA peak</td>
</tr>
<tr>
<td>DRP</td>
<td>Redundant record playback head.</td>
<td>18 MH</td>
<td>.005&quot;* each</td>
<td>4 MA peak</td>
<td></td>
</tr>
</tbody>
</table>
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SEE US AT WESCON... BOOTHS 2265-2266
RESEARCH CATALYZES GROWTH IN THE WEST

New developments include cryogenic gyroscope, X-band ruby maser, compact ferrite isolator for uhf, electrostatically focused traveling-wave amplifier and oscillator, high-power transmitter to contact the sun.

By HAROLD C. HOOD, Pacific Coast Regional Editor

LOS ANGELES—Two weeks from now Wescon will show there's no let-up in the growth of the electronics industry in the West. Like many companies displaying their wares this year Wescon has outgrown its old quarters, and has had to move. Los Angeles' new Sports Arena, lately the scene of the Democratic Convention, will house both technical sessions and 989 exhibit booths of some 805 companies. Latest figures from 759 companies in the eleven western states puts combined dollar volume at just over $2 billion (excluding broadcast and service revenue), or 22 percent of the nation's total electronics industry. Employment by latest count is 155,000 with 93,000 people working in the metropolitan Los Angeles area and drawing $785 million a year.

Boasting over two dozen science-oriented universities and many companies with a high interest in R&D, the area has spawned a host of electronics development.

A development in progress at Jet Propulsion Laboratory that challenges the electronic engineer as it opens up new areas for him is the cryogenic gyro. JPL feels the outgrowth of its experimental model will be an accurate, compact gyroscope for spacecraft.

This device, having a spherical rotor of niobium one inch in diameter, uses superconductivity or
complete loss of resistance to electricity at temperatures approaching absolute zero. The quarter-pound sphere repels the magnetic force field and levitates above its magnetic coil, which serves as a bearing. Since the ball is a superconductor of electricity, it can be spun with no electrical resistance, and since the ball is in a vacuum there is no other source of drag.

To get an ultra-cold environment for the experiment, both the ball and coil are placed in a vacuum chamber surrounded with liquid helium. The chamber is placed in liquid nitrogen that in turn is placed in another vacuum jacket. Spinning motion will probably be imparted to the rotor by focusing jets of gas against it.

Read-out will be accomplished by a series of phototubes that pick up a pattern on the rotor and feed information into a solid-state computer. Because the support forces are repulsive rather than attractive, the sphere is intrinsically stable with respect to displacement from equilibrium. However, developers of the gyro feel that, to keep the rotor from sagging in its electromagnetic field due to accelerations a servo device will have to be added in the support system.

Another problem anticipated is lack of sphericity in the rotor due to centrifugal force during spinning. Electronic feedback is planned to adjust the current in the support coil to compensate for the ellipsoidal shape the sphere may assume.

JPL scientists foresee other applications of the cryogenic gyro for ultra-sensitive instruments, such as galvanometers. Absence of friction and elimination of mechanical wear on critical parts may justify additional cost.

Contributions from the West to communications with satellites and space probes are exemplified by three developments: a ruby maser (Hughes Aircraft, Culver City), uhf isolator (Motorola Solid State Electronics Dept., Phoenix), and electrostatically focused traveling-wave tube and feedback cavity (Watkins-Johnson, Palo Alto).

Hughes says its 25-lb X-band solid-state ruby maser amplifier can extend tenfold the range of many Army electronics systems. The device, using a synthetic ruby crystal of aluminum oxide with a 0.1-percent chromium concentration, will help military defense systems using high-angle radars to detect an ICBM far earlier than formerly, and will be the heart of detectors that can pick up radio beeps from millions of miles farther into space than previously possible.

Gain-bandwidth product of the amplifier, when operating at -452F is 105 Mc. The cavity, formed from a solid block of ruby, is coated with silver, and has a small permanent magnet weighing only 12 ounces attached to the inside of the helium dewar. Cost of this magnet is $10 as contrasted with over $4,000 for external magnets in earlier masers.

A waveguide transition, containing a piece of clear sapphire to keep the waveguide above cutoff, and tapering from X-band dimensions to those of the cavity, is used for coupling. A similar taper transition is used for coupling K-band pumping power to the low-noise device. Liquid helium and nitrogen are used for supercooling the one-half inch square of ruby crystal.

In developing its compact uhf isolator, Motorola engineers worked on the premise that, at ranges approaching 20,000,000 miles, the conservation of only 0.1 db of signal adds another 200,000 miles of closed radio contact with deep-space probes. The result is a tiny ferrite device giving more than 10-dB isolation with less than 1-db insertion loss over a 30-Mc bandwidth.

The nonreciprocal properties of the unit reportedly achieve optimum stabilization of parametric amplifier gain. Thus antenna mismatch in satellite and space-probe tracking applications introduces minimum loss.

A low-loss ferrite biased to resonance is used so that for one direction of propagation the ferrite absorbs practically all the energy, while in the opposite direction little energy is absorbed.

Early versions of the isolator have performed well at primary receiving stations used for tracking
Pioneer V. Developers of the isolator claim it is adaptable to wide-band, low-power applications where minimum size and weight without sacrifice of performance are essential.

The need for wider bandwidths and higher effective radiated power in satellite-borne telemetry systems prompted Watkins-Johnson Co., under Air Force sponsorship to develop a microwave telemetry oscillator producing 10-15 watts of c-w power at an overall efficiency of over 30 percent. Power levels in this range at 2,000 Mc are beyond the capabilities of present solid-state devices.

W-J's amplifier-oscillator, using an electrostatically focused traveling-wave tube and feedback cavity with a total weight of 14 oz, reportedly has a life expectancy of 10,000 hours. Its developers point out that subsequent models will be required to operate for 30,000 to 40,000 hours.

The overall efficiency of the oscillator, according to W-J scientists, is due primarily to designing a tube with good basic beam efficiency and operating the collector electrode at a voltage depressed to approximately one-half the average helix voltage.

Low cathode current density (136 ma per sq cm), permitting an operating temperature of less than 700 C, is largely responsible for the tube's long life. With passive nickel used in the cathode, reaction rates of barium-oxide breakdown to pure barium in the cathode can be kept low, insuring an adequate supply of pure barium at the cathode to maintain emission for sustained periods.

The Electron Tube division of Litton Industries reports the development of a high-power klystron tube at L-band (See cover). Developed for, and currently being tested by MIT's Lincoln Laboratory in Lexington, Mass., the transmitting tube (designated the L-3387) is capable of peak output power of 30 megawatts with an average power output of 100 kilowatts.

This output is more than triple that of earlier tubes. Approximately 6-ft high, the mechanically tunable tube covers the frequency range from 1,215 to 1,350 Mc, has a 36-db gain and operates at 39-percent efficiency.

Litton scientists report that, to take the power in the tube's beam, the size of the collector was increased considerably. Improved high-temperature exhaust techniques and heat transfer designs were incorporated to achieve voltage hold-off, and assure long operating life.

A predecessor to the klystron pulse amplifier (Litton's L-3035) has currently logged 3,000 hours. Lincoln Laboratory will use the new tube primarily in long-range missile-detection systems research.

From Varian comes one of two developments which promise to save money for airline operators and the
What to Hear at WESCON

Wescon's technical program for 1960 is comprised of 40 sessions with over 200 papers. Several session subjects were chosen because of their controversial nature. Among this group are information theory and modulation methods, stereo multiplex broadcasting and air traffic control. An innovation this year is four supplemental workshop sessions. Man-machine systems will get a big play during the workshops.

Following are abstracts of representative papers that the Wescon technical committee has selected as being of wide interest and high technical significance:

PULSE-HANDLING TECHNIQUES SESSION. Pulsed R-F Storage in Long-Delay, Broadband Closed-Loop Systems. Discusses design of systems using fused silica delay lines, operating bandwidth of which is about 40 Mc. Storge time is several milliseconds. Potential applications include design of r-f pulse analyzers, frequency monitors and r-f repeaters.

The author analyzes storage time in terms of delay attenuation, media delay, regeneration-enhanced loop noise and broadband amplifier noise figure and saturation characteristics. He discusses design requirements of broadband amplifiers, pulse injection and extraction networks, equalization networks and automatic gain control circuits. (ITT Laboratories.)

SEMICONDUCTOR DEVICES AND TUBES SESSION. High Power at 1,000 Mc Using Semiconductor Devices. The authors describe device optimization and circuit innovations.

Several optimized device-circuit combinations are put together, consisting of a 100-mw transistor crystal oscillator driving a transistor delivering 1 watt at 125 Mc, in turn driving another transistor delivering 3.2 watts at 125 Mc. This output drives three successive semiconductor variable capacitor frequency doublers, with an output of 0.75 watt at 1,000 Mc. (Pacific Semiconductors, Inc.)

MICROWAVE THEORY AND TECHNIQUES—I: PASSIVE ELEMENTS. A Fast Switching X-Band Circulator Utilizing Ferrite Toroids. Nonreciprocable waveguide devices have been made using permanently magnetized ferrite tubes, with no magnet present. For switching, the remanent state of the ferrite material may be reversed by current pulses to a wire inserted through the tube.

The authors describe how a differential phase shift circulator has been developed that operates from 8.2 to 9.2 Gc. The loss between coupled ports is 0.5 db or less and the isolation between uncoupled ports is 25 db or greater. The circulator can be switched in less than 0.5 µsec.

Also reported are results when permanently magnetized ferrite toroids have been used in waveguide T and coaxial geometries. (Microwave Research Institute, Polytechnic Institute of Brooklyn.)

COMMUNICATIONS: NEW SOLUTIONS TO SOME OLD PROBLEMS. Determination of the Optimum Antenna Pattern for a Signal Burst Communication System. When scattering is used for communications between stations, the propagation path is oriented in various (stochastic) directions about a nominal (mean) path. A highly directional antenna pointed in one direction thus may not serve as well as a wider antenna designed to these statistics. The authors discuss design of such antenna patterns. (Sandia Corp. and Univ. of Washington.)

THE PIONEER V EXPERIMENTS. Radiation Measurements Made by Space Probe Pioneer V. Members of the University of Minnesota team that conducted radiation experiments with Pioneer V report. These detectors, similar to those used in Explorer VI, measure military. An electronic indicator that picks up the first hint of metallicity contamination in lubricating oil of reciprocating engines (also marine reduction gears and other machinery) is being evaluated by air carriers with an eye to eliminating premature overhaul and anticipating engine failure. Replacement parts for a routine airliner engine overhaul cost $10,000, and up to $20,000 with engine failure.

Sensing head of the indicator is the tank coil of a 220-Kc oscillator, and is installed around the scavange oil line of the engine. Minimum size of bearing flake or other metal particles to be detected determines the frequency. Any passage of conducting particles through the sensing head changes the Q of the tank coil. If the change in level of oscillation, after amplification, is sufficiently great to reach the triggering threshold of a preset multi-

vibrator, an output signal is displayed.

Convair's Autotrack analyzer, designed to trim down the tab for replacement and overhaul of military jet engines which approaches $1 billion annually uses a selective vibration pick-up. The out-of-tolerance vibration of a main rotor, pump or generator shaft, or aerodynamic vibration of compressor and turbine blades can be accurately isolated. The existing vibration meters determine the total vibratory motion of an engine, and require removal and tear-down of the entire unit upon indication of excessive vibration. The Autotrack reportedly makes in-place repairs feasible.

According to Convair, the instrument can differentiate between vibrations one cps apart, and has a range of 5 to 2,500 cps, sufficient to track engines to 110 percent of top speed. Microphones, pressure transducers or accelerometers can provide input. With a 100-Kc crystal-controlled oscillator, the instrument compares the input signal with the signal from the engine tachometer, then filters all but the component that is a direct measure of the amount of vibration.

Since man's first definitely established radar contact with the sun recently at Stanford University's Radioscience Lab, investigation of the sun and its corona has been intensified. Streams of particles hurled into space by solar flares and similar violent eruptions become trapped in the earth's magnetic field and form radiation belts hazardous to proposed space travel. Earthly symptoms of such eruptions are blackout of radio communications, magnetic storms, vivid displays of northern lights and possibly weather changes.
flx and ionizing power of interplanetary radiation.
After passage through trapped radiation surrounding the earth, where measurements were similar to those obtained by Explorer VI, the intensity was found to be at the cosmic-ray level of 2.5 counts per sec in the Anton type 302 Geiger counter, and had an ionizing power of 1.1 times that for Co\(^{60}\) radiation. (Univ. of Minnesota.)

VARACTORS AND TUNNEL DIODE APPLICATIONS. A Compact Tunnel Diode Amplifier for Ultra-High Frequencies. Possible applications for an amplifier designed to operate between 405 and 406 Mc are discussed. Used with an equally compact uhf isolator, a small, low-noise and stable amplifier is achieved.

The amplifier has 15-db gain, a 12-Mc bandwidth and a noise figure of 5.5 db across the band. With the isolator, system gain changes less than 3 db with antenna vswr variations from 1.0 to 1.8 db. Design of the amplifier is described, and it is shown that attention to the biasing circuit prevents low-frequency oscillation in the bias leads. (Motorola, Phoenix)

SEMICONDUCTOR DEVICES. A New Semiconductor Memory Element with Nondestructive Read-out and Electrostatic Storage. Specific device characteristics are discussed for a method of information storage that uses the stored charge in the depletion layers of pnpn structure. A large space charge indicates a zero, and a smaller charge a one.

In finding the state of the device, it is noted that the breakdown point is a function of the rate of rise of the applied voltage. Because interrogation is electrostatic, the only input power to the device is that which supplies the charge lost due to stray leakages. Interrogation does not alter the state, and readout is nondestructive. (Fairchild Semiconductor)

MICROMINIATURIZATION. Silicon Layer Junctions —A New Concept in Microcircuitry. The feasibility and potential of deposition of successive layers of single crystal silicon on single crystal silicon substrates as a new techniques in microelectronics are examined. Alternating single crystal silicon layers of controlled resistivity and type reportedly permit introduction of many functional elements directly into a structure.

Such elements which have been deposited include capacitors, resistors, rectifiers, voltage-limiting zener diodes, npn transistors and solar cells. Electrical performance and metallographic data on each configuration are presented, and test results from a seven-layer structure discussed. (Merck, Sharp & Dohme)

SYNTHESIS AND DESIGN OF MAN-MACHINE SYSTEMS. Introduction to Teaching Machines. A typical teaching machine is described and machine teaching is discussed. According to the author, a teaching machine is a controlled device with which the student learns what the machine is programmed to teach. The machine differs from an audio-visual device in that it is designed to use the laws of learning rather than acting only as a teaching tool to be manipulated by a teacher. (Litton)

ANTENNAS. Miniaturized VHF-UHF Antenna. A detailed analysis of impedance matching techniques, as well as information on radiation pattern, gain and efficiency is presented for a rigid waveguide cavity-fed slot antenna. Such miniaturized slot antennas are frequently required for missile and aircraft.

The design procedure applies to both single-ridge and dual-ridge cavities with the ridges laterally separated. Both configurations use high-dielectric-constant fillers in the cavities. Resonant frequency of either type may be adjusted by a capacitive screw in the cavity or by variation of a single cavity dimension or both. (The Martin Co.)

A 40,000-watt transmitter, used for the initial bounce off the sun's corona, was operated at 25.6 Mc to minimize signal absorption. Reflection occurred 500,000 miles from the sun's visible surface, and 164 minutes was required for the round trip. On-and-off pulses of 30 seconds each were flashed over a 15-minute period before the quadruple rhombic array antenna, used for both transmission and reception and covering an area 800 by 725 ft, was connected directly into the receiving system to pick up the echo.

Antenna gain, relative to that of an omnidirectional unit, was about 25 db, and the principal beam was directed east at 10 deg elevation where it played on the newly risen sun for 30 minutes. Magnetic tape was used to record the solar contacts, and tens of millions of IBM 707 computations were required to separate signal echoes from background noise which was 50,000 times stronger.

Efforts to partially duplicate the function and reliability of the human nervous system's neuron by developing components that make decisions and carry out learning have resulted in two potentially valuable concepts: Stanford Research Institute's Neuristor and Aeronutronic's Mind (Magnetic Integrator Neuron Duplicator). The latter, developed for Cornell Aeronautical Lab's Perceptron program, has reached the initial hardware stage.

A tiny magnetic core with an inner hole through which wires are strung is capped with a metal washer and again wound with wire. The doughnut-shaped artificial neuron remembers effects of past events by varying the amount of flux stored in its magnetic circuit. Readout is accomplished nondestructively by a field orthogonal to normal storage flux.

Mind is patterned after the site of memory in the human brain, the synaptic junction, which selectively passes signals from one nerve cell to another. The developers of Mind report that they are considering building a complex artificial nerve net for testing behavior in complex learning situations, in which problems might be posed visually, by sound or other types of signals. Mind uses several principles of Biax computer elements.

The tack taken by SRI researchers is that one-dimensional channels along which signals may flow can synthesize digital logic functions. Theoretically, arrays of these active lines (Neuristors) may constitute any digital logic system with no conventional components.

Use of this device-and-wire-in-one configuration in such elements

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as a binary variable storage ring, basic gate and controlled gate has been demonstrated by its developers who emphasize that homogeneity is the key characteristic of Neuristor systems. Next step for SRI is workable hardware.

By perfecting a technique for sealing vacuum-window quartz to metal, Eitel-McCullough reports that it has made possible quantity production of high frequency electron tubes. Also to benefit from the development, the company claims, are manufacturers of phototubes, waveguide devices, tv camera tubes and equipment exposed to atomic radiation.

The process consists of joining a metal coating of a few thousand angstroms thick to quartz at temperatures below 1,000 C, and bonding to this coating a layer of soft sealing metal. This approach prevents appreciable stress in the finished seal, and temperatures to 900 C can be withstood.

Heretofore-difficult-to-seal quartz is a low-loss dielectric with a low dielectric constant, having a high transparency for infrared and ultraviolet radiation. Since it is a glass and not a crystalline material, it is vacuum-tight at lesser wall thicknesses. It thus reduces capacitive loading of waveguides.

Quartz has great thermal shock stability, can withstand electron bombardment and x-rays without discoloring, and has a high breakdown-threshold in high-strength electric fields.

Two projects underway at CalTech are the investigation of plasma phenomena in superconducting metallic films and the development of cadmium sulfide solid-state devices. Prototypes emerging from the latter project operate at much higher temperatures, higher frequencies and higher input impedance than do ordinary germanium and silicon transistors. They also have characteristics similar to those of vacuum tubes and heretofore not seen in solid-state devices.

Their developers report that in these new components current will be space-charge limited, as in a vacuum tube, rather than diffusion-limited as in a transistor. Diodes of cadmium sulfide have been successfully tested and work is progressing on triodes. Fundamental investigation deals with properties of space-charge limited current flow in solids, and transverse electronic properties of thin films, these thin films will form the control electrodes of the cadmium triodes.

The studies of plasma phenomena in superconducting metallic films, being made at four degrees absolute, indicate that the behavior of electrons in superconducting metals is similar to the behavior of electrons in ionized gases. For example, electrons do not collide with the atomic nuclei of the crystal lattice. One exception to the similarity is that the density of electrons in the metals is millions of times greater than in gases.

The investigators hope to use the plasma-like oscillations of electrons in these superconducting films to make a transmission line whose velocity is about one-tenth the velocity of light. Slowing the waves in thin superconducting films is expected to be helpful in understanding superconductivity and may also have applications in computer circuits.

The Space Medicine section of the Boeing Airplane Company in Seattle reports development of an integrated system of miniaturized electronic instruments for measuring man's physiological condition related to man-into-space programs, such as the Dyna Soar space glider. Medical parameters that have been measured include electrocardiogram, respiration, heart sounds, brain waves, body internal temperature and extremity temperatures, galvanic skin resistance, and electromyogram. Instruments are under development for measuring blood pressure and other medical parameters.

Emphasis was placed on systems design and detailed specifications before hardware was built. Thus in the system any or all of these measurements can be taken simultaneously without interference or cross-talk and yielding records of clinical quality. Units use transistors, are rugged and miniaturized. Engineering and specifications are so complete and detailed that the units may be put out for bid by subcontractors.

Since the units have a high-level output, almost any recording instrument or telemeter may be used. As an example, several channels of medical information have been obtained by radio telemetry at Boeing in Seattle from a man subjected to stress at a research site in the Cascade Mountains, some 60 miles distant.
Temperature Telemetry Aids Frozen Food Study

Temperature-sensitive transmitters distributed throughout 50-ton batches of frozen fruit give temperature-distribution information

By R. H. EL SKEN,
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Albany 10, Calif.

IN THE PAST FEW YEARS, considerable work has been done here on the relation between food handling practices and frozen food quality. Surveys of conditions and practices in commercial freezer-plant operation required accurate temperature measuring equipment that would not interfere with plant operation and would allow access to large movable masses of the frozen product.

To make temperature measurements, radio telemetric instrumentation was studied. A number of miniature radio transmitters were strategically placed in a pack to be frozen. The information transmitted by these units was picked up by receiving apparatus and automatically recorded. The system was used for research and no attempt was made to develop an industrial instrument.

The work reported was concentrated on pallet freezing of strawberries, in batches up to 50 tons, and all requirements were specified to satisfy this type of operation. Several problems were encountered. A complete transmitting package could replace not more than one 10-ounce retail container in a case of berries. The transmitter and power supply had to operate in temperatures from -20 F to +80 F. Heat generated by the transmitting package must not upset the environment within a case. The transmitter must operate continuously without attention for up to two weeks. Satisfactory reception of signals was required at approximately 100 feet. All equipment must be movable from plant to plant for setting up on short notice. Simple and inexpensive construction was desired in the transmitter pack because ten units were used and it was possible to lose units. Transmitter carrier frequency and mode of propagation must be carefully chosen because the transmitters are immersed in water and various solids.

It was necessary to get the equipment into action at short notice, a factor which influenced the design. For example, the receiving antenna is a loop-type consisting of a number of turns of wire completely enclosing the area containing the strawberries. This antenna technique uses the magnetic induction field in the vicinity of the transmitters. This method was successfully used by others in similar situations. Also, the size and physical environment of the transmitter precluded the development of efficient transmitting antenna. This meant, therefore, that all usable signal must originate from the transmitter coil. It was simpler to develop ampere-turns on a coil, to which the induction field is proportional, rather than an efficient radiator. Finally, the susceptibility of the loop antenna to locally generated noise of the electric field type is much less than for the simple wire antenna of comparable intercept area. Since the apparatus is used in locations where there is electrical equipment, such as motors, compressors, and lift trucks, this interference may be a major factor in the limiting operational noise figure.

The propagation medium in a loaded freezer requires consideration. The strawberry tissue and solution of solids in water are in a composite container. The top and bottom of the containers are tin, the sides paperboard. This is a
propagation medium of isolated horizontal metallic planes separated vertically by a few inches of solution. For the induction field, the surrounding mass of metal is potentially a conducting shield. Fortunately this is not the actual situation, as the metal can ends are not electrically interconnected to form a continuous shield.

In these conditions, the low radio-frequency region appeared more desirable, regardless of whether the magnetic induction field or radiation field was used. There would be some attenuation of high frequencies through the propagation medium even with no metal to interfere. The low radio-frequency region of 100 Kc to 200 Kc was chosen, because this band was relatively free of outside interference.

A block diagram of the transmitter-receiver system as finally evolved is shown in Fig. 1A. A maximum of ten transmitter units operate continuously at carrier frequencies staggered approximately 10 Kc apart between 100 Kc and 200 Kc. Each transmitted signal contains the temperature information from one temperature-sensing probe. The transmitter is a self-quenched oscillator with the quench rate determined by the temperature. Quench rate is 250 to 550 cps, corresponding to a temperature range of −20 to +80 °F.

The receiving loop-type antenna, oriented in a horizontal plane, completely encloses the area containing the transmitters. It has been sufficient to put approximately six turns of insulated wire on the rooftop or in the attic space of the building over the area containing the transmitter units. The area of the loop roughly corresponds to the area containing the transmitters.

The receiving equipment is remotely located preferably in a sheltered low-density traffic area of the plant. A superheterodyne receiver is used, tunable over the frequency range 100 to 200 Kc. The main tuning dial was replaced by a reversible motor drive with limit-reverse switches. This provided automatic continuous scan over the total 100-Kc band at a rate of approximately 200 Kc an hour. Interrogation of each transmitter thus is made in time sequence.

The demodulated output of the receiver is fed to a frequency meter which is adjusted for an expanded scale range of 250 to 550 cps. As each transmitter signal is picked up by the receiver, the quench rate (correlated with temperature) is measured by the frequency meter. This meter has an analog current output designed to drive a 1-ma full-scale recorder.

A strip-chart recorder gives a permanent record of the frequency meter output. The chart speed is three inches an hour, giving 340 hours of operation on a roll of chart paper. With an initial notation of time and receiver frequency, all following readings are identified in time sequence as the receiver tuning drive moves over the radio-frequency range. A section of chart, shown in Fig. 2A, is a series of pedestals of varying amplitude. The temperature information from one transmitter is contained in the amplitude of each pedestal. Ten transmitters were used and a complete interrogation cycle is indicated.

The clean rising and trailing edges of each pedestal and the noise-free base line are obtained by a threshold relay, which switches the recorder into the circuit only when the receiver output has reached a predetermined value. Time constant is adjusted so that transient noise will not operate the relay.

The transmitter unit is completely transistorized to meet the need of miniaturization, low power input and low thermal output. As shown in Fig. 1B, a 2N169A transistor is used in a tuned collector oscillator with the base inductively coupled to the collector. By using a large R-C time constant in the emitter circuit, which is controlled by R₁, R₃, R, and Cₙ, self-modulation or quenching action is obtained. Variation in quench rate is accomplished with R₃. This is the temperature sensing element and consists of a glass-enclosed bead insertion-type thermistor. Thermistor R₃ is connected to the transmitter by flexible leads to allow temperature measurement in any carton of the case containing the transmitter.

With miniaturized components for transistor operation, the problem of compactness was readily solved with the exception of power supply. It was necessary to use special batteries, since dry cells or mercury cells had insufficient capacity at low temperatures. A rechargeable-type silver-zinc alkaline battery offered a compromise in size, availability and ampere-hour capacity at low temperatures. A type was available that could deliver 8 to 9 ma at a closed-circuit voltage of 1.8 volts fully charged and 1.5 volts after 350 hours discharge at −20 °F. One cell, however, occupied a volume of approximately three cubic inches, out of a total available vol-
ume of approximately 21 cubic inches. To conserve space and cost a d-c to d-c converter was incorporated to boost the battery voltage. A pair of 2N320 medium-power transistors were supplied by two silver-zinc cells; the output was stepped up by transformer Tn, then rectified and filtered, to give a d-c output voltage of 16 to 18 volts. The overall power efficiency of the converter is approximately 50 percent. With this arrangement it was possible to operate the 2N169A in the range of 1 ma collector current and not exceed the ampere-hour capacity of the battery or the FCC requirements for low-power communications devices that operate below 1,600 kc.

Total power input to the d-c to d-c converter is approximately 30 milliwatts. With the total power dissipated as heat this would represent about 26 calories an hour or 9,000 calories in 350 hours. With perfect insulation around a 15-pound case of berries, 9,000 calories could raise the internal temperature about 2.5 F. in 350 hours. In practice no change in freezing rate was detected with the transmitter unit in a case of berries.

Frequency stability, both r-f and quench rate, is important in the transmitter unit. Frequency variations caused by changes in transistor bias voltages were minimized by using a common source for both the emitter and collector bias so that the ratio of the two bias voltages remained constant. In an adjusted transmitter, a 15 percent change in battery voltage caused a 3 percent change in quench rate.

Tank circuit Q was made as high as possible by winding L, and L, on a flat ferrite strip. The ferrite core also brought the physical size of L, within practical dimensions and improved the radiation characteristics of the coil.

Unpredictable tank-circuit loading was encountered with the proximity effect of the metal ends of strawberry cartons immediately above and below the case containing the transmitter unit. This was reflected in the quench rate. In use, if cases are close-stack, the can ends may approach within 1 inch of the ferrite core of the transmitter coil. The effect could be minimized only by a trial-and-error method of adjusting L, to L, coupling, number of turns, and the collector tap point.

All parts are mounted on a 11 by 3-inch perforated phenolic deck with push-in terminals. Transistors are mounted without sockets in the phenolic deck and all connections soldered. Potentiometers R, and R, are miniature 25-turn screw-actuated types. The oscillator coil is isolated from the remaining hardware by mounting on standoffs. The complete assembly is mounted in a 10-ounce strawberry container with the metal ends removed. Placement is such that the oscillator coil is in the center and separated from the battery by a polystyrene-foam spacer. With adjustment of a transmitter, less than 1 percent change in quench rate was measured with close stacking of cases. The effect on r-f carrier frequency was minor considering the bandwidth allotted each channel.

Since the operating point of the 2N169A transistor had a tendency to shift with temperature, stabilization through use of thermistor R, and shaping network R, and R, was used. This raised the d-c emitter-to-base voltage with decreasing temperature, compensating for decreasing conduction. The design of this circuit is experimental. Using this stabilization scheme and components with low temperature coefficients, an adjusted transmitter has a deviation from calibration of approximately ± 2 F if the cooling rate does not exceed approximately 8 F an hour.

During a processing run, especially with 30 to 50 tons of berries to pack in a single shift, it was essential to have all telemetering equipment ready in advance. Just before the start of freezing, all transmitters were activated and placed in sealed plastic bags. This airtight covering prevented moisture condensing on the cold transmitter units at recovery time.

Stacking of cases was completed at 8 to 10 layers, giving a berry weight of as much as 2,000 lb.

Twelve plants were tested and approximately 75 time-temperature histories obtained from 6,000 transmitter hours of operation. Reduced data from these transmitters in three different plants are shown in Fig. 2B. These are typical of the range of conditions encountered. Supercooling prior to initial freezing has been observed, as shown by the sharp rise in temperature shortly after reaching approximately 25 F in curves B and C. Of importance in quality studies is the time to reach 0 F and the area under each curve. Apart from this, much is learned about overall plant operation. Air temperature, air velocity across cases, pallet-stacking techniques, and arrangement of pallets, when combined with time-temperature results as obtained by this telemetering method, reflect plant operating efficiency.

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REFERENCES

energy levels. Not only does trap distribution vary from crystal to crystal but their effect can be varied by external illumination. However most of the gain degeneration caused by traps results at signal frequencies below 5 cps.

The upper frequency limit of the transistor is imposed by the dielectric relaxation time, characterized by its dielectric constant and conductivity. Illumination determines the conductivity and therefore influences the upper frequency limit. Typical values are of the order of 100 Kc.

Modulation of incident illumination can be used in two general ways to modify the output signal of the CdS field effect transistor. First, the pinch-off current is approximately proportional to the square of the light intensity. Therefore a conversion from light intensity to output signal amplitude can be achieved. Second, the mutual transconductance of the transistor is approximately proportional to light intensity. Therefore light intensity can be used to modulate the output amplitude of the electrical signal applied to the gate.

Secondary illumination with infrared quenching radiation produces a different effect. Pinch-off current is decreased as quenching intensity is increased. Mid-frequency mutual transconductance is also reduced, but by a much smaller amount. However the transconductance at very low frequencies is increased by quenching intensity.

The upper frequency limit of light modulation is ideally imposed by the carrier lifetime but a lower value usually results from the equilibrium time of the shallow traps. A large variation exists but typical high-frequency limits are of the order of 1,000 cps. The upper frequency limit of the quenching modulation is determined by the equilibrium time of the deep traps influenced by the quenching. This limit is less than 5 cycles per second.

An order-of-magnitude comparison of the characteristics of the CdS field effect transistor, a Ge junction transistor (2N35), a vacuum triode (6C4) and a pentode (6SJ7) is tabulated in the table. The vacuum-tube comparisons assume a meghohm grid-return resistor. Comparison on the basis of almost any general figure of merit for an amplifier shows that the CdS transistor is inferior to the other devices, especially when upper frequency limits are considered. However the CdS transistor has advantages for special applications requiring a high input impedance amplifier or a constant current source.

Additional advantages result from features of CdS. These include high sensitivity to light, and temperature independence. Temperature independence results from the wide band gap. Furthermore, the CdS field effect transistor has the small size and high efficiency of the junction transistor but can be applied to high-impedance circuits that now require vacuum tubes.

If, by addition of impurities and modification of geometry, a one or two order-of-magnitude increase in $g_m$ can be realized, the $g_m$ and voltage gain of the CdS transistor would be equivalent to those of a low power pentode (at audio frequencies). Then the CdS unit would have the advantages of small size, higher input impedance and high efficiency over pentodes.

Field-effect transistors made from Ge or Si may be equivalent or superior to the CdS device in some respects. However CdS devices are better in photosensitivity and temperature independence and may be more economical to produce.

Figure 3A illustrates a relaxation oscillator. The sawtooth output voltage is linear because of the
ume of approximately 21 cubic inches. To conserve space and cost a d-c to d-c converter was incorporated to boost the battery voltage. A pair of 2N320 medium-power transistors were supplied by two silver-zinc cells; the output was stepped up by transformer T1, then rectified and filtered, to give a d-c output voltage of 16 to 18 volts. The overall power efficiency of the converter is approximately 50 percent. With this arrangement it was possible to operate the 2N169A in the range of 1 ma collector current and not exceed the ampere-hour capacity of the battery or the FCC requirements for low-power communication devices that operate below 1,600 Kc.

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Circuit Applications of Field Effect

Photosensitive cadmium-sulfide transistor can be used in relaxation oscillators, amplifiers and phase-shift oscillators. Characteristics are compared with characteristics of junction transistor, vacuum triode and vacuum pentode


RECENT development of a photosensitive cadmium-sulfide field-effect transistor1 extends the potential importance of group II-VI semiconductor compounds as useful electronic materials. Although the field-effect transistor concept is not new, devices combining field modulation of conductivity with the properties of insulating photoconductors have not had detailed consideration. Although not yet sufficiently developed for commercial use, such devices are capable of performing new and combined circuit functions which are impracticable with conventional circuit elements.

The simplest form (Fig. 1) of field-effect transistor consists of a thin rectangular semiconductor slab with ohmic contacts on each end situated so that current direction is parallel to the slab surfaces. A rectifying contact is formed on one of these surfaces. When the voltage between the rectifying contact (the gate) and the interior of the slab reverse biases the contact, carriers are forced out of the region nearest the contact surface. The resulting space charge layer is essentially void of carriers. Current between the two ohmic contacts is restricted to a smaller cross-section of the slab and conductance is reduced. Thus, the current through the slab can be varied by a voltage on the rectifying contact to obtain a finite mutual transconductance.

Gate voltage must be of the same polarity as the free carriers to reverse bias the contact. When the reverse-bias voltage is sufficiently great to cause the space-charge layer to penetrate the entire thickness of the slab, the bias is called the pinch-off voltage.

Reverse-bias voltage is equal to the potential difference between the gate and the conducting channel. A potential gradient exists along the conducting channel in the direction of the current. The bias voltage and corresponding space charge layer thickness is greatest near the drain end of the conducting channel and drain current increases as the drain to source voltage is increased. However as pinch-off voltage is approached, a constant current region is reached, as shown in Fig. 2A.

Although drain current is only slightly dependent on drain voltage in the pinch-off region, it is strongly dependent on gate voltage. Mutual transconductance from the gate to the drain reaches a maximum, equal to the bulk conductance of the slab, when the device is operated in the pinch-off region with zero gate voltage.

When a bias voltage is applied to a field-effect transistor, charge is transferred from the interior of the semiconductor slab, through the external circuit, to the exterior of the gate surface. If this charge transfer reduces the number of free carriers in the slab, conductance is reduced. However, removal of charges that were not contributing the conduction process does not modulate conductance. Such charges exist in insulating photoconductors such as CdS.

The charge density in the slab is neutral before application of external voltages. However, when a reverse bias is applied, a finite charge density exists in the space charge layer due to the removal of carriers of one sign from that layer. This charge is formed in a doped semiconductor by donors or acceptors from whose vicinity free carriers are removed. A somewhat different situation exists for insulating photoconductors.

Highly pure CdS is an insulator in the dark. Electron-hole pairs are generated when external illumination applied. The electrons are mobile and serve as current carriers. The holes, trapped rapidly, are immobile and contribute negligibly to the conduction process. The charge density in the space charge layer is formed by the immobile holes from whose vicinity the free electrons have been re- moved.

Impurity, stoichiometric and other defects in a CdS crystal per-
Transistors

Transistor is mounted on printed circuit board. Crystal dimensions are 3 by 2 by 0.1 mm

mit the photoexcited electrons to exist in energy states whose level is less than that required for conduction. The higher energy mobile electrons fall into these lower levels where they are trapped until they are thermally excited into the conduction band or recombine with a hole.

The ratio of free to trapped carriers in the photoconductor seeks a constant thermal equilibrium value. If the gate signal period is much less than the equilibrium time of the traps, only the free carrier density is modulated. However, lower signal frequencies which permit thermal equilibrium to be approached produce modulation of both the free and trapped carrier densities, and a lower mutual transconductance results.

The existence of deep traps in CdS influences the gain of the transistor at frequencies below a few cycles per second. Secondary illumination with near-infrared wavelengths has been found to alter trapping equilibrium such that it increases the low-frequency gain of the device.

The relationship between the space charge layer thickness and the bias voltage is determined by both the average density of movable charge and the distribution of this charge throughout the slab. For a given average charge density and quiescent operating current, the mutual transconductance is greater for distributions having greater charge density near the gate surface.

The movable charge density in a photoconductor decreases with distance from the illuminated surface at a rate dependent on the optical absorption coefficient of the material. This coefficient is a function of illumination wavelength. Infrared quenching radiation has also been found to cause charge density to decrease more rapidly with distance from the illuminated surface. Therefore the electronic characteristics of the transistor depend not only on the illumination intensity but on its wavelength and direction and on the intensity of secondary infrared illumination.

Both the input and output impedances of the CdS field-effect transistor are high and therefore the equivalent circuit is most conveniently shown as a pi-equivalent with Y matrix representation (Fig. 2B). The device is similar to a vacuum pentode in both its output characteristics and its equivalent circuit form except for the magnitude of the matrix parameters and the existence of an appreciable value of feedback conductance y_{in}. As in junction transistors, a finite y_{in} causes a dependence between the input impedance and load impedance and between the output impedance and source impedance.

Performance of this transistor at low frequencies is complex because of the various equilibrium times associated with traps at different

<table>
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energy levels. Not only does trap distribution vary from crystal to crystal but their effect can be varied by external illumination. However most of the gain degeneration caused by traps results at signal frequencies below 5 cps.

The upper frequency limit of the transistor is imposed by the dielectric relaxation time, characterized by its dielectric constant and conductivity. Illumination determines the conductivity and therefore influences the upper frequency limit. Typical values are of the order of 100 Kc.

Modulation of incident illumination can be used in two general ways to modify the output signal of the CdS field effect transistor. First, the pinch-off current is approximately proportional to the square of the light intensity. Therefore a conversion from light intensity to output signal amplitude can be achieved. Second, the mutual conductance of the transistor is approximately proportional to light intensity. Therefore light intensity can be used to modulate the output amplitude of the electrical signal applied to the gate.

Secondary illumination with infrared quenching radiation produces a different effect. Pinch-off current is decreased as quenching intensity is increased. Mid-frequency mutual transconductance is also reduced, but by a much smaller amount. However the transconductance at very low frequencies is increased by quenching intensity.

The upper frequency limit of light modulation is ideally imposed by the carrier lifetime but a lower value usually results from the equilibrium time of the shallow traps. A large variation exists but typical high-frequency limits are of the order of 1,000 cps. The upper frequency limit of the quenching modulation is determined by the equilibrium time of the deep traps influenced by the quenching. This limit is less than 5 cycles per second.

An order-of-magnitude comparison of the characteristics of the CdS field effect transistor, a Ge junction transistor (2N35), a vacuum triode (6C4) and a pentode (6SJ7) is tabulated in the table. The vacuum-tube comparisons assume a megohm grid-return resistor. Comparison on the basis of almost any general figure of merit for an amplifier shows that the CdS transistor is inferior to the other devices, especially when upper frequency limits are considered. However the CdS transistor has advantages for special applications requiring a high input impedance amplifier or a constant current source.

Additional advantages result from features of CdS. These include high sensitivity to light, and temperature independence. Temperature independence results from the wide band gap. Furthermore, the CdS field effect transistor has the small size and high efficiency of the junction transistor but can be applied to high-impedance circuits that now require vacuum tubes.

If, by addition of impurities and modification of geometry, a one or two order-of-magnitude increase in $g_m$ can be realized, the $g_m$ and voltage gain of the CdS transistor would be equivalent to those of a low power pentode (at audio frequencies). Then the CdS unit would have the advantages of small size, higher input impedance and high efficiency over pentodes.

Field-effect transistors made from Ge or Si may be equivalent or superior to the CdS device in some respects. However CdS devices are better in photosensitivity and temperature independence and may be more economical to produce.

Figure 3a illustrates a relaxation oscillator. The sawtooth output voltage is linear because of the
constant current charging source provided by the field-effect transistor. The sawtooth frequency is determined by the capacitor C and its charging current and therefore can be varied with gate potential or with incident illumination. This circuit provides a direct conversion of light intensity to frequency and voltage to frequency.

With a 0.001-μF capacitor and a 50-volt supply, the circuit of Fig. 3A produces a 15-volt sawtooth having a maximum deviation from linearity less than one percent. If the transistor were replaced by an ohmic resistor the deviation from linearity would be at least 15 percent. Furthermore, the repetition rate of the transistor circuit can be varied throughout the range from 1 to 10,000 cps by varying light intensity or gate bias. The 10,000-cps frequency is obtained at 100 foot candles and zero gate bias voltage. The frequency is approximately proportional to the square of the light intensity.

A family of circuit functions can be performed with either or both the light intensity and gate voltage as a synchronizing, frequency modulating, gating or control signal.

The amplifying circuit shown in Fig. 3B will perform several functions. The amplification of the gate signal is dependent on illumination. The sensitivity of output voltage to illumination is a function of gate voltage. If the gate voltage and light intensity are varied at different frequencies the output signal will consist of the higher frequency signal amplitude modulated by the lower frequency signal. If both frequencies are the same, a d-c component of the output signal will be a function of the in-phase components of the two signals and phase discrimination results.

The circuit in Fig. 3B, with a load resistance of 0.8 megohms, a 100-volt supply and illumination intensity of 100 foot candles (incandescent), provides a voltage gain of 15, an input impedance of 50 megohms and a power gain of 40 db. The voltage gain is proportional to the light intensity.

The phase shift oscillator, Fig. 3C, can either be gated on and off, or have its amplitude controlled by incident illumination. If the oscillator is operated in a submarginal mode the circuit is selective to light modulation frequencies corresponding to the resonant frequency of the oscillator. Many other feedback networks can be used to shape the frequency response of the device to light modulation.

Although the CdS field effect transistor has a relatively low g_m, its high dynamic output resistance permits high voltage gains to be obtained. Full realization of the high voltage gain capability requires that the load have a high dynamic resistance. An ohmic load would require an excessively high supply voltage. However the supply voltage requirement can be reduced to a reasonable value by a load having a high dynamic resistance and a low quiescent resistance. This function can be performed by another field-effect transistor. Such a circuit is illustrated in Fig. 4A where transistor Q_1 serves as the load for amplifier Q_3. The output impedance of the Q_1 – Q_3 network is high but can be reduced to a useful value by a third transistor Q_3, connected as a cathode follower. With this circuit it is possible to obtain an input resistance of 100 megohms, an output impedance of 1 megohm, a voltage gain near 1,000 and a power gain exceeding 10^6.

The power capabilities of the CdS field-effect transistor are not sufficient to drive most indicators or actuators that would terminate a system. Therefore most systems using the transistor require amplification by conventional components. Vacuum tubes have sufficiently high input impedance to permit conventional R-C or direct-coupling techniques.

Although the impedance levels of field-effect and junction transistors do not permit a matched coupling, the coupled circuit illustrated in Fig. 4B has useful characteristics. The base current of the junction transistor is determined by the gate voltage and illumination of the field-effect transistor. The circuit has an input impedance of 100 megohms, an output impedance of 10,000 ohms and a mutual transconductance of 10^4 mhos. The four-terminal characteristics of this combination are similar to those of a vacuum triode.

REFERENCES
ANALOG MULTIPLICATION

ELECTRONIC analog multiplication means have long been difficult. Methods capable of high accuracy have required extensive and complex circuits.

Use of time as an analog variable could produce high accuracy because time can be measured with great precision. However, to use time as a variable at least one analog quantity must be converted to a time interval as part of computation. Quite often these variables automatically arise as time intervals. An example is radar range, which is obtained in pulse-type systems as the time between transmitted and echo pulses. In multiplications where one or more variables are of this type, electronic multipliers offer advantages.

If the duration of a rectangular pulse is made proportional to one factor and pulse amplitude to the other, the area will be proportional to the product. Figure 1A shows a one-transistor switching circuit to mechanize this process. Factor \( X \) is introduced as the collector supply voltage of transistor \( Q \). The voltage is shown in the polarity that would be used to bias \( Q \) in its active region. If the \( X \) polarity is reversed, satisfactory operation will still occur if the positive excursion of the base waveform exceeds \( X \) in magnitude, so that the collector-base junction can still be reverse-biased during interval \( T \).

Factor \( Y \) is proportional to time interval \( T \) in the base gating waveform. During \( T \), the transistor is cut off by reverse bias on both junctions; hence, voltage \( X \) appears at the output. Following \( T \), \( Q \) conducts and the output is grounded. Solution rate \( 1/T \) must be high compared to rates of change of \( X \) and \( Y \) to enable the product to follow changes in the variables.

When \( Q \) conducts, output voltage \( V \) differs from ground by the small drop \( (V_c) \) across the saturated transistor. When \( Q \) is cut off, \( V \) differs from \( X \) by the drop caused by transistor leakage current \( (I_c) \) flowing through \( R_c \). The output waveform is shown in Fig. 1B, related in time to the base gating waveform. The average value of \( V \), would be exactly proportional to \( XY \) if both \( V_{cc} \) and \( I_c \) were zero.

The voltage \( V_{cc} \) during the saturated interval depends on the normal and inverted current amplification factors \( a \) and \( a_r \), base drive current \( I_b \) and collector current \( I_c \). These quantities are related by

\[
V_{cc} = K T_q \ln \left( \frac{a \left( 1 - I_c/I_b \right)(1-a/\alpha) \left( 1 + I_r/I_c \right)}{1 + I_c/I_b} \right)
\]

where \( \alpha \) is grounded-base d-c current gain, \( \alpha_r \) is inverted ground base d-c current gain, \( I_c \) is collector current, \( I_r \) is base current and \( K T/q \) equals 0.026 volt at room temperature (300 K).

Regard \( V_{cc} \) as being made up of two components—a d-c part present even when \( I_c = 0 \), and a dynamic resistance drop \( I \), \( R_a \), where \( R_a = dV_{cc}/dI_c \).

With this concept in mind, several general trends may be observed. Some of these trends are: \( V_{cc} \) decreases as the \( a \)'s increase, both the d-c part and the dynamic drop decrease; \( V_{cc} \) decreases if base drive is increased, the dynamic drop is reduced in this case; and \( V_{cc} \) varies linearly as \( I_c \) varies with a slope that is \( R_a \).

If the transistor is used in inverted connection the same relationship for \( V_{cc} \) applies. But \( a \) and \( a_r \) are interchanged and \( I_c \) becomes \( I_r \). Here the d-c component of \( V_{cc} \) will be smaller (because \( a \) is less than \( a_r \)), but a higher dynamic resistance will result.

Some static room-temperature
USING TIME AS ONE VARIABLE

Electronic multiplication can be implemented simply and accurately if one or more of the variables inherently appears as a time interval. Desired products can be proportional to either average or peak output voltage depending on circuit used


The general trends are illustrated by Fig. 2. Some conclusions are: to minimize error due to $V_{ce}$, high-$\alpha$ transistors in the inverted connection with considerable base drive and low collector current (high $R_C$) should be used. Time would have to be considered in the base drive as increased drive slows transistor switching by increasing storage time.

Potential $V_{ce}$ goes thru 0 at one point when the polarity of $X$ is reversed from that shown in Fig. 1A. For one quadrant operation the polarity of $X$ for which this happens is preferable provided that the base-emitter junction of the transistor is able to withstand the increased magnitude of the base-emitting wave-form without breaking down.

When $Q_i$ is cut off, leakage current $I_L$ depends upon $\alpha_1$, $\alpha$, and $I_{in}$ (or $I_{in}$ in the inverted connection). Leakage current can be made small than $I_{in}$ by reverse-biasing the base-emitter junction during the cut-off interval. The expression is

$$I_L = I_{in}(1 - \alpha_1)/(1 - \alpha_2\alpha)$$

Since both $\alpha_1$ and $\alpha_2$ are less than one, this represents a current less than $I_{in}$. If the transistor is inverted, so that $\alpha_1$ and $\alpha_2$ are interchanged and $I_{in}$ becomes $I_{ce}$, further reduction is possible.

The output error caused by $I_L$ depends directly on $R_C$. If $R_C$ is 10,000 ohms, for example, a value of $I_{in}$ of 0.1$\mu$A means a voltage drop of 1 millivolt. Figure 2 shows that an $R_C$ of 100,000 ohms will minimize $V_{ce}$.

An $I_L$ of 0.1$\mu$A would produce a 10-millivolt drop.

Silicon transistors solve the $I_L$ problem. The 2N496 has an average $I_{in}$ of 0.001 $\mu$A.

Errors due to $V_{ce}$ and $I_L$ are in opposite directions, so that they cancel. $V_{ce}$ causes the average output voltage magnitude to be too high, while $I_L$ causes it to be too low. The error which is due to both will then actually be less than the
worst case of one alone.

If the slope of a sawtooth wave is made proportional to one factor and the duration to the other, the peak height of the triangle will be proportional to the product. The theoretical relationship is shown in Fig. 1F while Fig. 1C shows a circuit with two transistors. Accuracy depends on \( V_{ce} \) and \( I_e \) and upon the linearity of the triangle generation. In Fig. 1C, the triangle is generated by charging capacitor \( C \) with the collector current of constant-current generator \( Q \), during the time interval in which \( Q \) is cut off. To the extent that \( Q \) collector current is proportional to signal voltage \( X \), the maximum triangle height \( H \) will be proportional to \( XY \). When \( Q \) is on, \( C \) is shorted and output voltage is zero. As in the rectangle method

\[
H = \frac{1}{C} \int_{0}^{T} i_{c} dt = I \frac{T}{C} \sim XY
\]

the solution rate \( 1/T_{n} \) must be high compared to the rates of change of factors \( X \) and \( Y \) to enable the multiplier to follow signal variations.

A theorem of probability theory states that if two unrelated events \( X \) and \( Y \) have probabilities of occurrence \( p_{X} \) and \( p_{Y} \), the probability of their simultaneous occurrence is \( p_{X} p_{Y} \). This theorem may be used by converting two analog factors to duty cycles of pulse trains of uncorrelated repetition rate. If the two pulse trains control an AND gate such that there is no output unless both are simultaneously positive, the average value of the gate output will be proportional to the product.

A circuit is shown in Fig. 1D. Factors \( X \) and \( Y \) are proportional to the pulse train duty cycles \( T_{X} / T \) and \( T_{Y} / T \); \( T \) and \( T_{X} \) are uncorrelated (frequencies \( 1/T \) and \( 1/T_{X} \) in the range of 1 to 10 Kc were tested). Voltage \( E \) appears in the output only when \( Q_{1} \) and \( Q_{2} \) are simultaneously turned off by positive base voltages. If either conducts, output is zero.

Error source is the drop \( V_{ce} \), across the saturated transistors, which causes the output voltage to be too high. Leakage current effects are negligible with the silicon transistors. If polarity of \( E \) is reversed and transistors inverted, the error can be minimized.

The circuits have indicated a time interval proportional to one of the analog variables. The circuit to convert an analog signal voltage to a time interval might be called a pulse-width modulator. Two approaches that may be used are to control the pulse duration of a single-shot multivibrator or similar pulse generator by the variable or to gate a switch with the sum of a triangular carrier wave and the variable.

Figure 1E illustrates the latter method. The triangular wave must be large enough to sweep the transistor rapidly from saturation to cutoff and conversely. Its frequency must be much higher than the expected signal variation rate to produce a time interval \( T \) continuously proportional to \( X \).

In an experimental model, six transistors were used—five to generate the triangle and one to do the multiplying. Thus, the advantage of circuit simplicity does not accrue unless one variable automatically enters the problem as a time interval. Producing the desired voltage-time proportionality is more complicated than multiplication.

The technique of generating many types of functions to any desired degree of accuracy by power series is well known mathematically. The multipliers can be used to form power series by cascading stages such that the output of the first is proportional to \( X \), the output of the second to \( X \) squared, and so on. Consider the use of triangular multipliers like that shown in Fig. 1C. If \( T \) is made proportional to \( X \), and a constant input voltage is applied to the emitter through \( R_{b} \) then the peak of the output voltage \( V \), will be proportional to \( X \), with a proportionality constant depending on \( R_{b} \), \( C \) and the constant emitter voltage; \( V \), then becomes the input (instead of the constant voltage) for a second stage \( R \), and \( C \) in addition to the stage one constants. Similarly, the third stage will have a peak output proportional to \( X \) cubed. By summing the peak outputs of the several stages, a series of the form \( AX + BX^2 + CX^3 + \cdots \) can be constructed. The coefficients are independently adjustable.

This technique could be used for multiplications called for by equations in bombing systems, inertial platforms and general analog computer applications. Products in which one or more factors enter the problem as a time interval are well-suited to this approach.

REFERENCES

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FIG. 2—Changes in \( V_{ce} \) plotted against \( X \) for a 2N396 transistor operating in the circuit configuration of Fig. 1A
automatic cartesian coordinate plotting of any test data that can be reduced to electrical form...

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August 12, 1960
Helical Resonator Design Chart

Helical resonators. Coils, from left to right: \( f_1 = 55 \text{ Mc, } Q_s = 600; \)
\( f_2 = 78 \text{ Mc, } Q_s = 720; \) \( f_3 = 101 \text{ Mc, } Q_s = 840; \)
\( f_4 = 145 \text{ Mc, } Q_s = 889; \)
\( f_5 = 215 \text{ Mc, } Q_s = 1,000. \) Shield inside diameter = 1.68 inches

Coaxial resonators with helical inner conductors may be used in subminiature equipment for the uhf range. This nomograph will aid designers in application

By W. W. MacAlpine and R. O. Schildknecht,
ITT Laboratories, Nutley, N. J.

Three of the four types of electrical resonators listed will be familiar to engineers and physicists; all four are used in many applications. The four types are:
inductance-capacitance tuned circuits; a cavity consisting of a coil in a shield, one end of the coil being short-circuited to the shield and the other end open, except possibly for a small trimming capacitor; reentrant cavities, such as a quarter-wave section of coaxial transmission line; and cavity resonators of the waveguide type. The frequency range in which these resonators are useful progresses from low to ultra high in the order in which they are listed.

Least familiar is the second type, the helical resonator. It is a coil operating at its lowest self-resonance or a quarter-wave section of transmission line having relatively high characteristic impedance and low axial velocity.

These helical resonators have been used over the past few years in applications such as these: as preselector filters and interstage tuning elements in the r-f end of vhf receivers, especially when the tuning frequency range is not greater than 10 to 20 percent; as interstage filters in i-f amplifiers, such as at 70 Mc; and as resonant elements in oscillators and transmitters when the tuning range is limited to 20 percent or less.

Experimental helical resonators have been built for frequencies ranging from less than 2 Mc, in a shield 7 inches in diameter, to 1,000 Mc in a shield of 0.7 inch in diameter. Unloaded \( Q_s \) ranged from 400 to 2,000 according to size and frequency. Some of these are used in equipment now in commercial use. Such resonators have prospective use in subminiature equipment for the uhf range.

A group of helical resonator coils and a cylindrical shield suitable for enclosing any one of them are shown in the photo. The coil and shield are sketched in Fig. 1A. Some idea of the size of a helical resonator for a given frequency and unloaded \( Q_s \) can be gained from Fig. 1B. This chart is drawn only for the approximate frequency range where the helical type gives optimum performance.

Figure 2 gives design information that is generally accurate to within ± 10 percent. Drawn from formulas, it is subject to the conditions listed. The unloaded \( Q_s \) of a resonator consisting of a copper coil on a low-loss form, mounted in a copper shield (whether the coil is self-resonant or tuned by a lossless capacitor), is

\[
Q_s = 50Df_s^3/n
\]

where \( f_s \) = resonance frequency in megacycles per second, and \( D \) = inside diameter of the shield in inches. If the shield is of square cross section, assume \( D \) to be 1.2 times the width of the side of the square. Conditions
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(a) A series of crab locks molded from Nylon.
(b) Electrical connectors for making and breaking as many as 41 electrical circuits at one time are used in missile tracking equipment.
(c) Comparator chart in background enlarges connectors 10 times and checks the accuracy of all holes and insets.
(d) Pick-up head for stereophonic record player. This is a complicated but very small part (one third the width shown) in which three insets are molded into the head.

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CIRCLE 141 ON READER SERVICE CARD 141
under which Eq. 1 holds are 0.45
< d/D < 0.6; b/d > 1; 0.4 < d/r
< 0.6 at b/d = 1.5; 0.5 < d/r
< 0.7 at b/d = 4; d > 5 times
skin depth; and B = b + D/2;
where B = inside length of
shield, b = axial length of coil,
d = mean diameter of turns,
d_0 = diameter of conductor, and
r = center-to-center spacing of
turns.

The total number of turns, winding pitch (reciprocal of
turns per inch) and characteris-
tic impedance, for air dielectric
between coil and shield, are

\[ N = 1,900/f_D \text{ turns} \] (2)
\[ \tau = 1/n = Df_D/2,300 \text{ inches} \] (3)
\[ Z_c = 98,000/f_D \text{ ohms} \] (4)

with these conditions: d/D
= 0.55 for Eq. 2, 3 and 4; b/d > 1
for Eq. 2; and b/d = 1.5 for Eq.
3 and 4. Equations in terms of
general values of these ratios
are given in Ref. 1.

The electrical length, the
fringing capacitance at the open-
circuited end of the coil and the
length of conductor in the wind-
ing are approximately: electrical
length = 94 percent of axial
quarter wavelength = 84.6 elec-
trical degrees; fringing capaci-
tance = 0.15 D \mu F; and con-
ductor length = 28 percent of
free-space wavelength.

Alignment on the chart, Fig. 2,
is illustrated by the dashed lines
and by examples. Two points on
the left-hand region of the chart
show the approximate limits of
greatest usefulness of the helical
type resonator. These points cor-
respond to the choice, the straight
type being longer and more
slender than the helical. An ex-
cellent helical resonator can be
built having less than three
turns.

The lower limit point lies
within the region where an L-C
tuned circuit design should be
compared to the helical reso-
nator. If the helical type is made
much smaller than indicated by
the lower limit, the wire size will
become so small that the Q will
drop below that indicated by the
chart.

Example I: A 10 Mc resonator
with unloaded Q of 1,000 is re-
quired. By the dashed lines of
Fig. 2 or by formulas, D = 6.3
inches inside diameter of shield
and N = 30 turns. Using d/D =
0.55, the coil mean diameter is
d = 3.5 inches. Reasonable val-
ues are n = 6 turns per inch and
b = 5 inches coil length. Shield
length B = 8.2 inches. Conductor
diameter d_0 can be any value be-
tween 0.064 and 0.102 inch (No.
14 to No. 10, B & S gauge).

Example II: A filter coil for
70 Mc is to have an unloaded Q
of at least 850 and is to be
mounted in a square cross-sec-
tion shield. From the chart, Fig.
2, a round shield would require
D = 2 inches. The inside of the
square shield would be D/1.2 or
1.65 inches on a side. Use 1\frac{1}{8} by
1\frac{1}{4} (outside) brass tubing with
0.051 inch wall. (The inside sur-
face of the shield and the coil
conductor are plated.) The re-
quired number of turns is 14.
A coil form of Teflon has 0.90
inch diameter, with winding
grooves rolled in. The winding
is of 0.064 inch diameter con-
ductor and the coil is two inches
long. Measurement on this reso-
nator indicates unloaded Q of
nearly 1,000, which is higher
than predicted. The measure-
ment is made by determining the
bandwidth with extremely weak
coupling to the measuring gear.

Example III: A resonator is
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to be tunable from 148 to 174 Mc by a miniature adjustable
trimming capacitor at the open-
circuited end (see Fig. 3A). Let
the shield be square cross sec-
tion, 1 inch on each side (equiva-
 lent to a cylindrical shield 1.20
inches diameter). The resonance
frequency will be 240 Mc when
the capacitor is omitted. By
Fig. 2, the coil has seven
turns on a 1 inch diameter form,
with one inch winding length.
The chart gives $Z_c = 350$ ohms.
The capacitor values are com-
puted by transmission-line equa-
tions. Under design equations,
electrical length of the resonator
is about $\theta = 84.6$ deg. Reactance
looking into a short-circuited
line is: $X = Z_c \tan \theta = 350 \tan
84.6$ deg = 3,750 ohms.

This is equal to the negative of
the reactance of the fringing
capacitance, which is: $C = 10^6/
2 \pi f X = 10^6 / 2 \pi (240) (3,750) =
0.18 \mu f$. Now, at 174 Mc, $\theta$

$$= 84.6 \left(\frac{174}{240}\right) = 61.5 \text{ deg.}$$

By computation like that above, this
requires $C = 1.4 \mu f$. Similarly,
the fringing capacitance is deducted, the re-
quired trimmer range is a little
wider than 1.2 to 2.2 $\mu f$. The
unloaded $Q$ computed by Eq. 1 is
790 at 174 Mc and 730 at 148 Mc.

Example IV: Design a reso-
nator for 400 Mc with unloaded
$Q$ of 2,000. By formulas or chart,
$D = 2$ inches and $N = 2.4$ turns.
Coil mean or pitch diameter can
be 1 inch and the winding pitch
0.75 inch center-to-center of
turns. Coil length is 1.8 inches
and shield length 2.8 or 3 inches.
Measurement of insertion loss
and loaded $Q$ with a load matched
to the generator through the
resonator indicates that an un-
loaded $Q$ of about 2,000 has been
achieved. For comparison, a
coxial transmission-line reso-
nator can be designed as shown
in Ref. 2. Use optimum ratio of
conductor radii, $b/a = 3.6$.

Denote the $Q$ by 10 percent to al-
low for surface imperfections
(as has been done in the $Q$ for-
mula for the helical type). Then,
with $f$, in megacycles and inner
diameter of outer conductor, $D,$
in inches: $Q = (0.9) (84)
(0.5) (2.54) D f_c = 96 D f_c$.
Then, for $Q = 2,000$ and $f =
400$ Mc, the outer conductor
diameter is $D = 1$ inch. The
length is almost quarter wave-
length, plus a little for clearance
at the open-circuited end, or
about 8 inches. The volume of
either type of resonator is pro-
portional to diameter squared
times length. Thus the approxi-
mate volume ratio is: (trans-
mision line) / (helical) = $\frac{3}{4}$.

However, the shape factor is one
by eight inches for the trans-
mision-line type against two by
three inches for the helical type,
which may favor one or the other

---

**FIG. 2**—Design chart for quarter-wave helical resonators. Dashed lines indicate example of chart's use.
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- NOMINAL D-C OUTPUT:
  28 v. & 300 amp. (continuous)
- VOLTAGE ADJUSTMENT RANGE:
  22 to 32 v. d-c
- VOLTAGE REGULATION:
  ±0.5% — combination of rated load and a-c input variations
  (Sensing: local or remote)
- VOLTAGE RIPPLE:
  1% rms. (—20°C to +55°C)
- VOLTAGE RECOVERY (63%):
  0.1 sec — full load application or removal
- D-C CURRENT OVERLOAD CAPACITY:
  125% for 5 min, every 20 min.
  250% for 5 sec, every 20 sec.
  350% for 1 sec, 500% peak
- A-C INPUT:
  400-490 v., 3-ph., 57-63 cps.
  (other voltages available)
- A-C CURRENT AT 440 V:
  25 amp.
- AMBIENT TEMPERATURE RANGE:
  Operating: —55°C to +55°C
  Storage: —62°C to +70°C
- ENVIRONMENT, SHOCK, VIBRATION:
  Built to MIL-E-4970
- RADIO INTERFERENCE:
  Built to MIL-I-26600

Mechanical Specifications:
- CABINET STYLE: STATIONARY
- Also other styles below
- SIZE & WEIGHT:
  19" W x 19" D x 31" H — 355 lbs.
- Standard Features:
  VOLTMETER & AMMETER:
  3½" ruggedized (MIL-M-10304)
  Recessed behind removable panel
  OVERLOAD PROTECTION,
  Magnetic & thermal
- PARALLEL OPERATION:
  Includes load sharing provision
- OTHER FEATURES:
  Input Contactor, Pilot Light, Fan, Fan Failure Protection.
type according to the application.

In order to attain the predicted unloaded Q, precautions must be observed. The coil form material should be low-loss material such as Teflon, Rexolite 1422. With strong dielectric materials, much of the coil form often can be cut away, even to the point of eliminating it completely on some larger-size resonators. It is desirable to silver plate the coil conductor and the inside surface of the shield to preserve good conductivity. A tinned copper conductor can be used up to about 100 Mc without seriously affecting the Q. On the other hand, a silver-clad or solid silver conductor will give about 3 percent higher Q than copper. Copper tubing is preferable for the shield. If brass tubing is used, a sufficiently thick copper and silverplate must be applied to obtain a low surface resistance. There should not be a seam in the shield parallel to the coil axis, or if one exists it must be effectively soldered for a low-resistance joint. The lower end of the coil should be carried over to the side of the shield as directly as possible and soldered thereto. If the coil end is run to the bottom cover of the shield, the cover must be thoroughly soldered to the shield tubing to reduce losses in the joint.

The sides of the shield are required to extend beyond each coil end by about one quarter of the shield diameter as shown in Fig. 1A. Clearance at the bottom end is required for passage of the magnetic field.

If the coil were carried to the bottom of the shield, the lowest few turns would be ineffective for storage of energy, but would still contribute loss. At the top end, the clearance is to reduce loading by fringing capacitance, and to avoid voltage flashover in power resonators. The top and/or bottom may be left open with little effect on frequency and Q.

In this case, the extensions of the shield beyond the coil are required to reduce stray external fields.

Coupling into and out of the resonators can be effected by a tap, loop, probe or aperture in a manner analogous to that with straight quarter-wave coaxial lines. In loop coupling, the plane resistance soldered joint to the shield. The low-loss capacitor \( C_0 \) at the top end trims the resonance frequency to the assigned channel.

A commercial ceramic capacitor of about 3 \( \mu \)F can be used, or one can be fabricated using a coaxial arrangement with a Teflon sleeve dielectric. Connector \( J \) and coupling loop \( L \) are adjusted for a 50-ohm input line.

Right-hand resonator coil \( X \), and its trimming capacitor \( C_0 \) are similar to the above. Instead of soldering the lower end of the coil to the shield, it passes through by a 1,000 \( \mu \)F ceramic feed-through capacitor \( C_m \). This permits d-c potential to be applied to the coil. Output coupling is by tap \( T \), which is only a fraction of a turn from the bottom end. The grounded-grid amplifier tube is shown for illustration. Coupling between the two resonators is provided by aperture \( K \).

Formulas and other information on the performance of resonators are found in various texts. Equations 1-4 on which the electrical design chart is based can be derived by analogy of the resonator to a section of coaxial transmission line. This can be done even though it does not function in a TEM mode, especially in regard to the magnetic field pattern.

It has been customary in the design of r-f coils to avoid even a remote approach to self-resonance. However, valuable improvement in performance can be attained in some applications by the completely opposite attack: that is, to operate the coil at its lowest self-resonant point. This has yielded higher-Q resonators.

**REFERENCES**


Does your new product design call for a high-pressure blower with unique or critical performance or size requirements? Have you assumed such a blower to be unavailable?

Rotron has designed and produced many unusual high-pressure (or high vacuum) blowers and many of them are listed in our current catalog. In addition...

- Rotron currently has several new design approaches under active development in our laboratories...
- Rotron is most anxious to confer and work with design engineers encountering unusual cooling problems so that we can correlate our new concepts and ideas with your problems...
- Rotron may have just the answer which you have been seeking. You may have just the problem that Rotron has been looking for and is anxious to tackle.

Can we get together? Write today giving full details on your blower problem with volume-pressure requirements to...

**ROTTRON mfg. co., inc.**
WOODSTOCK, NEW YORK  OROLE 9-2401
In Canada: The Hoover Co., Ltd., Hamilton, Ont.
SEE US AT WESCON BOOTHS 2806-2807
WIND-ENERGY CONVERTORS may be capable of producing several million volts at one ampere. Only about one microampere of current is provided by the Van de Graaf generator at a potential of about one million volts. Many applications are foreseen for the high-power, high-voltage generator including providing power for space vehicles.

Operation is similar to that of the Van de Graaf generator except that the latter uses a corona discharge to spray positive ions on a moving belt. The ions are transported against an opposing electric field to the cathode, where they are deposited. A flowing gas transports the ions in the electric wind generator instead of a belt.

The primary advantage of the wind-energy convertor is its large current-carrying capability. Larger currents are possible because more charge can be carried in a volume of gas than on the surface of a belt.

Device Functions As Artificial Mastoid

In addition, because a gas has less inertia, it can be moved faster than a belt. Liquids (kerosene) are also suitable as a working fluid.

An electric wind-energy convertor is shown in Fig. 1. Instead of adding ions to the flow by corona discharge, a method is proposed in which electrons are extracted from the gas after it is lightly ionized by alpha particles from Po\textsuperscript{210}. Because of their higher mobility, electrons are easily extracted from the flow by separation voltage $V_u$. The gas loses energy in opposing the electric field that appears in the external load at the rate $P_R$, where $I$ is electron current through the load and $R$ is load resistance. The electrons and ions recombine at the cathode beyond which the flow is neutral.

Detailed theoretical analysis of the electric wind-energy convertor has permitted prediction of typical operating conditions. Distance between electrodes $l$ is $10^4$ m, voltage $V$ is $4 \times 10^4$ volts, current density $j$ is $0.85$ amp/m$^2$ and ion concentration $n$ is $2.21 \times 10^6$ ions/m$^3$.

The gas is assumed to be argon at standard temperature and pressure with velocity $u$ of 480 m/sec. Under these conditions, there is approximately one ion for every 10$^9$ atoms, indicating high internal resistance in the generator. For efficient operation, load must equal internal resistance, which under these conditions is $1.5 \times 10^9$ ohms per square meter of channel area. As the percentage of ions in the flow is increased, internal resistance of the system is decreased.

The convertor could be useful in experimental physics as a source of high-energy beams of particles with much greater intensity than can be produced by the largest Van de Graaf generator. It might also be used to charge large capacitor banks, possible faster and more efficiently than with conventional means. Because separation voltage is usually much less than output voltage, the convertor might amplify a-c or d-c voltages, depending on input, or rectify a-c voltages.

Although calculations indicate conversion efficiency of less than one percent for a lightly ionized gas, the generator can perform some functions better than any conventional convertors. For example, it can convert flow energy of a two-phase wind tunnel into electrical energy. A system like that in Fig. 2 might provide power for ion propulsion motors in a space vehicle. The vehicle would be equipped with a heat source such as a fission or fusion reactor.

Energy conversion efficiency can be improved considerably by increasing the percentage of ions. The force field needed to establish convection in the two-phase wind tunnel could be conveniently supplied.
MAGNETIC CONTROLS chooses Tung-Sol flasher for Polaris guidance system temperature control

Magnetic Controls' portable temperature control maintains the Polaris guidance and stabilization system at safe temperatures while the system is in storage or in transit. Up until the time the system becomes operational in the submarine-launched missile, the control equipment keeps the temperature within a prescribed range. Should the temperature deviate, however, beyond preset tolerances, visual and audio alarms are set off to alert operators who can then quickly spot the system at fault for immediate inspection.

Magnetic Controls specified the Tung-Sol 608 Flasher as the trigger for the visual warning signal. Many competitive types were put under critical evaluation before the Tung-Sol Flasher was chosen. The reasons for selecting Tung-Sol, according to Magnetic Controls: "We demanded a compact unit which was readily available and which met our rigid reliability requirements. The Tung-Sol flasher was the only one which met these demands."

"We were also gratified by the cooperation and assistance of Tung-Sol engineers who designed a suitable mounting clip for the flasher when we encountered difficulty in locating one," Magnetic Controls reports.

Tung-Sol's outstanding experience in the design, development, production of special purpose flashers is readily available to you. Like all Tung-Sol components — tubes, semiconductors and miniature lamps — Tung-Sol flashers are the product of the highest manufacturing standards and assurance practises which have made Tung-Sol the name synonymous with the finest in componentry. Tung-Sol Electric Inc., Newark 4, New Jersey. TWX:NK193.

Technical assistance is available through the following sales offices: 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. Canada: Toronto, Ontario.
by rotating the vehicle at launch.

An electric wind-energy convertor would require simple, light-weight components with no moving parts. Producing the lightly ionized gas presents little difficulty. Although many problems would have to be solved in developing an electric wind-energy convertor, its potential usefulness and versatility is so attractive that increased activity in this field is expected.

REFERENCES

Circuit Removes D-C From Amplifier Signal Output

By E. W. VAN WINKLE,
Senior Project Engineer,
Eclipse-Pioneer Div.,
The Bendix Corp., Teterboro, N.J.

ELIMINATING the d-c component from the output signal of a direct-coupled d-c amplifier is possible with a recently declassified circuit. Normally this d-c component is present at the output of either current-gain or voltage-gain direct-coupled amplifiers. Output devices must either operate at this level or the d-c component must be removed from the signal.

An amplifier in a particular application provided a signal output that would be adequate if the d-c component could be removed with less than 0.5-db loss in signal gain. A resistance voltage divider returned to ground could not be used because the signal would be attenuated at the same rate as the d-c component. Although returning the voltage divider to a negative potential would result in less signal attenuation, the negative voltage required would be quite large to prevent large signal attenuation.

Another possible approach would be to drop the voltage through constant-current tubes or Zener diodes. The devices would be required to pass large currents and regulation would be poor with any changes in supply voltage reflected as changes
Constant-current tube $V_1$ removes d-c component from amplifier output with insignificant signal attenuation in d-c output level. In addition, a resistance voltage divider would also be required to remove the d-c component completely.

The circuit developed to remove the d-c component with insignificant loss in signal gain is shown in the figure. Amplifier tube $V_1$ is followed by constant-current tube $V_2$ in the coupling circuit. Tube $V_2$ and its plate and cathode resistances form a voltage divider. Voltage at the grid of $V_1$ is adjusted so the output voltage to ground is zero when there is no input to $V_1$. This grid voltage and the large cathode resistor hold current through $V_1$ substantially constant.

An input to amplifier $V_1$ changes voltage at its plate. Because current through $R_1$ is kept constant by $V_2$, voltage drop across $R_1$ is also constant. Therefore, the change in voltage at the plate of $V_1$ appears at the output. Specifically, output voltage is plate voltage at $V_1$ minus voltage drop across $R_1$.

Resistance of the divider can be quite high, resulting in little signal attenuation. Divider resistance is $r_1 + (\mu + 1) R_1$. If $R_1$ is 200,000 ohms and $\mu$ is 70, tube resistance exceeds 14 megohms. If $R_1$ is 500,000 ohms, more than 96 percent of the change in plate voltage at $V_1$ will appear at the output—a loss of only 0.3 db.

In addition, the circuit tends to compensate changes in supply voltage, which affect $V_1$ as well as $V_2$. For example, a rise in supply voltage that increases plate voltage of $V_1$ also increases current through $V_2$, and voltage drop across $R_1$. Therefore output voltage remains substantially constant.

The principle, applied to tubes in this case, can equally well be applied to transistors.
Electro-Optical Switching Device
USES NEON TUBE TO DRIVE PHOTORESISTOR

AT THE WESCON show this month in Los Angeles, engineers will be examining a signal switching device that answers problems faced by conventional relays, commutators, choppers and potentiometers. And a switching concept is now translated into commutation devices that require no moving parts, with low insertion losses and can be cased in compact packages.

Basically, these units are four terminal devices that have two terminals controlling the passage of information across the other two terminals by electro-optical coupling (see diagram). The control end of this unit consists of a light source which, when excited, lowers the resistance of a photoresistor in the signal end by a factor of about 10³, allowing a-c or d-c information to pass.

At present, one model is in production. This slow Raysistor cannot be turned on and off more than 50 to 100 times a second. This unit will, however, work with less switching power than other faster developmental models that are scheduled for production later this year, and next.

Typical values for the Raysistor are: I = 3 ma; E = 100 v; R = 10 Kohms on, 10 Mohms off. Life is not indefinite but should be better than 10,000 hours. Shunt capacity to r-f is about 4 pf. If one assumes 60 db attenuation in the off condition, the maximum frequency into a 10-Kohm load is 5 Ke.

According to J. C. Davis of Raytheon’s Industrial Components Division, the inventor of the Raysistor, his company is now developing a unit with the following characteristics: speed, on in 2 microsecs., off in 10 to 20; resistance about 1 Kohm; off, better than 1 megohm; capacity about 1 pf. Linear Raysistors are also under development by the firm. Present units are suitable for feedback circuits, but the ultimate hope is a unit at least as good as a triode tube.

Table gives the characteristics of the Raysistor model that is immediately available, compared with a transistor, thyratron and conventional relay. This Raysistor is designed for relay applications, and commutating matrices with scan rates not exceeding 100 bins per second.

Three additional models are under development and these units will be available later this year and during 1961: Model B, with on-off time constants in the microsecond range will be used for high-speed relays and commutation matrices with scan rates not exceeding 10,000 bins per second. Model C will be intended for age loop potentiometers and general control links in applications that require a continuous relation between control voltage and signal resistance. Model C provides complete isolation between control and signal voltages, even when a large voltage differential exists.

The fourth model, D, is a power switching version of Model B that uses a large light source and a photoresistor with a larger junction area. Except for a larger case size and an on resistance in the order of 10 to 100 ohms, the specs of Model D will be similar to those of Model A. A faster acting model is also under development.

For several years, the firm has been making a multi-filter spectrum analyzer in which the signal spectrum is broken up by resonant filters into some 400 parts and these are sequentially scanned by a commutator. In the very early models,

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<th>RAYSISTOR COMPARED WITH CONVENTIONAL SWITCHES</th>
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a—negligible on resistance
The Sanborn "650" is the first complete multi-channel high-speed optical recording system with medium gain general purpose amplification for each channel. Either the 8-channel amplifier or the recorder may be used separately. Together they provide a max. sensitivity of 2.5 mv/in and a frequency response of DC to 5000 cps (within 3 db at 4 in peak-to-peak) in a multi-channel "direct writing" system.

MODEL 658-3400 GENERAL PURPOSE AMPLIFIER. Here is the first sensitive multi-channel amplifier designed specifically for use with high frequency optical galvanometers — those in the Sanborn "650" and any similar recorder. The single chassis has 8 separate channels, each one complete from floating and guarded signal input to galvanometer output. They include front-end modulator and input transformer, medium gain carrier amplifier, demodulator, filter and driver amplifier. An internal pre-emphasis circuit increases galvanometer frequency range from 2000 cps to 5000 cps in the "650" recorder. The all transistorized circuitry is mounted on easily serviced printed plug-in cards. The Amplifier chassis has an output transfer chassis on the rear which simplifies coupling to optical recorders of other manufacturers. External damping resistors are easily added when required.

Specifications: Sensitivity: 7.2 ma/mv input, max. ... Attenuation: X2, 6, 10, 20, 50, 100, 200, 500, 1000, 2000 ... Common Mode Performance: tolerance — 500 volts max. rejection — 140 db for DC ... Input Resistance: 100,000 ohms all ranges floating and guarded.

MODEL 650 1-TO 24-CHANNEL OPTICAL RECORDER. The Model 650 Recorder provides high frequency direct writing recording, flexible housing and wide application possibilities. It may be used separately with a plug-in type galvanometers of various natural frequencies. When used with the 658-3400 Amplifier, the recorder is equipped with eight 2000 cps galvanometers — extended to 5000 cps by the amplifier pre-emphasis circuit — for wide range, high speed, wide deflection recording. The recorder has nine electrically controlled (local or remote) chart speeds, beam interrupters for trace identification, timing lines at 0.01 or 0.1 sec intervals; amplitude lines with manual washout from ¼, ½, ¾ or all of the record; full chart width deflection for each trace and trace overlap.

Specifications: Input Sensitivity: 17.5 ma/inch (with 2000 cps galvanometers) ... Chart Speeds: 0.25, 0.5, 1.0, 2.5, 5.0, 10, 25, 50 and 100 inches/second ... Dimensions: 19" wide by 17½" by 16½" deep ... Weight: approx. 120 lbs. (Data subject to change without notice)

Complete data is available from Sanborn Sales-Engineering Representatives located in principal cities throughout the United States, Canada and foreign countries.
Swivel Chair Substitutes for Lazy Susan

Lazy Susans or turntables are frequently used for step-by-step assembly, particularly of small or medium-sized units. The same benefits can be obtained by simply arranging individual units in a semicircle and seating the assembler in the center on a swivel chair.

The production setups shown were photographed at Ballantine Laboratories, Boonton, N. J. The firm uses the semicircular arrangement for larger units, for relatively small production runs of an instrument, or when other considerations make it advisable to keep the units on individual production fixtures. The depth of the normal workbench is increased by adding plywood tables between assembly stations.

When components for each assembly on a turntable must be kept segregated, the turntable is adapted by drilling holes behind each unit position. The holes are drilled along a radius to each position and the components lined up in assembly order by placing their leads in the holes. In the photo, matched sets of resistors are lined up for placement in vtm attenuators.

For assembly and soldering operations on small plug-in units, Ballantine employs a fixture which revolves around a horizontal axis. Any side of 5 units can be worked on at a time. The rotating portion looks like a box with 2 sides open. The closed sides are Bakelite drilled with holes into which the plug pins fit snugly. The sides are fastened to metal end pieces. The axles passes through the centers of the end pieces, is supported by upright metal plates and is turned by knobs at each end. Between the plates and end pieces are flat springs which prevent the fixture from revolving freely. A wooden wedge can be used to lock the fixture in position.

Black Light P-C Frame Saves Time

Efficiency of phototetched wiring board printers has been stepped up significantly at Western Electric Company's North Carolina works by the use of black light lamps instead of carbon arc lamps.

The sensitizing material used on the copper-clad laminate responds to ultraviolet light with a wavelength of 3,000 to 4,000 Angstrom units.

A survey of available lamps showed that 40-watt black light lamps have 32 times more radiation in this band than 40-watt standard cool-white fluorescent lamps. Carbon arc lamps previously used have a low percentage of light in the needed wavelength and require 11,-040 watts.

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**Sanborn Company**

**Industrial Division**

175 Wyman Street  Waltham 54, Mass.

At the WESCON SHOW — Booths 608-609

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**August 12, 1960**

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**8-channel Amplifier**

**2000 cps Optical Recorder**

**= a new 0 to 5000 cps direct writing system**
It's going into wind tunnels and rocket test stands... into airborne instrumentation... into the same rugged applications where you'll find many of CEC's growing family of unbonded strain-gage pressure transducers. This new spring-type sensing element assures linearity and hysteresis of 0.5% of full scale... zero shift of 0.01% and sensitivity shift 0.005% of full scale per degree F.

Meet CEC's pressure transducer family...

Improved Type 4-326... for measurement to 10,000 psi, now expanded downward into lower ranges of absolute, gage and differential pressures. *Bulletin CEC 1620A-X10.*

New version Type 4-327... for gage and absolute pressure measurement to 5,000 psi, now has a true flush diaphragm capable of measurement to 5 psi. *Bulletin CEC 1626-X6.*

Brand new Type 4-325... weighs only 8 grams, is less than 1 inch in diameter. *Bulletin CEC 1630-X2.*

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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at a constant speed, through a perfectly balanced diamond-edged wheel rotating at 6500 rpm's.

Sections as thin as 35 microns are sheared off evenly, without flaking, and in most cases are ready for direct mounting. Both stage assembly and wheel shut off automatically at the conclusion of each cut. The sample may then be repositioned for a second cut by means of a micrometer gauge and the cycle repeated.

High-Speed Transistor
For Computer Uses

A PNP germanium alloy switching transistor designed for high speed computer applications has been announced by Sylvania Electric Products Inc., a subsidiary of General Telephone & Electronics Corporation.

Roger A. Swanson, product sales manager—transistors of Sylvania's Semiconductor Division, said the new device (Type 2N404A) is interchangeable with its popular military prototype (2N404) "but excels it in voltage, current and heat characteristics."

Swanson said the superior performance and rigid AQL (acceptance qualification levels) of Type 2N404A make it ideal for use in airborne computers and missiles.

Commenting on the advantages of Type 2N404A over its prototype, Swanson listed the following characteristics:

Max Ratings at 25°C 2N404 2N404A
Call to Base volt 25 v 40 v
Junction Temp. 85°C 100°C
Collector Curr 100 ma 200 ma
Power Dissipation 120 mw 150 mw

Bomb for Rust

A new approach to the rust problem, moisture condensation and acid neutralization is an Aerosol bomb, applied in a fine jet mist spray which sets up a film barrier. The rust inhibitor contains fortified lanolin that absorbs up to five times its own weight in water. Cans are available for general protective use in small cans and bulk quantity from Crown Industrial Products Co. Woodstock, Illinois.

IT TOOK 22 YEARS TO PRODUCE THIS INSTRUMENT

You're looking at one of CEC's new high-performance galvanometers

Like all other CEC galvanometers, it's a self-contained, sealed unit that's been made to extremely close tolerances and rigidly tested in more than 30 quality control checks.

But its performance is what makes this instrument unusual. CEC galvanometers offer the ultimate in high-performance characteristics. They're available in 14 types with a wide range of frequency response.

What has all this to do with the fragile, bulky galvanometers of 22 years ago? Plenty. In 1939, CEC research and development created a totally new design concept that has meant technical superiority ever since. For complete information on the best galvanometers made for your oscillograph, write today for Bulletin CEC 1528-X3.
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NEW TI GENERAL-PURPOSE
SILICON MESA TRANSISTORS

only mesas give you maximum dissipation... Note how wafer is bonded directly to header, forming a direct, high-efficiency metal-to-metal thermal path through the header. High dissipation capabilities permit you to design conservatively for maximum reliability!

only mesas give you maximum mechanical ruggedness... Note how active element is bonded directly to header, close to unit's center of gravity—for maximum resistance to vibration and shock.

TI 2N1564 series GUARANTEES -55°C beta, 600-mw dissipation and gain at 30mc

Design now with industry's first small-signal silicon mesa transistors... the new TI 2N1564-series! Take advantage of guaranteed -55°C betas of 12, 20 and 40... guaranteed 600-mw free-air dissipation... guaranteed current gain at 30 mc. Apply the design flexibility of 1 to 50 ma collector current operating range; 20-50, 40-100 and 80-200 beta spreads at 25°C and 60-v collector-emitter breakdown voltage to your audio, medium-power and higher frequency amplifier and switching designs... Specify the new TI 2N1564-series.

Available TODAY in production quantities through all TI Sales Offices and Authorized TI Distributors.

<table>
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<tr>
<th>Parameter</th>
<th>2N1564</th>
<th>2N1565</th>
<th>2N1566</th>
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</thead>
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<tr>
<td>Collector Reverse Current</td>
<td>$V_{CB} = 40\text{v}$</td>
<td>$I_E = 0$</td>
<td>$I_E = 0$</td>
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<tr>
<td>Collector-Base Breakdown Voltage</td>
<td>$I_C = 10\mu\text{a}$</td>
<td>$I_E = 0$</td>
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<tr>
<td>Collector-Emitter Breakdown Voltage</td>
<td>$I_C = 10\text{ma}$</td>
<td>$I_E = 0$</td>
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<tr>
<td>Collector-Emitter Transfer Ratio</td>
<td>$V_{CE} = 5\text{v}$</td>
<td>$I_E = -5\text{ma}$</td>
<td>20</td>
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<tr>
<td>A-C Common-Em. Transfer Ratio</td>
<td>$V_{CE} = 5\text{v}$</td>
<td>$I_E = -5\text{ma}$</td>
<td>12</td>
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<tr>
<td></td>
<td>$I_T = -55\text{°C}$</td>
<td>$I_E = -5\text{ma}$</td>
<td>1</td>
</tr>
</tbody>
</table>

Note 1: The voltage at which $h_{FE}$ approaches one when the emitter-base diode is open circuited. This value can be exceeded in applications where the dc circuit resistance ($R_{BE}$) between base and emitter is a finite value.

Note 2: Derate linearly to 175°C case temperature at the rate of 8.0 mw/°C.

Note 3: Derate linearly to 175°C ambient temperature at the rate of 4.0 mw/°C.

Texas Instruments Incorporated

August 12, 1960
It costs less to **RENT AN**

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You can save costly investment in laboratory equipment and staff... and still get top-quality R/D services...by using the complete product testing and evaluation facilities of United States Testing Company. Since 1880 thousands of clients in all industries have used our services to get:

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**Mechanical Laboratory**—evaluates mechanical, electro-mechanical hydraulic and pneumatic devices.

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**United States Testing Co., Inc.**

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Branch Laboratories

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<th>BOSTON</th>
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<td>LOS ANGELES</td>
<td>MEMPHIS</td>
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<td>PHILADELPHIA</td>
</tr>
</tbody>
</table>

The World’s Most Diversified Independent Laboratory.

**Carbon arc lamp printing required more power, space and printing time**

**P-c printing table has 14 black light lamps in frame**

by tip burning. The black light lamps were incorporated in the printing frame, which was counterbalanced and mounted on a table. Savings in floor space amounted to 15 square feet.

The redesigned printing table uses 14 lamps, consuming 1,740 watts. The exposure time required was decreased from 3 minutes to 1 minute. Net energy consumed per exposure is 29 watt-hours compared with 552 watt-hours for an arc lamp.

**Silicon Crystals Are Grown in Copper Tubes**

WATER-COOLED copper tubing enables silicon crystals to be grown by the more rapid horizontal zone refining method. Using the cooled tubing as a container for the silicon overcomes the contamination problem that is usually solved by verti-
Sylvania Electric Products, Inc., reports in its annual Technical Progress that it is making aluminum-doped crystals for microwave diodes by this method. Processing time is about one-fifth that required by the Czochralski techniques, less expensive raw material can be used and more than 80 percent of each ingot is usable. Yield of select material is increased 10 times, the report states.

The basic setup is similar to that used for germanium refining. A heater coil is traversed over a Vycor tube. The hollow copper tubes are arranged in a half-cylinder with manifolds at each end to supply cooling water. This becomes the container for the silicon lumps or particles, which are then premelted. Aluminum is dissolved into one end of the ingot and the zone traversed.

Fixture Indicates Torque During Vibration Testing

TEST FIXTURE which evaluates output torque of magnetic clutches and clutch brakes under vibration has been devised by Dynamic Instrument Corp., Westbury, N. Y. The fixture holds 4 units. Each slips through a close-tolerance aperture on a vertical plate. Spring devices which create the required torque are clamped over the protruding shafts. The devices are graduated in inches-ounces to show torque ratings before, during and after testing. Power is first applied to the units and the devices set to the maximum torque that the units are expected to produce. The fixture is then placed on a shaker table and the tests performed.

NEW FROM WESTINGHOUSE:
STATIC POWER SUPPLIES FOR RADAR

Large static radar power supplies for d-c output call for regulated high power, high voltage. Westinghouse delivers it. Positively precise. Typical equipment now furnished by Westinghouse includes switchgear, voltage regulator, rectifier, resistor and capacitor assemblies, and associated controls. Unlimited power ratings can be delivered. Units rated 1,000 kw are currently available. Before a spec is written, consult Westinghouse. Rectifier assembly opposite is part of power package supplied for BMEWS. For help in solving your static power supply problems, contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

Westinghouse
Crystal Resistors

AID CHECKING

CRYSTAL TYPE resistors made by Filmohm Corp., 48 West 25th St., New York, N. Y., use a metal resistance film and plug in to any component normally using the equivalent crystal type. The plug-in feature allows checking and standardizing independently of crystal impedance.

The resistors, on IN21 or IN23 crystal bodies, are supplied in any value from 25 to 400 ohms with standard 2 percent or 5 percent tolerance.

In manufacturing, the pure metal resistance film is vacuum deposited on ceramic and immediately sealed by an impervious protective coating, making the resistors extremely stable and reliable. Power rating is 1 watt average at 100°C.

Television Camera

WITHSTANDS RADIATION

A SMALL television camera, designed to withstand long exposure to nuclear radiation without damage, has been delivered to the University of California's Radiation Laboratory at Livermore by International Telephone and Telegraph, San Fernando, Calif., manufacturer of the camera. The new camera, which allows atomic radiation to pass through it without harmful effects because of special elements in its construction—including aluminum, magnesium, silicon, titanium and zirconium and nonconventional circuits—permits close inspection of nuclear reactors where radiation is too intense for observation windows or where it is not desirable to use periscopes or other conventional means of inspection.

Named the CM-40, it will be first used in the Atomic Energy Commission's ramjet program. The camera will observe the operation of Tory II-A, an engineering test reactor, during tests, scheduled for later this year at the AEC's Nevada Test Site in southern Nevada, and relay a picture from the reactor site to a control center two miles away.

The picture pickup tube is made of quartz, which is radiation transparent. The lens is made of cerium and silica or of silica alone, depending on how the lens is to be used. Aperture settings and focus of the lens are adaptable to remote control.

Complete cooling under intense heat is made possible by a flow of gas through a heat exchanger built into the aluminum housing. Because no half-lived elements are used in the camera, no special decontamination is necessary following radiation exposure.

Valve Operation Analyzer

AUTOMATIC OR MANUAL

EXACT MEASUREMENT of time intervals in sequential operations of solenoid or relay-actuated components or systems is possible with a new automatic device introduced by Consolidated Avionics Corporation, 800 Shames Drive, Westbury, N. Y. The unit also provides position time plots for such operations as linear or nonlinear valve motion.

Its first application was in the checking of solenoid-operated control valves and associated pneumatic or hydraulic main valves. The unit measures intervals as short as 0.1 millisecond and presents readings in printed form and graphically. Up to 12 sequenti
100 tons of hyper pure water every day to keep crystal surfaces clean

Water is still a reliable cleaning agent. NEC is using 100 tons of it daily in its new semiconductor plant. This is ultra high purity water free of all organics and particles.

After each production step crystal surfaces are washed, rinsed, and dried. This may be 10 or 15 times. There is also ultrasonic cleaning, and just before sealing, electrolytic cleaning.

This devotion to cleanliness shows up in the characteristics, stability, and reliability of NEC semiconductors. After a perfect seal, 100% tested in Krypton isotopes, they offer a failure rate suitable for the most critical applications.

The range of industrial semiconductor products at NEC is perhaps the widest of any manufacturer. The entire production of some types goes into NEC's transistorized communications equipment. Specification sheets are available.
events occurring within a 3-sec span can be automatically timed.

In timing the operation of a solenoid valve, the analyzer gets signals from the discontinuity in electrical wave form caused by energization or de-energization of the solenoid and by completion of solenoid travel. In timing hydraulically or pneumatically operated valves, limit switches at the extremes of valve travel provide timing signals. Operation with relays involves detection of coil energization and closure of contacts.

In addition to automatic operation, a manual mode permits selection of any one of 12 preprogrammed sets of operations set up on a patch board. Timing is started by depressing a button which also energizes an internal source for operation of solenoids. In the manual mode, four events occurring within 1 second may be recorded.

For plotting position time curves of valve operation, useful in bench testing and adjusting, standardized transducer adapter plates are substituted for normal valve plates. Output of the transducer is connected to a high-speed graphic recorder. Open and closed indications from limit switch contacts are also recorded on the graph for reference.

CIRCLE 379 ON READER SERVICE CARD

Switch-Pack Design
CUTS ASSEMBLY COSTS

AN ECCENTRIC or cardiac cam is used in this new packaging technique to actuate a movable printed circuit board. Contact is made with another stationary circuit board, allowing complex switching sequences and at the same time reducing the number of components and solder connections. The patented technique was developed jointly by Ucinite and Graphik Circuits Divisions of United-Carr Fastener Corp.; further information is available from Ucinite Co., 459 Watertown St., Newtonville, Mass.

The package illustrated was developed for an electronic attenuator, manufactured by Electro-Instruments, Inc., San Diego, Calif.

The redesigned circuit simplified the associated circuits so that some thirty component parts, including several jumper wires, were eliminated, along with five soldering operations and a number of separate assembly functions. Terminal connections, instead of having to be soldered on many different and relatively inaccessible surfaces, were concentrated in a single plane on an easily accessible surface.

Utilizing the basic Dot Switch-Pak concept, Ucinite is embarking on a program of development to produce a nucleus of semi-standardized units in which switches and their associated printed circuits can be adapted for use in many applications.

CIRCLE 380 ON READER SERVICE CARD

Voltage Reference
FOR PRINTED CIRCUITS

VOLTAGE reference standards are designed to mount directly on printed circuit boards with standard ½ inch mounting. The standards, which operate directly from unregulated d-c power sources, are manufactured by Viking Industries Inc., 21343 Roscoe Blvd., Canoga Park, Calif.

The units are designed to provide a voltage reference having a temperature coefficient of ±0.005 percent per degree C from 0 through +60 C. Output voltages of 5.8, 8.5, or 10.5 volts d-c, ±5 percent, have a regulation of ±0.005 percent for a d-c input variation of ±10 percent.

The entire package is 1½ by 1½ by ⅜ inch; price range is $60.00, with delivery in one to three weeks.

CIRCLE 381 ON READER SERVICE CARD

Digital Readout Device
USES STEPPING MOTOR

A DIGITAL readout device that uses a stepping motor operating on pulses from a predetermined code has been developed by Sigma Instruments, Inc., 80 Pearl St., So. Braintree, Mass. The device, Series 9D digital readout, is for computers or other instruments requiring accurate digital display.

The number display drum, which is driven by the Sigma Cyclonome, a patented high-speed stepping motor, moves one position for each full a-c cycle or d-c pulse that is received. When the desired position is reached, brushes on the number
Instructor G. E. Olsen explains servomechanism control principles to student L. P. Hilton in laboratory of nationally-known Electronics Institute, Detroit.

SOUTHEASTERN MICHIGAN'S SCIENTIFIC CLIMATE—
a stimulating environment for electronics firms. The fast-moving electronics industry relies on skilled technicians to assist in the development and production of electronic materials and systems, well schooled technical graduates like those accredited by the Electronics Institute, Detroit. And the Institute is but one sample of the technical schools in this area.

They all are important contributors to the scientific climate of Southeastern Michigan—an invaluable, local resource that should interest electronics firms. It's a resource which encompasses a complete range of educational facilities, from trade schools to pioneering research opportunities at world-famous universities.

Southeastern Michigan possesses other resources. In the area are many progressive communities which have well-founded plans for industrial growth. All the basic elements now considered necessary for the mutual growth and prosperity of a community, and the industry it contains, have been provided.

If you are looking for a site which offers the right environment and growth conditions, write for information to Detroit Edison, Plant Location Service, Area Development Division, Detroit 26, Michigan.
Bendix Craftsmanship at work for you

BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 6116/TE-39 Klystron tube combines ruggedized construction and thermal tuning. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than ±1.3 MC... at vibration levels up to 10 G at 50 cps. Thermal tuning provides a twofold advantage. It permits tuning the tube over its entire operating frequency remotely without mechanical means—and the tube can be repeatedly cycled throughout its tuning range without damage or deterioration.

These Reflex Klystrons are but one example of how Bendix Red Bank technology can help you meet specialized tube needs. For information on these tubes... and on backward-wave oscillators and traveling-wave tubes... write RED BANK DIVISION, THE BENDIX CORPORATION, EATONTOWN, NEW JERSEY.

![Image](image_url)

### Toshiba Electron Tubes and Semiconductors

#### 1) Semiconductors

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*One in a Series*

*Dependable source for entertainment transistors*

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West Concord, A Strobotac is a instrument designed for measurement and study of speeds of up to 250,000 ft. features a specially-built electron lamp, housed in a swivel-
SOUTHEASTERN MICHIGAN'S SCIENTIFIC CLIMATE—
a stimulating environment for electronics firms. The fast-moving electronics industry relies on skilled technicians to assist in the development and production of electronic materials and systems, well schooled technical graduates like those accredited by the Electronics Institute, Detroit. And the Institute is but one sample of the technical schools in this area.

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<td>Single 1S50</td>
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<td>Gold bond 1S73, 82</td>
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NPN 2SC11, M8062, M8084

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<td>7309</td>
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4) Special Tubes

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<td>Image Amplifier 7018</td>
<td>Photo Tube 7309</td>
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<td>DK20, 22</td>
<td>2Etatron D-15-2</td>
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</tbody>
</table>

With monthly production of 4 million units, Toshiba leads the field in Japan's big semiconductor industry. These products can be classified among those of leading international suppliers in low failure rate, long life, and high power efficiency. Specification sheets for semiconductors and electron tubes may be obtained from Toshiba.

See Toshiba semiconductors and electron tubes at WESCON Booth 2410.
It's no accident that Gudelace is the best lacing tape you can buy. Excellence is engineered into Gudelace. A sturdy nylon mesh is meticulously combined with the optimum amount of special microcrystalline wax. Careful selection of raw materials and superior methods of combining them give Gudelace outstanding strength, toughness, and stability. Gudelace is the original flat lacing tape which distributes stress evenly over a wide area. It is engineered to stay flat; it will not stretch out of shape when pulled. Gudelace's nonskid surface prevents slipping, eliminating the too-tight pull that causes strangulation and cold flow. Durability and dependability make Gudelace your most economic buy—with no cut insulation, fingers, or feelings.

Write for Data Book with specifications on Gudelace and Gudebrod's complete line of braided lacing tapes and dial cords—Temp-Lace, Stur-D-Lace, and Gude-Glass.

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CIRCLE 300 ON READER SERVICE CARD

CIRCLE 382 ON READER SERVICE CARD

CIRCLE 383 ON READER SERVICE CARD

drum engage a wafer switch which, in turn, trips an external halting relay. Code signals include a 5-wire, 10-position code and a four-digit excess-3 binary code. Other codes are possible by using different wafer switches.

Operating power is approximately 4 watts max., which is required to drive the motor; the unit does not require standby power. Operation is by either d-c pulses or a-c. Other major specifications are: display—up to 11 characters; operating speed—proportional to input frequency; expected life—20,000,000 indications min.; display aperture dimensions—⅜ in. high by ⅜ in. or 1 in. high by ⅜ in. depending on model.

Ferrite Circulator

A COMPACT K,-band ferrite tee circulator that will handle 20 Kw peaks and average power of 20 watts has been introduced by the Airtron Division of Litton Industries, 200 East Hanover Ave., Morris Plains, N. J.

Size of the circulator is 1½ inch cube. Ferrites used in the device were developed by Airtron's ferrite materials laboratory, and are biased by Alnico V magnets. Isolation between channels is 20 db minimum, with maximum insertion loss of 0.5 db. Design frequency is 34.5 to 35.1 Gc, providing a 0.6 Gc bandwidth. Maximum vswr is 1.20.

The circulator is designed for use with RG 96/U waveguide, with internal dimensions of 0.28 by 0.14 inches, and mates with a modified UC 600/U flange.

Analog to Digital

MULTI-MC CONVERTER

A NEW FAMILY of high speed subminiature translators with 5 to 30

specify

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CIRCLE 165 ON READER SERVICE CARD
BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

The 6116/TE-39 Klytron tube combines ruggedized construction and thermal tuning. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than ±1.3 MC... at vibration levels up to 10 G at 50 cps. Thermal tuning provides a twofold advantage. It permits tuning the tube over its entire operating frequency remotely without mechanical means—and the tube can be repeatedly cycled throughout its tuning range without damage or deterioration.

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Pulse Generator
HIGH REPEITION RATE

RUTHERFORD ELECTRONICS CO., 8944 Lindglade St., Culver City, Calif. Model B-7B high repetition rate, low cost pulse generator is rack mountable and compact. Amplitude is 50 v delivered into a 50 ohm load; delay with respect to sync out, 0-10,000 µsec; width, 0.5 µsec—10,000 µsec; repetition rate, 20 cps to 2 Mc.

Tachometer
STROBOSCOPIC

GENERAL RADIO CO., West Concord, Mass. Type 1581-A Strobotac is a small, portable instrument designed for the measurement and study of machine speeds of up to 250,000 rpm. It features a specially-built Strobotron lamp, housed in a swivel-
Model 16-92 is the latest example of creative versatility from ESC, America's largest producer of custom-built and stock delay lines. The specifications: 1/10 usec. delay, 1,600 ohm impedance, $\frac{1}{4}$" x $\frac{1}{4}$" x $\frac{1}{2}$" dimensions. Only ESC produces so many different delay lines, for so many varied applications. From the largest to the smallest, ESC has the best, most economical answer to your particular delay line problem. Write today for complete technical data.

*shown actual size

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Distributed constant delay lines • Lumped constant delay lines • Variable delay networks • Continuously variable delay lines • Step variable delay lines • Shift registers • Video transformers • Filters of all types • Pulse-forming networks • Miniature plug-in encapsulated circuit assemblies

August 12, 1960
The big difference in
MIL-C-13777B
Neoprene Jacketed Cables!

BRAND-REX CABLEMANSHIP

Missilemen, especially, know the advantages of neoprene jacketed cables... low temperature flexibility, abrasion resistance, and resiliency. And missilemen who are also cablemen know it pays at the count down to count on Brand-Rex Cablemanship! And you should too. For there's more to the absolute reliability of Brand-Rex cables than just rigid inch-for-inch adherence to specifications!

Brand-Rex Cablemanship involves technology and skill, of course. But there's much more. Add broad cable engineering services through a tightly-knit organization of progressive cablemen backed by the vast resources of the American Enka Corporation. Then consider the production capability of three modern quality-controlled plants strategically located from coast to coast. When you include instantly available technical field service... then, you have Brand-Rex Cablemanship! Then you know why Brand-Rex neoprene jacketed cables have an envied record for absolute reliability.

Whatever your requirements for wire or cable, no matter how rigid your specifications for conductors, lay-up patterns, insulation, shielding or armoring, count on the Cablemanship of Brand-Rex. Information and samples available upon request.

Left: Resiliency and low-temp flexibility make Brand-Rex MIL-C-13777B neoprene jacketed cable ideal for missile ground control. Center: Polyethylene insulated primaries, neoprene jacketed, positioned in the cable exactly as per spec. Right: Brand-Rex quality control procedures cover every step of manufacture.
hinged parabolic reflector, which emits brilliant, white-light flashes over a range of 110 to 25,000 per minute—up to 7 million peak candlepower for single flashes and 1-6 μsec in duration. The intense light and extremely short duration permits optical “stopping” of very fast action even in brightly-lighted areas. The accuracy of speed measurement is ±1 percent of the dial reading after calibration check against line frequency. Unit is priced at $260.

CIRCLE 391 ON READER SERVICE CARD

Voltmeter
HIGHLY VERSATILE
HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model 411A vtvm has a voltage range of 1 mv to 10 v. It measures small voltages to 1,000 Mc with the convenience and accuracy associated with audio-frequency voltage measurement. Unit includes a linear scale for maximum resolution and high accuracy. Instrument has seven ranges, 1 mv to 10 v, and the meter includes a db scale for readings from —42 to +33 db. Accuracy is ±3 percent, 1 Mc to 50 Mc, and ±6 percent from 50 Mc to 150 Mc. Five probe tips provide maximum usefulness for the voltmeter.

CIRCLE 392 ON READER SERVICE CARD

Spectrum Equalizer
AUTOMATIC UNIT
MB ELECTRONICS, 781 Whalley Ave., New Haven 8, Conn. The AE 80/25 automatic spectrum equalizer for random motion vibration test systems uses the multi-band compensation principle. In this approach

CIRCLE 169 ON READER SERVICE CARD
DELTEX
RELIABILITY by DESIGN

The design and production of precision electronic equipment has been the specialty of the laboratory of Delta Exploration Company, Inc. since 1948. Now under the name of DELTEX, this same quality workmanship and production control is available for production items listed below as well as your special design problems.

OPERATIONAL AMPLIFIERS
Metal enclosure insures physical rigidity and electromagnetic isolation. These modules are physically and electrically interchangeable with equivalent amplifiers presently in use.

TRANSISTORIZED POWER SUPPLIES
Unregulated, transistor regulated, or mag amp regulation. Standard models for 12 volt input, 150 to 400 volt output at 70 to 200 ma. Other input and output on request.

MINIATURE HI-VOLTAGE SUPPLY
Fully transistorized for use with photo multiplier tubes, ionization chambers and GM tubes. Smaller than a pair of standard flashlight batteries. Input of 3 to 5 volts delivers 1500 to 2500 volts out.

LOW FREQUENCY FILTERS
These filters use Chebyshev design for high cut-off rate in a small package. Both high cut and low cut with attenuation rates to 120 db per octave. Ten cut-off frequencies from 125 cycles per second down to 18 cycles per second.

LOW FREQUENCY DELAY LINES
Delay from 0.5 milliseconds to excess of 150 milliseconds with 0.1% harmonic distortion at frequencies from 10 to 250 cycles per second. Various forms available including automatic programed delay functions, and miniature models.

DELTEX LABORATORIES
P. O. Drawer 2666
JACKSON, MISSISSIPPI
Fleetwood 5-9636
A DIVISION OF DELTA EXPLORATION CO., INC.

the spectrum is divided into 25 cps increments. By using solid state magnetostrictive filters with correct phase properties plus servo regulators on each of 80 channels in the 15 to 2,000 cps spectrum, vibration shaker systems can be automatically equalized in seconds. Time and labor costs for system equalization are drastically reduced, the company says. Design features in the equalizer include low distortion, rapid correction consistent with filter bandwidth, high accuracy and minimum ripple at filter crossover.

CIRCLE 393 ON READER SERVICE CARD

Pulse Counter
FOR PARALLEL ENTRY

PESSIN CO., 2014 Broadway, Santa Monica, Calif. EZ 10/0 is a single wheel electromagnetic counter designed for parallel entry. These elements, only 2 in. wide, 11 in. high and 3½ in. deep, may be stacked on common studs to the number of decades desired. The number wheels with digits 0-9, ½ in. high, are positioned individually by pulse at stepping rates to 10 per sec. Provision is made for automatic reset to zero. Standard 24 v d-c; other coils from 6-60 v. Also models with raised figure wheels for printing. Price $9.80 (quantity discounts to 40 percent). Availability: Stock.

CIRCLE 394 ON READER SERVICE CARD

Coax Frequency Meter
THREE-BAND RANGE

FXR, INC., 25-26 50th St., Woodside 77, N. Y., has a direct reading coaxial frequency meter, model N414A, with a range from 3,950 to 11,000 Mc. This coverage of over
In these rooms infinitesimal air-borne contaminants are scientifically whisked from the air...away from super-precision miniature ball bearing parts. New Departure's White Rooms date back nearly twenty years. And today, they're a major factor in N/D's growing recognition as a leader in M/I ball bearing reliability.

At N/D, miniature ball bearings are completely assembled in properly humidified, temperature controlled atmospheres. Advanced air filter systems completely change the air in these spotless rooms every few minutes. In addition, pressurized access air locks and individual counter-top pressurized chambers are used by N/D's skilled technicians during final assembly and statistical inspections.

These methods and equipment are only a few of the reasons why more and more major missile contractors, today, rely on New Departure Miniature and Instrument ball bearings.

If you are working on a new miniature ball bearing application where reliability is critical, include an N/D Sales Engineer in your design discussions. Call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.
The coil shown above is a \( \frac{1}{4}'' \) residual I.D. toroid being wound by machine on Boesch's new Model MW400 MINITOR. It's the smallest machine-wound coil ever made (only half as large as the smallest previously available), and it can only be wound on MINITOR!

This achievement reflects a completely new, unique method of coil winding perfected by Boesch. The wire is loaded inside a hollow, round cross-section shuttle, and the winding is spun out. A single loading of this unique shuttle is usually enough to wind several coils.

MINITOR handles wire sizes from \#36 to \#50 AWG, and winds up to 500 turns per minute. Maximum finished coil size is \( \frac{3}{4}'' \).

Shuttles for MINITOR are loaded by a Boesch PW-100 Loader. This machine can service as many as 20 winding machines, and it can load needles for hand winding as well.

If you now own a Boesch SM series machine, you can convert it to MINITOR operation economically by buying a 400-200 Head, a 400-300 Core Rotating Assembly, and the PW-100 Loader.

Tantalum Capacitors
TEN CASE SIZES

INTERNATIONAL ELECTRONIC INDUSTRIES, INC., Nashville, Tenn. Manufactured in accordance with MIL-C-3965, these tantalum capacitors are available in either polar or non-polar type plain or etched foil. They are built to operate over a temperature range from \(-44\) C to \(+85\) C without voltage derating, are available in a voltage range from 3 wvdc to 150 wvdc and carry a d-c surge rating of 116 percent of rated working voltage. Recommended for use in both military and industrial electronic equipment, they are offered in 10 case sizes.

Miniaturized Pot
WIREWOUND

BORG EQUIPMENT DIVISION, Amphenol-Borg Electronics Corp., 120 S. Main St., Janesville, Wisc. The
Here's a Memory Switch You Won't Forget...

A Full Line of Clare Stepping Switches with Many Improved Features

Type 210
Has 10 points, with as many as 120 contacts in twelve 10-point levels or four 30-point levels.

Type 211
Offers up to 132 contact points on twelve 11-point levels or four 33-point levels.

Type 20
Up to 480 contact points in twelve 40-point levels or 320 in sixteen 20-point levels.

Type 26
Up to 624 contact points in twelve 52-point levels or 416 in sixteen 26-point levels.

Direct Drive
Up to three 10-point levels, plus an off position.

The New

Cam-Operated Type 200 offers a program control unit in reduced space and with simpler wiring. Actuating cams can be cut with a sequence of notches and lobes programmed to meet the contact switching desired. In addition, the Type 200 acts as a memory switch of unusual dependability and long life.

Operating life is measured in millions of steps. Over 30,000,000 operations have been logged with two cams and a 36-tooth ratchet; 10,000,000 with eight cams. Models are available with from 1 to 8 cams. Operating speed is 60 sps, self-interrupted, 30 sps, remote-impulsed.

The Type 200, as are all Clare stepping switches, is available with a wide variety of hermetically sealed enclosures or dust covers to insure precise operation under all conditions.

Production quantities available in late fall. Send for Bulletin CPC-7.

C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., P. O. Box 134, Downsview, Ontario.
Cable Address: Clarelay

Relays and Related Control Components

Most Complete Stepping Switch Catalog ever offered!
Complete data on construction features, circuitry, performance characteristics and application advantages of the entire Clare line.

Send for Catalog 202 today
"For Bulletin, CPC-7" please circle number 162.
For catalog 202 please circle number 173.
Ballantine's Model 310-A is particularly valuable where precise voltage measurements must be made over a wide range of frequencies and voltages. As a null detector the signal input may be as low as 10 microvolts. The 10 cps to 2 mc calibrated amplifier feature adds usefulness in other applications.

The 310-A is in its 11th year of successful production. A continuing product improvement program has resulted in this "A" version.

**Input Impedance**
- 2 megohms shunted by 10 pf except 19 pf on two most sensitive ranges.

**Null Detector**
- 5 cps to 4 mc.

**Broad Band Amplifier**
- Max. voltage gain 60 db; max. output voltage is 1 volt; output impedance 500 ohms. Flat within 1 db.

**Accuracy**
- 3% from 15 cps to 1 mc, and 5% below 15 cps and above 1 mc, AT ANY POINT ON METER SCALE.

**Scale**
- Usual Ballantine log voltage and linear db.

**Accessories**
- See Ballantine catalog for shunts, amplifiers, inverters to extend usefulness.

**Power Supply**
- 115 or 230 v, 50-420 cps, 35 watts.

**Special Versions**
- 19 inch relay rack is Model 310A-S2. Ask about other versions.

---

**Ballantine Sensitive Electronic Voltmeter**

Model 310-A

![Voltmeter Image]

2100 series ¼ in. diameter wire-wound Micropots are available in 10-turn and 3-turn models. Assemblies of this series are capable of withstanding more than 1,000,000 revolutions without exceeding total resistance or linearity tolerances. Total resistances to 100,000 ohms are offered. Two types of mountings, servo and bushing, are available. Starting torque for servomount models is less than 0.4 oz/in.; and less than 0.5 oz/in. for bushing-mount models. The 2100 series is gangable. Two types of linearity, independent or zero-based, are offered. All units are able to withstand 1,000 v rms applied between the shaft and all terminals without damage, arc or breakdown.

**CIRCLE 397 ON READER SERVICE CARD**

**T-W Tubes**

LOW NOISE FACTOR

HUGGINS LABORATORIES, 999 E. Arques Ave., Sunnyvale, Calif. The HA-70 twt operates with an extremely low noise factor in the 1 to 5 mw power range. It is focused in a 750 gauss solenoid. It has a noise figure of 7 db maximum, 25 db gain minimum, 1 mw saturation power output minimum, frequency range of 2,300 to 3,400 Mc. Minimum of 70 db back attenuation. The tube is 22.4 in. long and 1 in. in diameter. Warranted for 1,000 hr, the HA-70 has lasted in actual performance in many cases three to four times this period.

**CIRCLE 398 ON READER SERVICE CARD**

**Elapsed Time Indicator**

MINIATURE UNIT

BOWMAR INSTRUMENT CORP., 8000 Bluffton Rd., Ft. Wayne, Ind. A decimal type counter with large
**TETRAC**...The first truly advanced large parabola design—engineered for operational accuracy in any environmental condition!

**TETRAC** design and construction is a technological breakthrough for larger, highly accurate radar reflectors. **TETRAC** is highly modular, resulting in low manufacturing costs and simplified transportation and assembly.

**ANTENNABILITY**—in a word, describes **TETRAC**'s Produc-ability—Erect-ability—St-ability—Reflect-ability—Reli-ability

For complete Technical Data, write to:

NARMCO MANUFACTURING
DIVISION OF NARMCO INDUSTRIES, INC.
SUBSIDIARY OF TELECOMPUTING CORPORATION
5350 Baltimore Drive, La Mesa, California - Phone: (800) 917-1

See us at Wescon Booth 447-448 CIRCLE 175 ON READER SERVICE CARD
HST HYBRID—ISOLATION TRANSFORMER
Has Universal Application in Signal Circuits

APPLICATION: Used to isolate an unwanted signal in certain parts of a circuit yet allows the same signal to be used in other parts of the circuit. HI-0394 may be used inverted.

TEST CIRCUITS FOR LONGITUDINAL BALANCE

Specifications—Model HI-0394

<table>
<thead>
<tr>
<th>Nominal Input</th>
<th>Total Primary @ 60 ma DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 ± 25 db</td>
<td>&gt; 75 db</td>
</tr>
<tr>
<td>1000 ± 20 db</td>
<td>&gt; 50 db</td>
</tr>
<tr>
<td>500 ± 15 db</td>
<td>&gt; 30 db</td>
</tr>
<tr>
<td>200 ± 10 db</td>
<td>&gt; 20 db</td>
</tr>
<tr>
<td>100 ± 5 db</td>
<td>&gt; 15 db</td>
</tr>
<tr>
<td>50 ± 2.5 db</td>
<td>&gt; 10 db</td>
</tr>
<tr>
<td>≥ 25 db ± 12.5%</td>
<td>≥ 10 db</td>
</tr>
</tbody>
</table>

| Longitudinal Balance | =20 LOG R1/R2 and 20 LOG R1/R2 |

Longitudinal Balance = 20 LOG R1/R2 and 20 LOG R1/R2

R1/R2 = 0.1%  R1 + R2 = 600 ± 0.5% OHMS

Visit Our WESCON Booths 2423 and 2424

Digital Voltmeter
ALL-ELECTRONIC
NON-LINEAR SYSTEMS, INC., Del Mar, Calif. The V44 all-electronic digital voltmeter is designed for measuring and data logging applications that demand maximum speed with stability and reliability matching that of electromechanical instruments. It makes 200 readings per sec in ranges of ±9.999/99.99/999.9 v d-c. Accuracy is ±1 digit and its input impedance is 10 megohms. Unit has no pots at all in its decade circuits. All basic circuitry is mounted on plug-in modules for maximum ease and speed of servicing. Price is $6.150.

CIRCLE 399 ON READER SERVICE CARD

Ratio Bridge
SELF-NULTING
GERTSCH PRODUCTS, INC., 3211 S. La Cienega Blvd., Los Angeles 16, Calif. Model CRB-3 complex ratio bridge is self-nulling and gives a digital reading of both quadrature and in-phase ratios simultaneously. Both components are nulled automatically. Average time for a read-
The LEL TP-5 Telemetry Preamplifier is designed to be installed at a telemetry receiving antenna. The unit is weatherproofed for outdoor use. Ceramic tubes are used to provide a low noise figure and stable performance without forced air cooling.

Specifications:
- Gain: 23db
- Bandpass: 215-260mc
- Noise Figure: 3.5db Typical
- Weight: 6 lbs.
- Size: 7-7/8" x 8" x 4-3/4"

Send for comprehensive Microwave, IF, RF Amplifier Catalog.

CIRCLE 263 ON READER SERVICE CARD

The Oki Klystron 50V10 Makes Possible Greater Stability and Output Than Ever Before

The 50V10 is a reflex Klystron for 6mm band and is tunable over a range of from 6mm to 7mm. The nominal output is 40mW at 48,000 MC. Ample, stable output power of approximately 100mW can be obtained with this Klystron which is vastly superior to that of conventional types used hitherto in this band. Besides, we are manufacturing various types of Millimeter Wave Tubes as listed below.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Model No</th>
<th>Frequency Range</th>
<th>Power Output</th>
<th>Operating Voltage</th>
<th>Operating Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klystron-1</td>
<td>35V10</td>
<td>33.27K-33.37KMC</td>
<td>40mW</td>
<td>2,000V</td>
<td>12mA</td>
</tr>
<tr>
<td>2</td>
<td>35V11</td>
<td>33.50-33.67KMC</td>
<td>50mW</td>
<td>2,300V</td>
<td>25mA</td>
</tr>
<tr>
<td>3</td>
<td>50V10</td>
<td>43.61-43.80KMC</td>
<td>100mW</td>
<td>2,300V</td>
<td>30mA</td>
</tr>
<tr>
<td>4</td>
<td>1070V10</td>
<td>65.75-66.00KMC</td>
<td>14</td>
<td>3,000V</td>
<td>35mA</td>
</tr>
<tr>
<td>Magnetron-1</td>
<td>24M10</td>
<td>24.000MC-24.100MC</td>
<td>50KW</td>
<td>13KV</td>
<td>15A</td>
</tr>
<tr>
<td>2</td>
<td>33M10</td>
<td>32.600-32.900MC</td>
<td>50KW</td>
<td>13KV</td>
<td>18A</td>
</tr>
<tr>
<td>3</td>
<td>35M10</td>
<td>34.300-34.600MC</td>
<td>50KW</td>
<td>13KV</td>
<td>16A</td>
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<tr>
<td>4</td>
<td>50M10</td>
<td>50.000-50.300MC</td>
<td>70</td>
<td>12KV</td>
<td>14A</td>
</tr>
</tbody>
</table>

For further information write us, using Circle Reader Service Card.

CIRCLE 177 ON READER SERVICE CARD

OKI ELECTRIC INDUSTRY CO., LTD. TOKYO JAPAN

CIRCLE 177 ON READER SERVICE CARD

August 12, 1960
Safe. Easy to operate.
Rate of voltage application conforms to ASTM standards. Portable models. Floor mounted models.

These Sorensen a-c and a-c/d-c testers completely cover the voltage range from 0-150,000 vac and 0-300,000 vdc with current capacities as high as 4000 milliampere a-c (plus 5 milliampere d-c for the a-c/d-c units).

All components are conservatively rated to insure maximum life and top performance. Maximum rated current can be drawn continuously over the entire output range and overloads may be supplied for a short time to "burn" faults. Easily reversible d-c polarity of a-c/d-c testers.

New Catalog. Just off the press, Sorensen's new 32-page catalog gives technical data on the complete line of Sorensen a-c and a-c/d-c testers as well as on Sorensen h-v d-c supplies, h-v electrostatic generators, low-voltage d-c power supplies, a-c line-voltage regulators, and frequency changers. Extensive power supply application data is also given. Write for your copy today. Sorensen & Company, Richards Ave., South Norwalk, Conn.

Laboratory Recorder
MAXIMUM FLEXIBILITY
THE BRISTOL CO., Waterbury 20, Conn. New Dynamaster potentiometer recorder is especially adapted to laboratory and test requirements. Input signal selection switches and span adjustments provide maximum flexibility. A four-position input selector switch provides for millivolt, volt, microampere, or milliampere input. A five-position span selector offers ranges 0-2, 0-5, 0-10, 0-25, and 0-50. A continuously adjustable span from 0-2 and 0-50 is also available. Adjustable zero and pushbutton standardization are standard. Automatic standardization (for long-duration test work) is optional. Attachments offered include: a dual-speed chart-drive, or a multispeed chart-drive (six speeds); a time pen (for making reference points in test work); chart-footage indicator (amount of unused chart); manual chart rewind (for easy comparisons); manual or electric pen lifters; and retransmitting slide-wires.

Insulation Sleeving
MANY TYPES
SUFLEX CORP., 33-30 57th St., Woodside, N. Y., announces a complete line of coated insulation tubing and sleeving in temperature ranges from 105 C to 230 C, in varnished cottons and rayons, varnished fiber glass, vinyl glass, silicon resin and silicon rubber fiber glass, silverflex...
NEW THUMB INDEX FOR FAST FINDING

Buy All these leading lines of Relays

From this ONE catalog
Immediate delivery from stock
Factory Prices

Write for your personal copy
of this catalog TODAY!

RELAY SALES, INC.
P.O. BOX 186-A, WEST CHICAGO, ILL.
JENNINGS VACUUM RELAYS AND CAPACITORS

...when reliability counts

Jennings Vacuum Relays and Variable Capacitors play an important role in the Air Force’s “Project Sideband,” aimed at constant radio contact on intercontinental missions.

The high standards of reliability and performance required by the Air Force were more than met by Collins Radio Company’s new 1 KW SSB system for “Project Sideband.” The airborne end of the system, designated ARC-58, includes an automatically tuned antenna coupler. Jennings vacuum relay, RB3, and vacuum variable capacitor, USLS 465, are used in the coupler to match the 52 ohm impedance of the equipment with the antenna.

Jennings vacuum components were chosen for their recognized ability to withstand high voltage in limited space applications. The Type RB3 vacuum transfer relay is designed to meet peak voltages of 15 kv and rf currents to 15 amps yet it is only 3½ inches long. The relay also has an auxiliary set of low voltage contacts for control purposes designed to operate after and release before the high voltage set. The Type USLS 465 is only 5 inches long and will withstand 10 kv at its minimum capacity of 5 mmfd and 5 kv at its maximum capacity of 465 mmfd. Both units will withstand 10G vibration to 500 cycles, 90G shock, and 50 hours salt spray.

Send for catalog literature on Jennings complete line of vacuum capacitors and relays.

JENNINGS RADIO MANUFACTURING CORPORATION
970 McLaughlin Ave., P. O. Box 1278  SAN JOSE 8, CALIF

heat treated fiber glass, and featuring Isolastube, a fiber glass based isocyanate coated material, designated Class F, guaranteed for continuous performance of 155 C.

CIRCLE 403 ON READER SERVICE CARD

Recorder/Reproducer
MAGNETIC TAPE
MINNESOTA MINING AND MFG. CO.,
2049 S. Barington Ave., Los Angeles 25, Calif. The CM-100 is an all-transistorized instrumentation recorder/reproducer used in a broad range of telemetering applications. System features modular construction, dynamic braking, instantaneous selection of six speeds with no belt changes, and d-c top plate. It is insensitive to power variations, and thus provides continuous maximum performance and reliability. Overall speed bandwidth is 50 cps to 120 Kc. The CM-100 is a multispeed video band recorder/reproducer which combines the capabilities of both analog and pulse recording in a single rack. At 120 ips, it achieves a frequency range of 400 cps to 1.0 Mc on each of the seven video tracks.

CIRCLE 404 ON READER SERVICE CARD

Crystal Oven
COMPACT UNIT
MONITOR PRODUCTS CO., 815 Fremont, South Pasadena, Calif. New precision crystal oven, developed
### Wide Range Models

<table>
<thead>
<tr>
<th>D.C. Output</th>
<th>Volts</th>
<th>Amps</th>
<th>Model Number</th>
<th>Dimensions in Inches</th>
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<tr>
<td></td>
<td>0.2</td>
<td>0.30</td>
<td>TO7-30</td>
<td>15% 16 16</td>
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<tr>
<td></td>
<td>0.7</td>
<td>0.15</td>
<td>TO7-15</td>
<td>8% 19 15</td>
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<tr>
<td></td>
<td>0.7</td>
<td>0.15</td>
<td>TO7-10</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>0.15</td>
<td>TO7-0.7</td>
<td>7% 19 15</td>
</tr>
<tr>
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<td>0.14</td>
<td>0.20</td>
<td>TO14-20</td>
<td>15% 16 16</td>
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<td></td>
<td>0.14</td>
<td>0.20</td>
<td>TO14-10</td>
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</tr>
<tr>
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<td>TO14-7.5</td>
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<td>0.15</td>
<td>TO32-15</td>
<td>8% 19 15</td>
</tr>
<tr>
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<td>0.15</td>
<td>TO32-10</td>
<td>8% 19 15</td>
</tr>
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<td></td>
<td>0.22</td>
<td>0.15</td>
<td>TO32-0.7</td>
<td>7% 19 15</td>
</tr>
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<td>TO36-30</td>
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<td>TO36-15</td>
<td>8% 19 15</td>
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<td>TO36-10</td>
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<td>0.15</td>
<td>TO36-0.7</td>
<td>7% 19 15</td>
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<td></td>
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<td>0.15</td>
<td>TO36-7.5</td>
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<td>TO60-15</td>
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<td>0.60</td>
<td>0.15</td>
<td>TO60-0.7</td>
<td>7% 19 15</td>
</tr>
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<td></td>
<td>0.60</td>
<td>0.15</td>
<td>TO60-7.5</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>0.60</td>
<td>0.15</td>
<td>TO60-10</td>
<td>8% 19 15</td>
</tr>
</tbody>
</table>

*Models marked with an asterisk are programmable.

### Narrow Range Models

<table>
<thead>
<tr>
<th>Narrow Range Models</th>
<th>Volts</th>
<th>Amps</th>
<th>Model Number</th>
<th>Dimensions in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.75</td>
<td>0.20</td>
<td>T6-30</td>
<td>15% 16 16</td>
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<tr>
<td></td>
<td>5.75</td>
<td>0.15</td>
<td>T6-15</td>
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<td>5.75</td>
<td>0.15</td>
<td>T6-10</td>
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<td></td>
<td>5.75</td>
<td>0.15</td>
<td>T6-0.7</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>7.11</td>
<td>0.15</td>
<td>T8-15</td>
<td>8% 19 15</td>
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<tr>
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<td>7.11</td>
<td>0.15</td>
<td>T8-10</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>7.11</td>
<td>0.15</td>
<td>T8-0.7</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>11.14</td>
<td>0.20</td>
<td>T12-15</td>
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<tr>
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<td>11.14</td>
<td>0.15</td>
<td>T12-10</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>11.14</td>
<td>0.15</td>
<td>T12-0.7</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>11.14</td>
<td>0.15</td>
<td>T12-7.5</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>14.17</td>
<td>0.15</td>
<td>T16-15</td>
<td>8% 19 15</td>
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<tr>
<td></td>
<td>14.17</td>
<td>0.15</td>
<td>T16-10</td>
<td>7% 19 15</td>
</tr>
<tr>
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<td>14.17</td>
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<td>T16-0.7</td>
<td>7% 19 15</td>
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<tr>
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<td>0.15</td>
<td>T19-15</td>
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<td>0.15</td>
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<td>7% 19 15</td>
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<td>17.20</td>
<td>0.15</td>
<td>T19-0.7</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>20.23</td>
<td>0.15</td>
<td>T22-15</td>
<td>8% 19 15</td>
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<tr>
<td></td>
<td>20.23</td>
<td>0.15</td>
<td>T22-10</td>
<td>7% 19 15</td>
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<tr>
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<td>20.23</td>
<td>0.15</td>
<td>T22-0.7</td>
<td>7% 19 15</td>
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<tr>
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<td>23.27</td>
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<td>T25-30</td>
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<tr>
<td></td>
<td>23.27</td>
<td>0.20</td>
<td>T25-15</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>23.27</td>
<td>0.20</td>
<td>T25-10</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>23.27</td>
<td>0.20</td>
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<td>7% 19 15</td>
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<tr>
<td></td>
<td>25.21</td>
<td>0.20</td>
<td>T28-30</td>
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<td>T28-15</td>
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<td>0.20</td>
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<td>25.21</td>
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<td>31.25</td>
<td>0.15</td>
<td>T32-20</td>
<td>8% 19 15</td>
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<td>31.25</td>
<td>0.15</td>
<td>T32-15</td>
<td>7% 19 15</td>
</tr>
<tr>
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<td>31.25</td>
<td>0.15</td>
<td>T32-10</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>31.25</td>
<td>0.15</td>
<td>T32-0.7</td>
<td>7% 19 15</td>
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<tr>
<td></td>
<td>31.25</td>
<td>0.15</td>
<td>T32-7.5</td>
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<td></td>
<td>33.55</td>
<td>0.15</td>
<td>T35-30</td>
<td>8% 19 15</td>
</tr>
<tr>
<td></td>
<td>33.55</td>
<td>0.15</td>
<td>T35-15</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>33.55</td>
<td>0.15</td>
<td>T35-10</td>
<td>7% 19 15</td>
</tr>
<tr>
<td></td>
<td>33.55</td>
<td>0.15</td>
<td>T35-0.7</td>
<td>7% 19 15</td>
</tr>
</tbody>
</table>

*All narrow range models are programmable.

**REGATRAN® SEMICONDUCTOR POWER SUPPLIES**

**SPECIFICATIONS**

- **Regulation:** 0.03% or 0.01 V from no load to full load and 105 to 125 V line. (0.1% or 0.01 V for 3-amp models.)
- **Ripple:** Less than 1 millivolt rms.
- **Input:** 105 V to 125 V, 50 to 60 cps.
- **Circuit Protection:** Four-year field-tested electronic and electrical circuit protection.
- **Mounting:** Rack and table.

*0.01% or 0.003 V regulation available on special order.

**REQUEST BULLETIN 721A.**

---

**August 12, 1960**

**CIRCLE 181 ON READER SERVICE CARD**
Another "impossible" job done by the Airbrasive...

...cutting tungsten

abrading • cutting • deburring • stripping • drilling • cleaning • scribing

Comstock & Wescott found:
"The most practical way to cut tungsten sheet without cracking!"

Here was a tricky job for the Airbrasive. Comstock & Wescott, Inc., Development and Research Engineers, Cambridge, Massachusetts, had to cut 0.005" thick tungsten sheet into circular components for missile systems. Mechanical cutting methods caused the brittle tungsten parts to crack. The Airbrasive did it successfully!

How does the Airbrasive work? It obtains its precise cutting action from a high-speed jet of dry gas and abrasive particles that quickly cuts, slices or abrades, as needed, almost any hard brittle material...germanium, silicon, glass, alloy steels, ferrites, mica, ceramics and others.

Important too...the cost is low. For under $1000.00 you can set up your own Airbrasive cutting unit!

Send us samples of your "impossible" jobs and we will test them for you at no cost.

SEND FOR BULLETIN 6006
...complete information.

to fill the needs for compactness, reliability and ability to perform over large ambient ranges, will be extremely useful in military applications. Stability of the oven is constant ambient ±0.005 C., with a temperature range of 0.001 C per deg C ambient change from -20 C to +65 C. Power consumption is 8 w maximum. Input voltage is 115 v a-c. The oven has a thermostatic mercury control with transistor switching. Unit can be used in conjunction with the company's 1 Mc precision crystal for a frequency stability of 1 part 10^6, with precision 100 Kc crystal, 2 part 10^6.

CIRCLE 405 ON READER SERVICE CARD

Assembly Cabinets
PRESSURIZED

MANUFACTURING ASSOCIATES, 11924 Santa Monica Blvd., Los Angeles, Calif., announces a line of pressurized assembly cabinets that assure ultra-clean assembly facilities. Designed primarily for use in production line assembly of electronic and instrument devices, they are built to fit a normal working bench. Each cabinet, affording comfort and uninterrupted vision for the operator, is a complete unit with its own filtration unit, heater, blower and lighting system. The blower system draws air through the filters and forces it into the working area within the cabinet. Standard assembly cabinets are equipped with permanent Micantite filters, with filtration to 2 microns.

CIRCLE 406 ON READER SERVICE CARD

Transmitter Tube
HIGH CATHODE CURRENT

MACLETT LABORATORIES, INC., Springdale, Conn. The ML-7211 is a very rugged radio transmitter tube featuring high cathode current capability. It is designed for use
Siegler's Hufford Division, long a leader in metal forming techniques, announces the installation of its 120" Spin Forge Machine, entirely paid for from corporate funds at a cost of $1,250,000. This giant machine, augmented by the existing 72" Spin Forge, comprises the largest and most complete Spin Forging facility in the world. It enables aerospace scientists to design well beyond previous limitations.

The Hufford Division Spin Forge facility is capable of producing precision surface-of-revolution parts from 4 inches to 120 inches in diameter, to 25 feet long, and with wall thicknesses from forty thousandths of an inch to one inch — out of all metals, including space age exotic materials. The giant Spin Forges can exert a pressure exceeding a million pounds per square inch — to flow metal to the desired shape quickly, with great accuracy, and with little or no metal lost to machining. Hufford Division also produces Spin Forges for the aerospace industry.

The outstanding performance of every Siegler division derives from divisional coordination under the Siegler basic corporate concept: Progressive management of diverse activities with outstanding military, industrial, commercial and consumer capabilities — in order to bring to each of these fields the strengths of the others.

CAREER OPPORTUNITIES are available for engineers and scientists. Write for complete information.

THE SIEGLER CORPORATION
610 South Harvard Boulevard, Los Angeles 5, California

PLANT LOCATIONS: HUFFORD DIVISION, EL SEGUNDO, CALIFORNIA • HALLAMORE ELECTRONICS DIVISION, ANAHEIM, CALIFORNIA • OLYMPIC RADIO AND TELEVISION DIVISION, LONG ISLAND CITY, NEW YORK • MAGNETIC AMPLIFIERS DIVISION, NEW YORK CITY, NEW YORK • BOGEN PRESTO DIVISION, PARAMUS, NEW JERSEY • SIEGLER HEATER DIVISION, CENTRALIA, ILLINOIS • HOLLY GENERAL DIVISION PASADENA AND BURBANK, CALIFORNIA • VAC-LIFT DIVISION, SALEM, ILLINOIS • COMET MANUFACTURING DIVISION, LOS ANGELES, CALIFORNIA • COMMUNITY ANTENNA DIVISION, RENO, NEVADA

August 12, 1960
The SMALLEST CHOPPER in the WORLD!

AIRPAX MICRO-MIDGET ELECTROMECHANICAL CHOPPER

This new low noise chopper has "full size" reliability and performance. The principle, assembly and materials are unique. Life tests have proven the engineering concepts leading to its development. Uses jewel bearings. Hermetically sealed. Noise is exceedingly low, in fact it is almost non-existent.

**GENERAL CHARACTERISTICS... MODEL 30**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive</td>
<td>6.3 volts, 60 CPS</td>
</tr>
<tr>
<td>Dwell</td>
<td>25° ± 10°</td>
</tr>
<tr>
<td>Contact Rating</td>
<td>2 ma, 10 v.</td>
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<tr>
<td>Contact Action</td>
<td>SPDT BBM</td>
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<tr>
<td>Phase</td>
<td>175°</td>
</tr>
<tr>
<td>Balance</td>
<td>Within 15°</td>
</tr>
<tr>
<td>Duration</td>
<td>0.05 to 1,000 µsec</td>
</tr>
<tr>
<td>Rise time</td>
<td>10 nanoseconds</td>
</tr>
<tr>
<td>Output amplitude</td>
<td>12 v open circuit, 8 v into 180 ohm load</td>
</tr>
</tbody>
</table>

*Nominal. Non-resonant armature construction permits wide drive frequency span.

CIRCLE 409 ON READER SERVICE CARD

Pulse Generator
TEN MEGACYCLE

ELECTRO-PULSE, INC., 11861 Teale St., Culver City, Calif. Model 4550A is a ten megacycle pulse generator for applications in design and test of ultra high speed pulse circuitry. It also performs well in the low and medium ranges as a general purpose test instrument. The transistorized unit features low power consumption. Plug-in modular construction permits addition of special features as required, including: d-c coupled input amplifier module 1A310 for external triggering plus one-shot push button operation; time base module TB801 with divided down sync pulse output for synchronization of oscilloscope sweep with output pulse at high frequencies. Specifications: repetition rate variable 10 Mc to 100 cps, delay variable 0.02 to 1,000 µsec, duration variable 0.05 to 1,000 µsec, rise time less than 10 nanoseconds, output amplitude 12 v open circuit, 8 v into 180 ohm load.

CIRCLE 410 ON READER SERVICE CARD

Filters
MEET MIL-F-18327A

CHICAGO STANDARD TRANSFORMER CORP., 3501 W. Addison St., Chicago 18, Ill., introduces 16 new cataloged filters for military and other high reliability applications. All are designed to meet MIL-F-18327A specifications. There are 8 tele-metering band pass filters in this
Siegler: 
...outstanding performance through a family of talents

— forms giant units to precision tolerances... with no metal waste!

Siegler's Hufford Division, long a leader in metal forming techniques, announces the installation of its 120” Spin Forge Machine, entirely paid for from corporate funds at a cost of $1,250,000. This giant machine, augmented by the existing 72” Spin Forge, comprises the largest and most complete Spin Forging facility in the world. It enables aerospace scientists to design well beyond previous limitations.

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THE SIEGLER CORPORATION
610 South Harvard Boulevard, Los Angeles 5, California
CRIMP POKE HOME® CONTACTS give plus value to each of the five AMPHENOL connector families illustrated below. Crimped outside of the connector by hand or power tool, Poke Home contacts are quickly inspected and easily inserted. The strength and uniformity of the crimp provide the most reliable means of wire termination available.

Poke Home contact crimping is being demonstrated at booths 848-849. Stop by and see reliability at work!

48 Series Connectors to MIL-C-26500. Performance unaffected by 1000 hours at 200°C. 3 shell styles, 4 to 55 contacts.

69 Series Poke "R" Connectors. Upgraded MIL-C-5015-type "R" construction. 3 shell styles, sizes 10SL through 36.

17 Series Min Rac 17. Space- and weight-saving miniature rack & panels. 9 to 50 contacts. Cable clamps available.

93 Series Complete family of rack & panel, cable-to-chassis, cable-to-cable connectors. 34, 42 and 50 contacts.

94 Series Up to 63 contacts, coax. connectors in some inserts. Primarily rack & panel, but cable clamps available.

Primary Battery
FOR MISSILES
YARDNEY ELECTRIC CORP., 40-50 Leonard St., New York, N. Y. Model P-3000 Silvercel battery is curved for optimum space utilization in missiles. It is a primary (one-shot) unit designed for wide variations in discharge rates (as high as 100 amperes continuously) and the most stringent requirements in voltage regulation. Its two sections, A and B, each consist of 20 cells of 3-ampere-hour nominal capacity. Both sections of the battery are automatically activated in 0.4 sec by a single activation mechanism. Unit weighs 22 lb.; measures 5 in. wide, 6 in. high and 15 in. long; is completely maintenance free; and has a dry shelf life of 5 years or more.

Stand-Off Terminals
AND FEED-THROUGHS
GOE ENGINEERING CO., 219 S. Mednik Ave., Los Angeles 22, Calif., has
4 Exclusive Quality Features for Optimum User Conditions of Solid Electrolyte Tantalum Electrolytic Capacitors - Type STP

All Efcon Type STP, prior to final test and acceptance for shipment, are:

1. 100% stabilized for 250 hours
2. at full voltage
3. and high test temperature operation "burn in"
4. with low series impedance

Other important advantages:

- $-55^\circ C$ to $+125^\circ C$ operation
- $\pm 10\%$, $\pm 20\%$ tolerance
- Polar operation
- Positive hermetic seal
- Meets or exceed MIL-C-26655A electrically and mechanically
- Low power loss, high insulation resistance
- Minimum size, long life and stable operation

Write today

For complete information
New catalogs
- Solid Tantalum
- Miniature Mylar
- High Temperature Teflon
- Miniature Polystyrene
The SMALLEST CHOPPER in the WORLD!

AIRPAK

MICRO-MIDGET ELECTROMECHANICAL CHOPPER

This new low noise chopper has "full size" reliability and performance. The principle, assembly and materials are unique. Life tests have proven the engineering concepts leading to its development. Uses jewel bearings. Hermetically sealed. Noise is exceedingly low, in fact it is almost non-existent.

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Dwell: Average, 175°  Balance: Within 15°
Contact Rating: 2 ma, 10 v.  Contact Action: SPDT BBM

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FILTERS

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CIRCLE 409 ON READER SERVICE CARD
Complete Sweeping Oscillator and Frequency Marker Systems

KAY Vari-Sweeps®

- Fundamental Frequency — No Spurious Beats
- Built-in Attenuators • Direct Reading Frequency Dials
- Stable Wide Sweeps • Stable Narrow Sweeps
- 1.0 V into 70 ohms, AGC’d

MODEL IF and MODEL RADAR

4-120 MC VARI-SWEEP MODEL IF
Frequency Range: 4 to 120 mc in six overlapping bands.
Sweep Width: Continuously variable to maximum of at least 30 mc (above 50 mc) or 60% of center frequency below 50 mc.
Sweep Rate: Variable around 60 cps. Locks to line frequency.
RF Output: 1.0 V rms into nominal 70 ohms (50 ohms upon request). AGC’d to ±0.5 db over widest sweep and over tuning range.
Zero Reference: True zero line during retrace.
Attenuators: Switched 20, 10 and 3 db; variable 6 db.
Fixed Markers: Up to eleven, pulse-type, crystal-controlled markers at customer specified frequencies. Accurate to ±0.05%.
Variable Marker: "Birdie pip" marker continuously variable from 2 to 135 mc in 6 overlapping bands. Direct-reading frequency dial accurate to within ±1.0%.
Marker Output: Approx. 5 V peak. Sweep Output: Approx. 7 V peak.

10-145 MC VARI-SWEEP MODEL RADAR
Same as Model IF in a different frequency range.
Price: $695.00 f.o.b. factory, including cabinet and eleven crystal markers.
Rack Mount deduct $20.00.

WRITE FOR CATALOG INFORMATION.

KAY ELECTRIC COMPANY
DEPT. E-8 MAPLE AVE., PINE BROOK, NEW JERSEY CAPITAL 6-4000

TWO UNIT SYSTEM 2-220 mc

KAY Vari-Sweep
Frequency Range (CW or Sweeping Operation): 2-220 mc, 10 bands, Direct-reading dial.
Sweep Width: Continuously variable to maximum of at least 30 mc (above 50 mc) or 60% of center frequency below 50 mc.
Sweep Rate: Variable, 10 to 40 cps; line lock.
RF Output: 1.0 V rms (metered) into nominal 70 ohms (50 ohms upon request). AGC’d to ±0.5 db over widest sweep and tuning range.
Attenuators: Switched 20, 20, 10, 6 and 3 db, plus continuously variable 6 db.
Price: $795.00 f.o.b. factory.

KAY Vari-Marker MODEL M
VARIABLE MARKER: (CW or "Birdie pip").
Frequency Range: 1.7 to 230 mc in ten overlapping bands.
RF Levels: 1.0 V rms into 70 or 50 ohms, metered.
Flatness: ±0.5 db, AGC’d.
Attenuators: Switched 20, 10, 6, 3 db, continuously 6 db.
Frequency Dial: Direct reading, accurate to ±1%.
Marker Amplitude: Variable to 5.0 volts peak.
HARMONIC MARKER: (Picket-fence pip or CW).
Intervals: Switched 250 kc, 500 kc, 2.5 mc, 5.0 mc, other frequencies can be specified.
Accuracy: ±0.01%.
Price: $845.00 f.o.b. factory.
Other Vari-Marker Models — Fixed and Variable Markers.

KAY ELECTRIC COMPANY
DEPT. E-8 MAPLE AVE., PINE BROOK, NEW JERSEY CAPITAL 6-4000

See Us At The Wescon Show — Booths 2062-2063

CIRCLE 187 ON READER SERVICE CARD 187
High-Speed Solid State Relays
MICROSECOND SWITCHING...
SHOCK RESISTANT

Curtiss-Wright Relays have been proven time and again in high speed sled tests and component test equipment switching applications. Designed for missile, aircraft and complex industrial controls and instrumentation and pulse circuit applications, these pulse-triggered relays switch DC power to loads in microseconds. There are no moving parts...no RF radiation...and “On” resistance is constant. Models are available for high temperature service; also custom designs for special applications.

WRITE FOR INFORMATION/ON COMPLETE SOLID STATE RELAY LINE

Tape Recorder
MISSILE-BORNE

Westrex Corp., 6601 Romaine St., Hollywood 38, Calif., has developed a miniature missile-borne magnetic tape recorder designed to record through a 500-g impact deceleration and survive a 1,500-g shock without loss of recorded data. The recorder is mounted in a hermetically sealed cylindrical can 3 in. high and 4 in. in diameter. Weight of the package, including tape, is less than 4 lb. Unit is designed to record more than 30 sec of critical analog data during the flight of a surface-to-surface missile. Fourteen tracks on one-in. tape are utilized to record this data from accelerometers and other types of transducers.

Electronic Counter
MINIATURE UNIT

Burroughs Corp., P. O. Box 1226, Plainfield, N. J. The DC-111 is a miniature decade counter module with an absolute minimum of com-
NOT JUST ULTRASONIC...
• ULTRA-Compact (only 8 3/4" high)
• ULTRA-Versatile (so many applications)
• ULTRA-Fast-Easy-to-read-Economical

Panoramic's advanced Model SB-15a automatically and repetitively scans spectrum segments from 1 kc to 200 kc wide through the entire range (0.1 kc to 600 kc) ... plots frequency and amplitude along the calibrated X and Y axes of a long persistence CRT, or on a 12 x 4 1/2" chart (optional RC-3a/15). Sweep rates are adjustable from 1 to 60 cps.

Adjustable resolution enables selection and detailed examination of signals as close as 100 cps. Self-checking internal frequency markers every 10 kc. Also internal amplitude reference. Only 8 3/4" high, the SB-15a is completely self-contained, needs no external power supply or regulator.

PANORAMIC PRESENTATION MEANS
- quick signal location, minimum chance of missing weak signals or holes in spectrum
- faster measurements—no tedious point-by-point plots
- reliable spotting of low level discrete signals in noise
- positive identification and dynamic analysis at all types of modulation

ALL THESE APPLICATIONS . . .
- Noise, vibration, harmonic analysis
- Filter & transmission line checks
- Telemetry analysis
- Communication System Monitoring . . . and more
- Power Spectral Density Analysis (with Model GDA-1 Analyzer)
- Frequency Response Plotting (with Model G-15 Sweep Generator)

Write now for specifications, other applications of PANORAMIC'S Model SB-15a. Get on our regular mailing list for THE PANORAMIC ANALYZER, featuring application data.

PANORAMIC'S SB-15a SPECTRUM ANALYZER 0.1 KC TO 600 KC

SUMMARY OF SPECIFICATIONS
Frequency Range: 0.1 kc to 600 kc.
Sweepwidth: Variable, calibrated from 1 kc to 200 kc.
Center Frequency: Variable, calibrated from 0 to 500 kc.
Markers: Crystal controlled, 10 kc and 100 kc plus harmonics.
IF Bandwidth: Variable, 100 cps to 5 kc.
Sweep Rate: Variable, 1 cps to 60 cps.
Amplitude Scales: Linear, 40 db log (extendable to 60 db) and 2.5 db expanded.
Sensitivity: 200 μv to 200 v full scale deflection.
Accuracy: ± 0.5 db.
Input Impedance: 50,000 ohms.

Be sure to see us at WESCON
PACKAGING PROBLEMS?

SOLVED!!

WITH KI CAPACITORS

Radial lead—axial lead & feed-through capacitors at 200WDC & 150°C. Radial lead-type C1R 75WVDC.

All are temperature stable, humidity proof, vibration resistant & 100% TESTED.

Delivery by factory stock or your local distributor:

KING ELECTRONICS INC.

915 Meridian Ave., South Pasadena, Calif.

Potentiometers

FOUR NEW TYPES

CLAROSTAT MFG. CO., INC., Dover, N. H., announces a new series 42

ponent parts. It combines the Beam-X switch, type BX-1000, with transistors in a circuit capable of resolving pulses at 110 Kc. Electrical outputs are provided to operate remote Nixie indicator tubes and printers, and to perform other circuit functions. It features total power consumption of only $2$ w; elimination of as many as 90 components from counting circuits; increased reliability due to component reduction and use of the ultra reliable Beam-X switch. The DC-111 has been designed as a plug-in module for use in computers, electronic counters, machine control, automation and test equipment. The units may be directly cascaded and can be driven by a 12-v signal, making them compatible with existing transistor logic circuits. The electronic and visual outputs which are provided suggest their use as preset or variable scale counters.

CIRCLE 413 ON READER SERVICE CARD

Slicing Machines

FOR FRIABLE MATERIALS

THE DOALL CO., Des Plaines, Ill. New model MTA-70 Microtom-atic slicing machine is equipped with the I/D Micro-Slicer, the new i.d. sawing machine that reduces kerf loss 40 to 50 percent and enables semiconductor manufacturers to obtain many more wafers per ingot. Cutting wheels only 0.006 to 0.010-in. thick are used on the I/D Micro-Slicer. The MTA-70 is a high-production, automatic machine. Its repeat index accuracy is guaranteed to within ±0.0002 in.

CIRCLE 414 ON READER SERVICE CARD
Centralab Model

Linear Motion Variable Resistors

different types

contact bounce

No contact bounce when vibration tested, 20-20,000 cps at 30 g's, loaded at 80% rated load, at 80% wiper travel, 3 planes, 10 minutes each. Induced noise less than 10 millivolts.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MODEL</th>
<th>TERMINAL LEADS</th>
<th>RESISTANCE RANGE</th>
<th>POWER RATING (Watts)</th>
<th>MAXIMUM OPERATING TEMP.</th>
<th>ENCAPSULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen. Purpose (Composition)</td>
<td>BA-701</td>
<td>Nylon or Teflon</td>
<td>10K to 2.5 Meg</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>No</td>
</tr>
<tr>
<td>Gen. Purpose (Wirewound)</td>
<td>BA-702</td>
<td>Nylon or Teflon</td>
<td>10K to 20K</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>No</td>
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<tr>
<td>Gen. Purpose (Composition)</td>
<td>BA-703</td>
<td>Printed Circuit</td>
<td>10K to 2.5 Meg</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>Yes</td>
</tr>
<tr>
<td>Gen. Purpose (Wirewound)</td>
<td>BA-704</td>
<td>Printed Circuit</td>
<td>10K to 20K</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>Yes</td>
</tr>
<tr>
<td>Gen. Purpose (Composition)</td>
<td>BA-705</td>
<td>Nylon or Teflon</td>
<td>10K to 2.5 Meg</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>Yes</td>
</tr>
<tr>
<td>Gen. Purpose (Wirewound)</td>
<td>BA-706</td>
<td>Nylon or Teflon</td>
<td>10K to 20K</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>Yes</td>
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<tr>
<td>Gen. Purpose (Composition)</td>
<td>BA-707</td>
<td>Printed Circuit</td>
<td>10K to 2.5 Meg</td>
<td>0.25@50°C</td>
<td>+125°C</td>
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<tr>
<td>Gen. Purpose (Wirewound)</td>
<td>BA-708</td>
<td>Printed Circuit</td>
<td>10K to 20K</td>
<td>0.25@50°C</td>
<td>+125°C</td>
<td>No</td>
</tr>
<tr>
<td>High Temp. (Wirewound)</td>
<td>BA-712</td>
<td>Teflon</td>
<td>10K to 20K</td>
<td>1.0 @ 70°C</td>
<td>+175°C</td>
<td>No</td>
</tr>
<tr>
<td>High Temp. (Wirewound)</td>
<td>BA-714</td>
<td>Teflon</td>
<td>10K to 20K</td>
<td>1.0 @ 70°C</td>
<td>+175°C</td>
<td>Yes</td>
</tr>
<tr>
<td>High Temp. (Wirewound)</td>
<td>BA-716</td>
<td>Printed Circuit</td>
<td>10K to 20K</td>
<td>1.0 @ 70°C</td>
<td>+175°C</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Maximum end resistance: < 1% of total.
Size: encapsulated 23/64" x 19/64" x 1-11/32", without encapsulation 5/16" x 1/4" x 1-1/4".
Standard Tolerances: ±5% Wirewound, ±20% Composition. Closer tolerances available upon request.
Shock: Less than 1% change in resistance with JAN-S-44 apparatus at 100 g, 5 shocks in each of 3 planes, Method 202A.
Meet or exceed all specifications of applicable MIL-STD 202-A, MIL-R-19A and MIL-R-94B tests.
HOSKINS ALLOY

815-R
Precision Resistor Wire

12.8 to 14.1% more ohms per pound! 10.8 to 12.7% less cost per megohm! These are worthwhile savings you can realize by using Hoskins Alloy 815-R in your precision wire-wound resistors. It's lower in density, has higher resistivity than standard 800-ohm nickel-chromium alloys. Yet it possesses comparable strength, ductility, resistance to corrosion. Its low temperature coefficient (0 ±10ppm per °C. from -65° to +150°C.)* is inherently controlled in the melt, rather than by "aging", to assure optimum uniformity. And it's available now bare or enameled in wire sizes ranging from .0031" down to and including .0004" to meet your particular application requirements.

*Wire controlled to 0 ±20ppm/°C. also available at greater savings — up to 19.8% lower cost/megohm.

Your for the Asking—Handy new Resistor Wire Comparator showing actual savings obtainable for each wire size. 12-page catalog containing complete technical data. Sample spools of wire for testing and evaluation. Send for them today!

HOSKINS MANUFACTURING COMPANY
4451 Lawton Avenue • Detroit 8, Michigan • Tyler 5-2860
In Canada: Hoskins Alloys of Canada, Ltd., 45 Racine Rd., Rexdale P.O., Toronto, Ontario

high temperature potentiometer rated at 10 w at 40 C and derated to zero power at 250 C; a low cost, single-turn, precision potentiometer, series 64; a ¼ in. single-turn precision potentiometer with glass sealed terminals, series 57; and a low-cost, precision ten-turn potentiometer, series 59.

CIRCLE 415 ON READER SERVICE CARD

D-C Power Supply
MILITARIZED

CHRISTIE ELECTRIC CORP., 3410 W. 67th St., Los Angeles 43, Calif. New high capacity d-c power supply, designed for helicopter starting, is automatically regulated, with magnetic amplifier control and silicon diode rectifying elements. Unit is rated 26 to 38 v d-c, 300 amperes with overloads permissible up to 900 amperes. Model BS41-400K4 has been built to meet power supply specifications MIL-P-15736C (SHIPS). It has been precision engineered and designed to meet all requirements for high impact shock (MIL-S-901B, Class HI, Type A) and vibration (MIL-STD-167 (SHIPS), Type 1) as encountered aboard Naval vessels.

CIRCLE 416 ON READER SERVICE CARD

Tape Recorder
MULTICHANNEL

PACIFIC ELECTRIC MAGNETICS CO., 942 Commercial St., Palo Alto, Calif. The PMR-400 series measures 10 in. by 9 in. by 12 in. and weighs only 20 lb. It provides up to seven channels of record and reproduce at standard tape speeds up to 30 ips. Recording bandwidth is 100 Kc for direct recording, and 10 Kc for the f-m carrier system. Conical 8 in. reels in stacked ar-
YOU CAN SPECIFY savings in weight, improvements in performance, increases in reliability for your electronic systems from this box. This is Sperry's Speci-File—a complete electronic and physical biography of the traveling wave and klystron tubes offered by Sperry Gainesville. To speed your specifying, to make it more accurate, and to secure the benefits of outstanding microwave tube performance for your systems, order your free Sperry Speci-File today. Just fill in and mail the attached coupon.

Gainesville, Florida A Division of Sperry Rand Corporation
specialized alloys for glass hermetic seals

**RODAR**

**NIRON® 52**

**NIROMET® 46**

Specified Industry-wide for

PERMANENTLY-BONDED VACUUM-TIGHT SEALS!

**RODAR®**

**NIRON® 52**

**NIROMET® 46**

**VISIT BOOTH 207 Wescon Show!**

<table>
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<tr>
<th>Temperature Range</th>
<th>Average Thermal Expansion°C/cm°C×10⁻⁷</th>
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<td>30°C to 200°C</td>
<td>43.5 to 43.6</td>
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<tr>
<td>30°C to 300°C</td>
<td>44.1 to 51.7</td>
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<tr>
<td>30°C to 400°C</td>
<td>45.4 to 50.8</td>
</tr>
<tr>
<td>30°C to 500°C</td>
<td>50.1 to 53.7</td>
</tr>
</tbody>
</table>

**NIROMET® 46**

**NIRON® 52**

**WILBUR B. DRIVER CO.**

**NEWARK 4, NEW JERSEY, U.S.A.**

IN CANADA: Canadian Wilbur B. Driver Company, Ltd.,
50 Ronson Drive, Rexdale (Toronto)

**Call or write for Sealing Alloy Bulletin**

<table>
<thead>
<tr>
<th>Average Thermal Expansion°C/cm°C×10⁻⁷</th>
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<tbody>
<tr>
<td>50°C to 700°C</td>
</tr>
<tr>
<td>53.7 to 62.1</td>
</tr>
</tbody>
</table>

**Automatic Tester**

**FOR SEMICONDUCTORS**

OPTIMIZED DEVICES, INC., 864 Franklin Ave., Thornwood, N. Y. This automatic semiconductor test station was developed to meet the need for increased quality in production and incoming inspection testing. Unit features completely automatic high speed testing with evaluation of transistor or diode performance accomplished by means of a precision G0, NO-GO comparator. Seven hundred semiconductors may be tested per hour with 100 percent measurement reliability. Selection of any of over 100 measurements is readily accomplished by means of modular components. Power ratings are from 0-100 v and up to 3 amperes. Sequencing and loading may be automatic or manual. Programming is by means of 10 turn dials and selector switches. Read-out is GO, NO-GO, digital display, automatic typewriter printout or punch card. Test accuracy is 1 percent.

**CIRCLE 418 ON READER SERVICE CARD**

**Joining Unit**

ULTRASONIC

RAYTHEON CO., 1415 Providence Turnpike, Norwood, Mass. Emit-
It's what's in here that counts.

Do you know, for instance... which electronic stocks are hottest? Who's in the news and why? About "Three Approaches to Microminiaturization"? About the newest product ideas hitting the market? What's up in production? Opportunities overseas? What's going on in Washington?

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Company:

Street:

City Zone State

Your Title Department

Product Manufactured or Service Performed

Mail reply to: electronics, 330 West 42nd Street, New York 36, N.Y.
Semiconductor Mount MODULAR DEVICE

SANDERS ASSOCIATES, INC., 95 Canal St., Nashua, N. H. New modular Tri-Plate semiconductor mounts extend the breadboarding versatility in strip transmission line circuits with Sanders' Tri-Plate modules. Microwaves and computer engineers can incorporate the new semiconductor devices directly into their circuits using standard Tri-Plate module building blocks. These new modules are available for cartridge, double ended, pill, or pigtailed glass packages.

Panel Instruments EXPANDED SCALE

WESTON INSTRUMENTS, Division of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J., announces two new expanded scale panel instruments, offering greatly im-

ELECTROMECHANICAL SWITCHES FOR TELEMETERING SYSTEMS!

Specifications, performances, applications for typical electromechanical commutators for long-range sampling, programming.  Quick comparisons let you know what's going on ... see ... October 2nd, 1959 issue (did you miss it?).  Another reason to subscribe to electronics (or renew your subscription).  Fill in Reader Service Card box.  Easy to use. Postage free.

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Street
City_________________________Zone________State________
Your Title____________________Department________________
Product Manufactured or Service Performed________________

Mail reply to: electronics, 330 West 42nd Street, New York 36, N.Y.
High gain...low noise...absence of microphonics...low distortion...reliability—these are the primary qualities circuit designers look for in electron tubes. Once again, Harman-Kardon engineers have found these qualities best exemplified in Amperex tubes. Small wonder, then, that the tube complement of the new Harman-Kardon "Stereo Recital" Model TA224 Integrated Stereophonic Receiver includes four Amperex 12AX7/ECC83's, one 12AU7/ECC82, and two 6AU6's.

These and many other Amperex 'preferred' tube types have proven their reliability and unique design advantages in the world's finest audio components. Applications engineering assistance and detailed data are always available to equipment manufacturers. Write: Amperex Electronic Corp., Special Purpose Tube Division, 230 Duffy Avenue, Hicksville, L. I., New York.

Semiconductor Mount
MODULAR DEVICE

SANDERS ASSOCIATES, INC., 95 Canal St., Nashua, N. H. New modular Tri-Plate semiconductor mounts extend the breadboarding versatility in strip transmission line circuits with Sanders' Tri-Plate modules. Microwave and computer engineers can incorporate the new semiconductor devices directly into their circuits using standard Tri-Plate module building blocks. These new modules are available for cartridge, double ended, pill, or pigtailed glass packages.

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FIND WHAT YOU NEED IN...

electronics
WHICH METER WOULD YOU CHOOSE TO GET MORE SENSITIVE LINE VOLTAGE READINGS?

No need to hesitate. If you are facing exceptionally tough voltage sensing problems your No. 1 choice is the meter shown at your right.

Easy to see our suggestion is well-founded. This meter is far more sensitive because it employs non-linear elements that precisely control voltage and compensate for temperature: FXC's Varistors (VDR's) and Thermistors (NTC's).

Easy to understand how these components make for more simplified circuitry . . . greater stability . . . and less susceptibility to overloads. Take a look at the circuit shown below . . .

The meter is but one of many products made better by the use of FXC's VDR's and NTC's.* Write for complete technical information — or, better still, obtain the VDR's and NTC's you'll need for making initial investigations by ordering our FERROXKIT NO. VT-1. The kit, priced at $10.00, contains the 9 Varistors and 2 Thermistors used in the circuit illustrated here.

*These same units also provide improved sensitivity in automatic feedback control circuits.

FERROXCUBE CORPORATION OF AMERICA
50 East Bridge Street, Saugerties, New York

August 12, 1960
proved readability and precise indication of true rms values. Both the model 1761 a-c voltmeter and the model 2531 ruggedized unit have an accuracy of ± 0.5 percent of center-scale value, are temperature compensated from -55°C to +70°C and capable of operation with a triangular wave input. The new expanded scale voltmeters, unlike conventional rectifier instruments, give true rms readings of alternating voltages even when their frequencies vary or when they are distorted.

CIRCLE 421 ON READER SERVICE CARD

Control Knobs
MEET MS-91528
LERCO ELECTRONICS, INC., 501 S. Varney St., Burbank, Calif. Series 500 instrument control knobs are designed to MS-91528 specifications for military applications. They are available in six types—rounds, skirted rounds, dial-skirted rounds, plain and skirted pointers, and crank-types. Six different sizes are provided in MIL-Spec matte black finish, and also in mirror finish. Knobs are molded of black Tenite No. 2, with ribbed construction used in large diameter knobs for added strength. Two hardened set screws are furnished in each. Standard ⅜ in. shaft hole is provided in MIL-Spec knobs, with ¼ in. hole available on special order.

CIRCLE 422 ON READER SERVICE CARD

P-C Connector
TWIN-PIN CONTACTS
ELCO CORP., "M" St. below Erie Ave., Philadelphia 24, Pa., announces series 5011 Varicon printed circuit connector, employing twin-pin (bi-furcated) contacts. The receptacle will accept series No. 53 taper pins. The insulator body is of glass-filled
GLOBAL SYSTEMS ENGINEERING

International Electric is the prime participant — the systems manager — in the development of a global digital command and control system which will provide SAC a rapid, highly modern means of controlling and supporting its forces throughout the world.

Creation of this digital data processing system involves operations research, systems analysis, formulation of equipment requirements, programming and the systems engineering of an integrated complex of electronic sub-systems to meet operational requirements. Electronic systems engineers will find at I.E.C. an exceptional opportunity to express imagination and technical competence.

Engineering positions are open in these areas: systems engineering, logical design, equipment development, preparation and performance of acceptance test, design and application of peripheral equipment. Programmer positions involve creation of advanced techniques in real-time programming, automatic programming simulation and automatic recovery. To inquire about these positions, write Mr. J. J. Crawford, Director of Industrial Relations.

INTERNATIONAL ELECTRIC CORPORATION
An Associate of International Telephone and Telegraph Corporation
Route 17 & Garden State Plaza, Paramus, New Jersey

CIRCLE 578 ON READER SERVICE CARD
DURANT

ELECTRIC COUNTERS

There's a standard Durant Electric Counter to fit practically any OEM application... enabling you to build modern electric counting into your PRODUCT, MACHINE or METHOD.

Durant's "HIGH VISIBILITY", with clean-cut legible figures set high up and close to the window, show the exact figure at a glance. Many Durant fully enclosed Electrics have been performing accurately and dependably under varying conditions for years and years — giving the reliability so necessary in a counting operation.

"Y" Electric Series
(Model 6-Y-1-MF)
1000 CPM

"CS" Electric Series
(larger size — larger figures)

"YE" Electric Series
Push Button Reset
(Model S-YE-8047-Q)
1500 CPM

"Y" Electric — Small, compact; AC counters equipped with integral rectifier for high speed and long life. Records accurately at high, low, or intermediate speeds.

"CS" Electric — Same external design and features as "Y" Series, but with larger case size and larger figures... for more rugged, heavy duty applications.

"YE" Electric — With electric instant reset or finger/flick instant reset.

ACTUATORS and CONTACTORS
Durant offers photo-electric, lever, roller arm, star wheel, or limit switch units for use with Electric Counters.

Send for Catalog Number 55
DURANT MANUFACTURING CO.
dependable since 1879
1912 Buffum St. 12 Thurbers Ave.
Milwaukee 1, Wis. Providence 5, R. I.

Tape Container
MAGNETIC SHIELDING

MAGNETIC SHIELD DIVISION PERFECTION MICA CO., 1322 N. Elston Ave., Chicago 22, Ill. A new 10 in. single reel, Netic magnetic tape container simplifies identification of program material contained within while affording ultimate magnetic shielding. The Netic material affords complete protection against tape erasure or the introduction of noise from unpredictable and extraneous magnetic fields during storage and transport, even if accidentally placed on a tape degausser. Maximum shielding and structural strength is obtained by using 0.049 in. Netic S-3 alloy. Container may be padlocked through convenient hasp. The containers are non-shock sensitive, non-retentive and do not require periodic annealing to maintain shielding effectiveness.

CIRCLE 424 ON READER SERVICE CARD

Crystal Modulator
1,000-6,000 MC

MELABS, INC., 3300 Hillview Ave., Palo Alto, Calif. Amplitude modulation of octave wide frequency ranges is produced by the model
If you sell to the electronics industry, you will be more successful if you understand exactly how electronic products and services are bought.

You can see at any purchasing meeting how the electronics industry differs from most—It's in the conversation! The President may discuss the fine points of circuit design with the research engineer. The production engineer may suggest a choice of components to the design man. The difference is that men from areas of management, design, production and use can and do influence purchase of electronic suppliers.

Look at the badge that identifies the electronics man. It reads Research-Design-Production-Management. The interests of the electronics man are in any or all of the four areas.

No matter where you find the electronics man his engineering background enables him to influence the purchase of electronic components and equipment. Your advertising must reach him to sell electronic goods.

Only electronics is specially edited each week to reach, interest and influence the electronics man...whatever his title. If you have something to sell the electronics industry—it pays to advertise in electronics.

THE ELECTRONICS MAN "BUYS" WHAT HE READS IN...

electronics
AC and DC
10<sup>9</sup> to 10 amps ± 2% DC, ± 3% AC

10 ohms to 10 megohms ± 5% center scale

AC 1 mv to 1 kv ± 3%
20 cps to 1 mc

DC 1 mv to 1 kv ± 2%

with the New
Smith-Florence
Multi-Function IRE Meter

This versatile new instrument combines all the desirable functions of a multimeter, vacuum tube voltmeter, and exceptionally wide range AC and DC ammeter in one space saving, easy-to-use package. Truly the design engineer's answer to bench clutter, the Smith-Florence Model 810 takes the measurements you make most for only 1/2 the cost of comparable instrumentation.

And These Features, Too—Individually illuminated ranges controlled by the positioning of the function switch. Two calibrating output voltages: 1 vdc and 1 vac rms square wave controlled by a zener reference circuit to an accuracy of .1%. Scope and recorder output. 1 mc dbm scale for audio work. Measures two functions simultaneously. Rack mounting at no extra cost.

OTHER
INPUT IMPEDANCE, 10 megohms • POWER REQUIREMENTS, 117 vac • SPECIFICATIONS, ± 10%, 50-60 cps • DIMENSIONS, 13" W x 7½" H x 13" D (cabinet) — 19" W x 7" H x 13" D (rack) • WEIGHT, 18 lbs.

For complete technical information, contact your nearby Smith-Florence engineering representative, or write the factory.

WESCON — See this instrument at Booth #903A

SMITH-FLORENCE, INC.
4228-36 23RD WEST • SEATTLE 99, WASHINGTON • ATWATER 4-0170

Another New Instrument For The Sixties From Smith-Florence

X-154 crystal modulator. A low, 3-v maximum modulation signal permits amplitude modulation of an r-f signal within its frequency range in excess of 10 db dynamic range without frequency modulation. The modulation element involves use of a high switching speed crystal diode, permitting modulation rates as high as 10 Mc. Device is useful from 1,000 to 6,000 Mc and employs type N connectors for direct attachment to existing signal generators which presently have no internal modulation.

CIRCLE 425 ON READER SERVICE CARD

D-C Power Supplies
TRANSISTORIZED

SORENSEN & COMPANY, South Norwalk, Conn., introduces seven new QM model transistorized d-c power supplies ranging from 6.3 to 36 v output. The new component-type units are completely encased in military-type can. Maximum output rating is 30 w with voltage regulated to ±0.05 percent against line and load variations.

CIRCLE 426 ON READER SERVICE CARD

Latch-In Relay
MINIATURE DEVICE

MAGNECRAFT ELECTRIC CO., 3352 W. Grand Ave., Chicago 51, Ill. Class 11LHS versatile enclosed latch-in relay requires only 2½ by 1½ in.
New Cubic 3-in-1 d-c amplifier has built-in strain-gauge power supply

Important savings in cost, space, and setup time are now possible for users of strain gauges with the Cubic Model 1100 d-c wideband amplifier. This newest addition to the Cubic line of instrumentation amplifiers is really three units in one. It is (1) a differential-input, wideband d-c amplifier, (2) a bridge balance circuit, and (3) a well regulated strain-gauge power supply.

For applications not requiring the self-contained power supply, modules which contain two d-c amplifiers can be supplied. You can mount 8 of these modules abreast (16 amplifiers) in a single standard rack.

Model 1100 amplifiers with built-in power supplies eliminate the hookup problems formerly encountered in multiple-strain-gauge operations. Even more important, they permit saving $200-400 per channel since separate power supplies and bridge balance circuits are no longer needed.

**ALSO THE 1000-SERIES**

The Cubic line of d-c wideband amplifiers also includes the Model 1000 series. These highly sophisticated solid-state instruments incorporate all the design improvements of 1960's state-of-the-art. Key to their versatility is the Cubi-plug, a module that plugs into the 1000-series amplifier chassis to provide any required gain, fixed or variable, and single-ended or differential input.

**SPECIFICATIONS AVAILABLE**

Write for complete specifications and ordering information on Cubic's complete line of instrumentation amplifiers. Dept. E-1, Industrial Division, Cubic Corporation, San Diego 11, California.

August 12, 1960
HERE'S WHY VELOCITY DAMPING IMPROVES SERVOSYSTEM RELIABILITY... The velocity-damp servomotor is a replacement for complicated rate-feedback loops—it achieves stability by simple and self-contained electromagnetic means.

For example, the Beckman® Size 8 Velocity-Damp Servomotor offers up to 25 dyne-cm.-sec./rad. additional damping, and can replace damping generators in 80% of present applications. In addition to elimination of phase shift and null voltage problems inherent in rate feedback systems, the velocity-damp unit is shorter, lighter, and consumes less power.

In Beckman Velocity-Damp Servomotors, damping is a direct function of velocity. A low-inertia drag cup, integral with the motor shaft rotates in a magnetic field generated by a pair of permanent magnets. Polarity of one magnet is variable with respect to the other, so that total force due to induced currents may be externally adjusted during operation.

In addition to Size 8 Velocity-Damp Servomotors, Beckman offers similar units in their Size 11, 15 and 18 lines.

For a complete delineation of servomotor damping theory...including transfer functions to help you determine damping needs...write for our Servo Brief entitled, "Electromagnetic Damping!"

Microwave Signal Source

CONSTANT POWER

MENLO PARK ENGINEERING, 711 Hamilton Ave., Menlo Park, Calif. Designed for operational ease and versatility, model 944 constant power microwave signal source provides the development and production engineer with a convenient tool for rapid response analysis of both active and passive microwave networks and devices. It consists of the model 450 microwave oscillator and the series 500 microwave power level used together as a system. Features include swept frequency operation up to 100 cps over the 8,200 to 11,000 Mc range. Output power capability is 10 dbm minimum.

Transformers

ISOLATION TYPE

UNITED TRANSFORMER CORP., 150 Varick St., New York 13, N. Y., announces hermetically sealed shielded isolation transformers designed to give the ultimate in iso-
NOW—Complete Line

**dekatron**

Electronic Counting Tubes
(up to 20,000 counts/sec.)

Typical Drive Circuit

Now available — only complete "Hand Book of Counting Tubes" in print. Tube specifications, applications, sample, circuits, design criteria are included. Available at $1.00 a copy through Dekatron Tube Section, Baird-Atomic, Inc.

No C. O. D. or purchase orders, please! Cash, check or money order accepted.

**Baird-Atomic, Inc.**

33 University Rd., Cambridge 39, Mass.

Instrumentation for Better Analysis
CIRCLE 305 ON READER SERVICE CARD

**CECO**

Low Noise
VHF and UHF
Amplifiers and Preamplifiers
SERIES 1000

For application as receiver preamplifiers or wide band i. f. amplifiers . . . in scatter communications systems, laboratory, or nuclear research. Eight standard models cover VHF and UHF to 900 mc. High gain, low noise. Special pass bands available.

Advanced techniques permit modification of standard units at minimum cost.

Write for complete details:

**COMMUNITY ENGINEERING CORPORATION**
P. O. BOX 824
STATE COLLEGE, PA.
CIRCLE 305 ON READER SERVICE CARD

August 12, 1960

Like Autonetics, Bendix, Boeing, Chalco, Convair/Astronautics, GE, Magnavox, Martin, McDonnell, Radioplane, Ramo Wooldridge, and STL:

Count on Hydro-Aire for Reliable Transistorized Time Delay Devices

Available now: time delay relays, sequence timers, and computer timing modules. Custom-designed and built by Hydro-Aire for these valued customers. All can be readily adapted to meet a broad range of requirements, or we can custom-design to your specs. Write for a prompt quote.

**NEW ELECTRONICS CATALOG** describes Hydro-Aire solid-state devices including time delay devices, voltage regulators, power supplies, and inverters. Write on company letterhead for your copy.
Radio Command System for Unmanned Balloons

Low cost, lightweight unit gives accurate control

This three-unit radio command system represents the first application of miniaturization to unmanned balloon flights. Extremely small size permits use of smaller balloons. Includes low-power internal transmitter to permit pre-flight testing.

Solving problems is our business

One of our customers engaged in balloon flights needed a miniaturized radio-command system. He brought the problem to us. The product shown here is the result. Our people thrive on challenges of this sort.

New ideas are our business. Every new product that emanates from G. T. Schjeldahl Co. is the result of ideas of creative people applied to a customer's problem.

Miniaturization of electronic equipment necessary in telemetry is a logical step for us. After pioneering the development, use and manufacture of superpressure balloons, we realized the need for better, smaller and lighter electronic equipment. As a result, in our Electronics Laboratory, we are constantly working on miniaturizing equipment, primarily for use in balloons and space vehicles.

If you have a special problem involving miniature electronics or any phase of balloon flights, give us a chance to help. Send this coupon for further information.

Please send me further information about the Radio Command System and other miniature electronic equipment for balloon flights.

Name ___________________________ Title ___________________________

Firm name ___________________________

Address ___________________________

command control signal generator

Sends signals to the balloon via three precise audio-frequency tones. Battery is self-contained.

Output—1 volt across 200 ohms
Audio Frequencies—3 selected in 200 to 1000 cps range
Radio Frequency—according to user's allocation
Power Supply—12 V, 15 ma
Size—8½ x 4½ x 4 inches

Command control receiver

Miniature receiver is key to favorable weight, performance and cost. Receives coded audio signals from ground control and passes them on to signal decoder.

Selectivity—5 kc at 6 db points
Sensitivity—4 micro-Volt for 20 db S/N ratio
Image rejection—40 db
Output—3 v. across resonant reed load
Environment—-20° C to +40° C
Power Requirement—6 v, 14 ma
Size—2 x 6 x 1 inches

Command decoder

Responds to coded signals through relay contact closures. Operates on crowded communications channel without masking, since a series of two precise frequencies plus a time constant are necessary in command signal.

Power requirements—4.5 v, 1 ma and 6 v, 100 ma
Output—2 sets of relay contacts
Size—2 x 6 x 1 inches
Specifications for these units apply to a specific customer's need. Comparable system can be designed to your requirements in the HF and VHF range.

Unit or adaptations may be used in a variety of remote control applications!

Comparator

HIGH IMPEDANCE

WAYNE KERR CORP., 1683 Race St., Philadelphia 3, Pa. Type B-921 precision high impedance comparator is a three-terminal bridge to compare impedances of the order of megohms against a known standard. Accurate to 0.001 percent, it has a voltage ratio adjustable between 0.5:3.1 and 3:1. Frequency range is 400 cps to 10 Kc; range of comparison—0-3; and discrimination, 1 in 104 (at ratios 1 to 3). Unit was designed for either absolute measurement or comparison of liquid permittivity, it being used originally with oils, ketones, etc. For physical convenience, the cells used for these measurements have capacities of the order of 10 µfd.

CIRCLE 430 ON READER SERVICE CARD

Transistor Tester

COMPACT AND RUGGED

BAIRD-ATOMIC, INC., 33 University Road, Cambridge 38, Mass. Model NC-1 test set employs a pulse drive technique to make direct measurements of d-c parameters at power levels equal to the maximum dissipation of the transistor. Both the
TWIXT TRIMMERS...

there's little difference in shape
not much difference in size

but a BIG DIFFERENCE INSIDE

Reliability thru proven manufacturing techniques is inherent in TIC Trimmers. TIC Standard Trimmers are not only dependable but are AVAILABLE FROM STOCK throughout the nation for fast deliveries.

And as an extra feature TIC has simplified your selection — military types in a choice of 4 mountings — all have a temperature range of -55°C to -225°C.

TIC box trimmers with recessed lid are designed for the most efficient four point sealing against moisture and dust.

Standard box trimmers are individually subjected to bubble testing.

All welded connections and dual contacts on both resistance element and slip rings are quality manufacturing features of TIC Trimmers.

COMPARE you'll see the BIG DIFFERENCE INSIDE

distributed nationally by AVNET

TYPE
RTW-W1 (Wire Leads)
RTW-L1 (Solder Lugs)
RTW-L2 (Solder Lugs)
RTW-P1 (Printed Circuit Pins)

25 turn lead screw adjustment (9000°). Standard Resistance Values: 50 — 100K ohms. Non-standard values between 10 ohms and 125K ohms available on special order. Values below 10 ohms and between 125K and 225K ohms also available through the use of special techniques.

Subminiature TPC-P1 for printed circuit application.
57 turn lead screw adjustment (13320°). Standard Resistance Values 50 — 30K ohms. Non-standard values between 10 ohms and 30K ohms available on special order.

TYPE RWT-C1 (Wire Leads)
25 turn lead screw adjustment (9000°).

Commercial type, low cost trimmers have a temperature range of -55°C to +85°C. Anodized metal cases and eyelet mounts permit stacking multiple units in limited areas.

Standard Resistance Values 50 — 20K ohms.

Non-standard resistance values between 10 ohms and 25K ohms available on special order.

For full details write, wire, or call

TECHNOLOGY INSTRUMENT CORP.
OF ILLINOIS
10130 West Pacific Ave., Franklin Park, Illinois, Gladstone 1-1140
Subsidiary of TECHNOLOGY INSTRUMENT CORPORATION
531 Main Street, Acton, Massachusetts, Colonial 3-7756
VISIT US AT BOOTH548 & 549 AT WESCON

AVNET

AVNET TRIMMERS
are dependable because they are designed and manufactured by TECHNOLOGY Instrument Corp.

AVNET SERVICE
is dependable because a wide selection of types and standards are AVAILABLE FROM STOCK where and when you need them. Quantities 1 to 250 of an item at factory prices.

Call your Avnet Sales Engineer for dependable service and immediate delivery.

AVNET

CIRCLE 51 ON READER SERVICE CARD August 12, 1960
NEW FROM WESTINGHOUSE:
STATIC POWER SUPPLIES FOR SONAR

Static power packages from Westinghouse supply unfailing power for sonar. In unit shown at right, which will power sonar for Edo Corporation, modular packaging permits replacement of 13 diodes per unit in less than one minute. Ratings to meet any system range or performance can be supplied. This equipment meets Mil P-15736. For help in solving your static power supply problems, just contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

Cooling System
MINIATURE SIZE
EASTERN INDUSTRIES INC., 100 Skiff St., Hamden 14, Conn. Model E/HT-100, type 100 cooling system provides OS-45 coolant heat sink for an airborne electron tube of 250 w dissipation. It meets MIL-E-5400 for Class II equipment. Design provides a minimum number of fluid and electrical connections and practical minimum number of com-

CIRCLE 431 ON READER SERVICE CARD

Connectors
MICROMINIATURE
AMPHENOL-BORG ELECTRONICS CORP., 1830 S. 54th Ave., Chicago 50, Ill. The Micro Mod series of microminiature connectors provides a means of interconnection and quick removability for “stick” or module packaged circuits. Two versions are available. One mating pair consists of a receptacle and receptacle base, and a polarized plug. In the alternate pair, the receptacle is supplied without the contacts. In certain cases the module leads can then be used to form the female contacts. Both mating pairs have 12 contacts on 0.075 in. centers. The MicroMod is 0.380 in. square.
CIRCLE 432 ON READER SERVICE CARD

ammeter and voltmeter peak-detect current pulses producing a measure value equivalent to a steady d-c current. Readings are registered on 3 in. meters. Power transistor d-c current gain, saturation measurements, input and output impedance, leakage current and breakdown voltage can be tested by the NC-1 as well as diode leakage and breakdown measurements. Tests are conducted in common emitter configuration giving readings of V, I, V, and I. under pulse conditions and giving readings of leakage current and floating potential by standard techniques.
CIRCLE 431 ON READER SERVICE CARD

CIRCLE 208 ON READER SERVICE CARD
"Without speculation there is no good and original observation"

—Charles Darwin, naturalist

Man's search for scientific knowledge and understanding has its taproots in the above thought expressed by Darwin in a letter to his distinguished contemporary, Alfred Russel Wallace, in 1857.

Speculation—intuitive contemplation guided by past discoveries—led Darwin to his famous observations set forth in *Origin of Species*. Similarly, it led Alexander Graham Bell to the invention of the telephone—and has since led to many major advances in electrical communications.

At Bell Telephone Laboratories, the puzzling flow of current in semiconductors provoked speculation which yielded the transistor—and a Nobel Prize. Speculation about the behavior of the electron led to experimental proof of its wave nature—and another Nobel Prize. “Brains” capable of guiding missiles and space probes first took form in the bold speculations of Bell Laboratories scientists.

Today, Bell Laboratories scientists and engineers are more keenly aware than ever of the importance of speculative thinking. The far-reaching scientific and technological developments of tomorrow are already the subject of advanced research. Among them are radically new materials and devices—basically new switching systems, transmission via satellites, and waveguide networks able to carry hundreds of thousands of voices simultaneously.

Through informed speculation about Nature's laws, Bell Laboratories will continue to search for the “good and original observations” which are so vital to the ever-improving Bell Telephone System.

BELL TELEPHONE LABORATORIES
WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT
Components. The thermodynamic design both at the unit and component level is carried out to a refined degree, resulting in a miniaturized cooling system weighing 3.9 lb and requiring only 95 va of electrical power under continuous operation. In addition to acting as a heat sink the unit provides for coolant expansion, visual coolant inspection, coolant over pressure protection, over heat protection, and interlocks circuits protecting against low coolant flow and high coolant temperature.

CIRCLE 433 ON READER SERVICE CARD

Speed Reducers & Gearheads

DYNAMIC GEAR CO., INC., Dixon Ave., Amityville, L. I., N. Y., has introduced a line of Buord size 11 frame speed reducers and gearheads that feature whole-number ratios, eliminating the need for the design engineer to make extensive, time-consuming calculations. Featuring postless type construction the units are accurate to within 0.5 percent. They are for mounting on standard Buord MK14 servomotors. The Dynaco speed reducers and center-shaft gearheads are available in over 190 stock ratios—from 7:1 to 5,950:1. Units are either opposite or direct rotation and lubricated for life (−55 C to +100 C) and measure only 1.420 in. overall.

CIRCLE 434 ON READER SERVICE CARD

Components

FOR RIDGED WAVEGUIDES

THE NARDA MICROWAVE CORP., 118-160 Herricks Road, Mineola, L. I., N. Y., announces a new line of measurement equipment and components for the D9 double ridged waveguide in the 4,750 to 11,000 Mc band. Ridged waveguides are capable of handling a broader band
Higher permeability values now guaranteed for Allegheny Ludlum’s Moly Permalloy

Means new, consistent and predictable magnetic core performance

Molybdenum Permalloy nickel-iron strip is now available from Allegheny Ludlum, with higher guaranteed permeability values than former typical values. For the buyer, this new high quality means greater uniformity... more consistent and predictable magnetic core performance.

This higher permeability is the result of Allegheny Ludlum’s intensive research on nickel-bearing electrical alloys. A similar improvement has been made in AL-4750 strip steel. A-L continues its research on silicon steels, including Silectron, well-known grain-oriented silicon steel, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available from Allegheny Ludlum. In addition, you can be assured of close gage tolerance, uniformity of gage throughout the coil, and minimum spread of gage across the coil-width.

If you have a problem relating to electrical steels, laminations or magnetic materials, call A-L. Prompt technical assistance will be yours. And write for more information on Moly Permalloy. Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.

Address Dept. E-8.
Electronic Timers
SOLID STATE
WESTON, INC., 816 N. Kedzie Ave., Chicago 51, III. The WC-600 series solid state timers, while designed for airborne and ground support equipment for missiles and aircraft application, have many other uses in the electronic industry. The WC-605 repeat cycle timer illustrated, operating from 24-30 v d-c, cuts off the power 60 sec after the triggering of the cycle. Power is gated on again at the end of a second 60 sec "off" period. Using an R-C method of measuring the timing interval, the circuit has an inherent overall accuracy of ±3 sec. Potted modular construction, transistorized circuitry with no moving parts, insure the units of faultless operation. Accuracy of ±5 percent, not affected by extreme shock and vibrations in temperatures ranging from -55 C to +71 C.
CIRCLE 436 ON READER SERVICE CARD

Lab Tape Recorder
PORTABLE UNIT
AMPTEX CORP., Instrumentation Division, 934 Charter St., Redwood City, Calif. The CP-100, a complete 7 or 14-channel recording and reproducing system, is a reliable reel-to-reel machine for instrumentation or
ANSWER

TO COMPUTER MATRIX PROBLEMS

LOW LEAKAGE TRANSISTORS AND FAST RECOVERY, LOW CAPACITANCE DIODES FROM FAIRCHILD

Approach to the ideal matrix. 2N1613 silicon transistors and FD200 silicon diodes from Fairchild are unique in making feasible the ideal matrix. They give you low leakage and low capacitance with high conductance and high speed, even at high ambient temperatures. These characteristics are combined only in Fairchild Planar devices. With them you can now largely ignore stray leakage or capacitance build-up across the matrix. Temperature effects and long-term performance decay are no longer critical. You can eliminate complex circuitry previously necessary in designing around these losses.

Fairchild's Planar structure for transistors and diodes features the industry's most advanced diffusion and surface passivation techniques. Current leakage is reduced to 10 mA maximum (2N1613) and 0.1 mA maximum (FD200) at 25°C. Maximum values at 150°C are 100 mA and 1000 mA.

Surface passivation also prevents significant degeneration of parameters during circuit life which could introduce error or failure in the matrix. This technique also lends itself to precisely controlled manufacture, assuring excellent product uniformity.

**2N1613 ELECTRICAL CHARACTERISTICS (25°C except as noted)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEE</td>
<td>B.C. Current Gain</td>
<td>40</td>
<td>120</td>
<td>Ic = 150 mA</td>
<td>Ycg = 10 V</td>
</tr>
<tr>
<td>ITSat</td>
<td>Base Saturation Voltage</td>
<td>1.3 V</td>
<td>Ic = 150 mA</td>
<td>Ib = 15 mA</td>
<td></td>
</tr>
<tr>
<td>VCE(sat)</td>
<td>Collector Saturation Voltage</td>
<td>1.5 V</td>
<td>Ic = 150 mA</td>
<td>Ib = 15 mA</td>
<td></td>
</tr>
<tr>
<td>Cc</td>
<td>Collector Capacitance</td>
<td>18</td>
<td>25 µf</td>
<td>Ib = 0</td>
<td>Ycg = 10 V</td>
</tr>
<tr>
<td>CBO</td>
<td>Collector-Base Off Current</td>
<td>0.8 mA A</td>
<td>10 mA</td>
<td>VCB = 50</td>
<td>T = 25°C</td>
</tr>
<tr>
<td>ICBO</td>
<td>Collector-Base On Current</td>
<td>1.5 A</td>
<td>10 A</td>
<td>VCB = 60</td>
<td></td>
</tr>
</tbody>
</table>

**FD200 ELECTRICAL SPECIFICATIONS (25°C except as noted)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1V</td>
<td>Forward Voltage</td>
<td>1.0 V</td>
<td>1 V = 100 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1g</td>
<td>Reverse Current</td>
<td>0.1 A</td>
<td>Yg = 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1e</td>
<td>Reverse Current</td>
<td>100 µA</td>
<td>Yg = 250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BY</td>
<td>Breakdown Voltage</td>
<td>200 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Reverse Recovery Time</td>
<td>500 µsec</td>
<td>Yf = 30 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cc</td>
<td>Capacitance</td>
<td>0.5 µf</td>
<td>1.0 µf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSE</td>
<td>Rectification Efficiency</td>
<td>35%</td>
<td>0.1 mV/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Forward Voltage Temperature Coefficient</td>
<td>-1.8 mV/°C</td>
<td>100 mV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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IN CANADA: PREMIER METAL HOUSINGS, Ltd., 5810 Smart Ave., Montreal

SEE THE LATEST ADDITIONS TO THE PREM-O-RAK MODULAR CONSOLE SYSTEM • WESCON SHOW—BOOTH 340-341

general laboratory application. It accommodates either 3⁄4 or 1-in.-wide tape on 101-in. reels, and provides six tape speeds—1⁄2, 3⁄4, 7⁄16, 15, 30 and 60 ips as well as fast-forward and rewind. Direct or f-m carrier recording is employed. Cumulative flutter of the unit is below 0.6 percent peak-to-peak at 60 ips, with tape-speed deviations of no more than ±0.25 percent and start time less than 3 sec. Frequency response from d-c to 200 Kc is available (with –25 db signal-to-noise ratio). Built for use at altitudes up to 10,000 ft, the CP-100 operates while in motion, in airplanes, surface ships, trailers, submarines and other mobile applications.

CIRCLE 437 ON READER SERVICE CARD

OTHER NEW PRODUCTS

Dust-Free Cabinet FOR WORK BENCHES

SPECIALTIES, INC., Skunks Misery Road, Syosset, L. I., N. Y., announces Specialaire, a new inexpensive dust-free illuminated work chamber with double filtration for maximum air cleanliness, now available for standard work benches. The self-contained cabinet was designed to provide high dust arrestance for assembly, research and test of electronic components and other precision instruments in both cleaned and non-cleaned areas. Rejects due to dust contamination are eliminated by use of the portable cabinet with a continuous flow of filtered air which prevents fine dust particles from entering the work area. The self-charging electrostatic filtration has an arrestance value of 95 percent on dust particles ranging from 0.08 to 80 microns in diameter. Cabinet features a hinged panel to permit insertion of large work specimens, permanent washable type filters.
and adjustable air flow. Specialaire measures 36 in. by 28 in. by 18 in.

CIRCLE 438 ON READER SERVICE CARD

T-R Tubes
FOR HIGH POWER USE

TUCOR, INC., 18 Marshall St., South Norwalk, Conn., has available a new series of T-R tubes of the folded cylindrical type for high level, high average power applications. The T48U series are available in a wide variety of sizes and in 7052, 707, Pyrex or quartz. Having been successfully tested in air-cooled duplexers at over 100 Kw average power, the tubes are designed to cover a range from uhf to S-band. Delivery is stock to 30 days depending on type.

CIRCLE 439 ON READER SERVICE CARD

Coil Winder
FULLY AUTOMATIC

ASSOCIATED AMERICAN WINDING MACHINERY, INC., 750 St. Ann's Ave., New York 56, N. Y. New Blu-Red automatic winding machine will wind radio, tv and communication type coils without human assistance. Model KWA-58 automatically loads, winds, cements, bakes and unloads. Intended for high produc-

CIRCLE 439 ON READER SERVICE CARD

Improve the quality of your semi-conductors through crystal purity!

Kinney Floating Zone Refiner

This Kinney development, handling rods up to 1 1/2" in diameter, 6" to 10" in length, is significant to producers of transistors, diodes, rectifiers, capacitors, etc. In addition to highest purity Silicon and Germanium, you can produce refractory metals of maximum purity...Tantalum, Molybdenum, Tungsten and Columbium in Vacuum of 1 x 10^-5 mm Hg or other controlled atmosphere. Get the facts - write today!

Kinney Vacuum Division
The New York Air Brake Company

Please send me full information on the Kinney Floating Zone Refiner and other Electronic Equipment.

Name__________________________
Company______________________
Address_______________________
City_______________________ Zone_____ State_____

WRITE TODAY FOR SPECIFICATIONS AND PERFORMANCE DATA ON THIS AND OTHER KINNEY HIGH VACUUM EQUIPMENT

CIRCLE 215 ON READER SERVICE CARD
An important NEW GUIDE to ELECTRONIC CHEMICALS of high, defined purity

...may we send you your complimentary copy? Mail coupon below.

More than 40 electronic chemicals of exceptional purity appear in this handy new reference guide. You will find, for example, high purity 'Baker Analyzed' Reagents for semiconductors... vacuum tubes... ferrites... thermistors.

Do you know that every 'Baker Analyzed' Reagent electronic chemical is labeled with an Actual Lot Analysis that defines the degree of purity to the decimal? And that many are labeled with an Actual Lot Assay as still a further proof of purity? Do you know that in many of these chemicals copper, nickel and other critical impurities are defined at levels of .1 and .2 parts per million? And that several important solvents are now controlled to meet stringent resistivity specifications?

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It lists J. T. Baker electronic chemicals controlled to extremely low limits of critical impurities, and includes specification sheets that prove the superiority of 'Baker Analyzed' Reagents for electronic specifications. Fill in coupon now.

J. T. Baker Chemical Co. Phillipsburg, New Jersey Dept. E

Gentlemen: Please send me my copy of "J. T. Baker Electronic Chemicals."

Name __________________________

Title __________________________

Company ________________________

Street Address ____________________

City ___________ Zone _____ State ___________


BROADBAND POWER DENSITY METER Model NF-157

For fast, accurate determination of RF power density and location of areas presenting RF hazards to personnel

Description: A broadband device providing direct reading of RF power densities from 1 mw/cm² to 1000 mw/cm² (mid-scale readings), over the continuous frequency range from 200 to 10,000 Mc.

Features:

- Direct reading of power density insures immediate awareness of hazardous areas.
- Broad frequency range and high accuracy permit universal application to mapping of high level RF fields from VHF to X-Band.
- Accurate built-in step attenuator provides capability of handling power densities over a dynamic range of 10,000 to 1.
- Three constant-gain calibrated probes permit direct reading in mw/cm² over the continuous frequency range from 200 to 10,000 Mc.
- Physical separation of probes from main unit vastly increases flexibility of applications.
- Battery-powered, light-weight design permits complete portability.
- Convenient carrying case simplifies transportation of instrument.
- Efficient shielding prevents stray RF pick-up.
- Conservation design insures resistance to over-load.
- Main unit may be used independently as an accurate, rugged RF power meter over a wide power range.

Send for our Catalog No. 604

EMPIRE DEVICES PRODUCTS CORPORATION

AMSTERDAM, N. Y. Victor 2-8400

MANUFACTURERS OF FIELD INTENSITY METERS DISTORTION ANALYZERS • IMPULSE GENERATORS COAXIAL ATTENUATORS • CRYSTAL MIXERS VISIT OUR BOOTH 2819-2820 AT THE WESCON SHOW

Mixer-Preamplifier LOW NOISE

LEL, INC., 380 Oak St., Copiague, L. I., N. Y. A new addition to the company's series of microwave receiver head-ends, the MMK-1 matched-mixer assembly covers a frequency band from 15,000 to 17,000 Mc, has a nominal bandwidth of 8 Mc and a noise figure of 9.1 db. Gain is 25 db, and one milliwatt of local oscillator power is required.

CIRCLE 441 ON READER SERVICE CARD

Subcarrier Oscillator TRANSISTORIZED

SOLIDTRONICS DIVISION, Electro-cells Corp., 14751 Keswick St., Van Nuys, Calif. New, completely solid state subminiature subcarrier
The electronics man may be found in any or all of the areas of research, design, production, management.

Your problem: sell him (wherever he is) and keep him sold all year long. Here's the simplified key to this job!

Use electronics to arouse his interest and create acceptance for your products in the magazine's weekly issues.

Use the electronics BUYERS' GUIDE and Reference Issue to be there all year long whenever he is ready to buy.

This is the best selling combination in the electronics industry...and the one that carries the most weight!

THE ELECTRONICS MAN
"BUYS" WHAT HE READS IN...

8x12, 1960
NEW FROM WESTINGHOUSE:

STATIC POWER SUPPLIES FOR GROUND SUPPORT EQUIPMENT

Static inverters and converters in kilowatts from Westinghouse convert d-c to a-c, d-c to d-c and a-c to a-c. For ground support equipment applications—from test to launch—these inverters perform unerringly. Operation is completely static. High efficiencies, smaller size and weight, increased reliability, greater packaging flexibility, reduced maintenance are all attainable through use of Westinghouse static inverters and converters. Ratings of 10 kva are obtainable. Higher ratings are now under development. A 4.5 kw, d-c to 400 cycle converter is displayed at right. For help in solving your static power supply problems, contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box868, Pittsburgh 30, Pennsylvania.

Ceramic Parts

METALLIZED

MITRONICS INC., 1290 Central Ave., Hillside, N. J., announces an extremely subminiature metallized housing with an o-d of 0.030 in. and an i-d of 0.012 in. This ceramic part is only 0.008 in. thick including the metallized portion. The part is metallized with molybdenum manganese and nickel plated on both flat surfaces. In spite of its small size, this part can be hermetically sealed by brazing or soft solder. Part has possible application to diodes.

Oscilloscope

MILITARIZED

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model 170A is a rugged, militarized 30 Mc scope with maximum reliability and versatility. It features conven-
tional controls and provides a big, bright presentation on a 5-in. crt. The instrument also includes a new beam finder and dual plug-in system. Increasing its versatility is the new 166D sweep delay generator plug-in, which delays the main sweep to permit detailed examination of a complex signal or pulse train.

CIRCLE 444 ON READER SERVICE CARD

Synchro Test Fixture
PER MIL-S-20708A

ANGLER INDUSTRIES, 3 Lexington Drive, Metuchen, N. J. The fixture illustrated is made to hold synchros for tranformation ratio, phase shift, impedance, primary power and current tests as specified in MIL-S-20708A. The synchros are installed and removed readily by specially designed quick mounting and disconnect clamps, clamp wrench and hardware which are supplied. The fixture features in addition a ground lug which insures complete electrical ground return path. Components in the size range from 5 to 19 may be tested with this fixture. Price is $32.

CIRCLE 445 ON READER SERVICE CARD

Synchronous Motor
VERSATILE

THE SUPERIOR ELECTRIC CO., 83 Laurel St., Bristol, Conn. Type SS150M militarized Slo-Syn synchronous motor finds application as a driving motor for beacons, searchlights, radar antennas and similar duty where an a-c syn-

NEW FROM WESTINGHOUSE:
STATIC POWER SUPPLIES FOR AIRCRAFT/MISSILES

Westinghouse packages silent, lightweight, static transformer-rectifier units now in use on Snark and Sergeant missiles, Lockheed Electra and U.S.A.F. C-130 aircraft. The 200 ampere regulated d-c power supply shown at right is used on the Lockheed Electra. Size: 0.4 cu. ft. Weight: 19 lbs. Regulation is never more than ±.8 volts under all input conditions. Our breadth and depth of line in T-R units meets any specific altitude or environmental condition. For help in solving your static power supply problems, contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

Westinghouse

August 12, 1960
chronous motor having a torque of 150 oz-in. and a speed of 72 rpm is required. Its instant stop, start and reverse characteristics and capability for use as a d-c stepping or "inch ing" motor makes it extremely versatile. Ratings are: input 120 v, 40/70 cycles single phase, 0.4 ampere maximum current (at 60 cycles); 72 rpm output speed, 150 oz-in. torque at 60 cycles. Weight is 6½ lb. Standard types are available with specially designed planetary gear speed reduction assemblies providing speeds of approximately 16.6, 3.3, 0.67, 0.133 or 0.027 rpm.

CIRCLE 446 ON READER SERVICE CARD

The Application of DATA PROCESSING TECHNIQUES

• • • In tracking, timing, guidance and test systems is a familiar problem to Analex® Systems Division engineers.

For almost ten years, they have worked together in the development of logical solutions to special military problems of air, land and sea operations, including equipment for M.I. Spec environments. During this time, they have also developed unusual systems for industrial and commercial applications.

Finished equipment required for these systems may be produced by the customer or by the Analex manufacturing facility under the direct supervision of the engineering group. This division is staffed by technicians and skilled craftsmen who have specialized in the production of sophisticated data processing equipment.

We will be glad to tell you frankly and promptly whether your particular requirement is within the capabilities of our Systems Division.

for further information, write or telephone

ANELEX CORPORATION
150-F CAUSEWAY ST., BOSTON 14, MASS.

CIRCLE 220 ON READER SERVICE CARD
of — 55 C to + 125 C. Any capacitance value can be made between 75 pF and 5,000 pF, with rated voltage of 25 V d-c, 200 V d-c and 500 V d-c. Sizes vary from a in. sq by 0.090 in. thick to 17/32 in. sq by 0.120 in. thick. Capacitors made with Low-Var ceramic material can be obtained with radial leads, axial leads, radial ribbon leads, and axial ribbon leads. Three styles of standoffs are also available.

**CIRCLE 448 ON READER SERVICE CARD**

**Bobbin Winder**

*5-IN. STROKE, 5-IN. O-D*

**GEO. STEVENS MFG. CO., INC., Pulaski Road at Peterson, Chicago 46, Ill.**

Model 315-AM is a 5,000 rpm bobbin-solenoid-repeater-resistor coil winder designed for greater operating convenience. It offers additional freedom of movement for finishing operations by rear mounting traverse rod and wire guide mechanism. Consistent cam tracking is made possible by new cam yoke and traverse system. Quick, convenient change-over is assured by mounting change gears on the front of the head and cam on the rear of the head. Maximum o-d clearance for coil is 5 in.; maximum coil length, 3 in.; maximum loading distance for multiple winding 9 in. and wire sizes wound 18 to 46. Furnished with tension, winding set-up, motor, pre-determining automatic counter, magnetic brake and tailstock.

**CIRCLE 449 ON READER SERVICE CARD**

**SSB Receiver**

**FOR A-M BROADCASTERS**

**KAHN RESEARCH LABORATORIES, INC., 81 S. Bergen Place, Freeport, N. Y.**

Designed for relaying radio broadcast signals, program monitoring in difficult reception areas and various Conelrad applications, model RSSB-59-1A receiver brings to the broadcast industry the most advanced techniques for minimizing selective

**EXCELLENT form-factor and operating versatility make these rugged magnetrons ideal for many small-package applications including CW or pulsed radar beacons, test equipment oscillators, airborne navigation, proximity detection, surveillance, and transponder type operations.**

Light, dependable, and with proven capabilities, these tubes operate at 500 to 600 peak volts and 150 ma peak pulsed current, permitting low-cost modulator components for all applications. They give a nominal power output of 1 watt CW and 15 watts peak.

Engineering programs in progress at Microwave Associates are directed towards development of this tube as a voltage-tunable magnetron within the same form-factor. Your inquiries are welcomed on these and other magnetrons.

*A copy of our new 72 page Magnetron Catalog is available upon written request on your company letterhead.*

**MICROWAVE ASSOCIATES, INC.**

**BURLINGTON, MASSACHUSETTS**

Western Union FAX - TWX: Burlington, Mass., 942 - BRowning 2-3000

**CIRCLE 221 ON READER SERVICE CARD**
The Great Competitive Game being what it is, drastic measures are often necessary if a new product is to be assured of success. Frequently, one must even resort to publishing better specs than the competitor has announced, and then build a product to meet them. Some companies even go so far as to reverse the order of these events but the procedure is rare in North America.

We used to say the Sigma Series 33 was a sliding current relay and that it would work on 200 milliwatts. Now there is evidence to the contrary: (1) the "33" works best when abruptly energized, and (2) there's a new adjustment coded "VG" that needs only 100 µw for operation. (How's that for being wrong two out of two?)

This new subminiature competitor (on the left, next to Dr. Guillotin) stays within spec and won't open its contacts, energized or not, at 30 g to 5000 cycles, under 70 g shocks, and over a -65°C to +125°C temperature range. Contact form is DPDT, polarized, magnetically biased. This is designated "Form Y" by us and means that the armature occupies one closed position when there is no coil signal, the other closed position when a signal of correct polarity and magnitude is applied, and back to the first position when the signal is removed. On special order, 33VG's can be supplied with dual coils and/or gold alloy contacts for dry circuit work.

One other thing about applications: the VG adjustment of the 33 is good for either on-off or off-on requirements; order device in main illustration only if your application is the former. Series 33 Bulletin and VG supplement on request.

At WESCON—Booth 749-750

fading distortion and improving the signal-to-noise ratio of conventional a-m and compatible ssb transmissions. High front end selectivity materially reduces adjacent channel interference, even when interfering signals are many times stronger than desired station. Product de-modulation, utilizing local carrier or reconditioned carrier insertion to minimize selective fading distortion, or conventional a-m diode detection can be selected by front panel switch to suit local reception conditions. Upper or lower sideband reception is also selected by front panel switch.

CIRCLE 450 ON READER SERVICE CARD

Microwave Amplifier
BROADBAND UNIT

ALFRED ELECTRONICS, 897 Commercial St., Palo Alto, Calif. New compact microwave amplifier provides more than 1 w of broadband power output over the entire C band spectrum of 4 to 8 Ge. Model 5-542, which uses a p-m focused twt, provides high gain and flat response over the entire 4 Ge range at one setting of the front panel controls. Some key specifications are: saturated power output, 1 w minimum output, 25 db minimum; external amplitude modulation, front panel BNC connector capacitively coupled to twt grid with response of 10 cps to above 10 Mc.

CIRCLE 451 ON READER SERVICE CARD

Transistor Oscillator
EPOXY ENCAPSULATED

SOLID STATE ELECTRONICS CO., 15321 Rayen St., Sepulveda, Calif. Model
S-200 silicon transistor sinusoidal oscillator is completely epoxy encapsulated. Frequency stability as a function of supply voltage and temperature have been emphasized together with rugged reliability. Power requirements are extremely low. This oscillator makes possible the concentration of a large number of discrete control and information functions per unit volume and weight. It has an inherently long life and should provide years of trouble-free service. Model S-200 is virtually immune to the effects of shock, vibration and acceleration making it ideal for military, missile and space vehicle, industrial and portable applications; also wherever power conservation, miniaturization and elimination of maintenance are a necessity.

CIRCLE 452 ON READER SERVICE CARD

Servo Amplifiers
SOLID STATE
K-F PRODUCTS, INC., 3100 E. 43rd Ave., Denver 16, Colo. Model 101 is a 20 W, 60 cps servo amplifier for use with d-c input signals. The lightweight unit contains no vacuum tubes. A 100 mv d-c input will cause 115 v, 60 cps output to rated load. The unit is self protected from overload due to excessive input signal. Input impedance is resistive and over 500 K ohms. Noise output is negligible and the waveform shows less than 10 percent harmonic distortion. Gain, zeroing and output controls are provided.

CIRCLE 453 ON READER SERVICE CARD

Transistors
INTERMEDIATE POWER
TRANSISTRON ELECTRONIC CORP., 168 Albion St., Wakefield, Mass., announces a series of four intermediate power diffused mesa transistors in the convenient 3½ in. stud-mounted hex package. Characteri-

Yuba is constantly developing precision specialty components for integrated electronic systems in aircraft, missiles and industry. Yuba's proven capabilities for research, design, development and production assure you of the finest in precision equipment. In the field of airborne motors and generators, for example, Yuba-Dalmotor Division has moved ahead. They will design and produce to your strict specification—with minimum lead time. Shown above are several of the Yuba-Dalmotor's carefully produced precision products.

Yuba also produces signal converters, radio sondes, special purpose computers, telemetering and communications systems, and special instrumentation as well as mass-produced precision motors of all sizes.

CIRCLE 223 ON READER SERVICE CARD
new!
First Subminiature 10 amp Magnetic Latching Relay

Newest in a series of recent state-of-the-art advancements at Babcock is the 1.1 oz. BR-9 Magnetic Latching Relay. Permuting contact loads from dry circuit to 10 amps, the BR-9 standard relay meets MIL-R-5757C and MIL-R-25018 specifications and is applicable for numerous airborne, ground and undersea programs. Available in two DPDT types: BR-9X with contacts rated to 10 amps and BR-9Y with contacts rated to 5 amps dry circuit. Life tests prove the BR-9 series capable of over 200,000 miss-free operations at extremes of temperature and load. Write for Bulletin BR-A.

SPECIFICATIONS
Vibration: 30 g, 10-2000 cycles. Shock: 50 g, 11 millisec. Diel. Str.: 1250 V. Insul. Res.: 10,000 MΩ. Life: 100,000 operations min. @125 C to MIL-R-5757C. Temp. Range: -65°C to +125°C to MIL-R-5757C. Duty: Continuous.

Other Babcock Relays include BR-1SZ 5 mw Relays, BR-7 ten amp Relays and BR-8 subminiature Relays.

BABCOCK RELAYS, INC.
1640 Monrovia Avenue
Costa Mesa, California

tics include a power dissipation of 20 w at 100°C case; a low saturation resistance (typical resistance 1.7 ohms); good beta linearity with an operating current range of 50 ma to 2 amperes; and voltage of up to 120. Applications include regulated power supplies and amplifier output stages.

Circle 454 on Reader Service Card

Tape Reader

SINGLE LINE

CALIFORNIA TECHNICAL INDUSTRIES,
1421 Old County Road, Belmont,
Calif. Model 220 tape reader can operate either single line or continuous run from an external trigger source on the front panel switch. It is designed to accommodate 5, 6, 7 or 8 hole, one inch paper Mylar tape, and can operate at a reading speed of 60 lines (or characters) per sec self-stepping or 50 lines per sec impulse stepping. It will maintain positive indexing of tapes, free from kickback or overshooting. The contact head is pivoted into accurate alignment and permits the tape to be changed easily. Unit is 6 in. high by 6 in. wide by 6 in. deep, enabling it to be easily mounted in a relay rack paneling. Price is $235.

Circle 455 on Reader Service Card

Chopper Package

FOR PRINTED BOARD USE

JAMES ELECTRONICS INC., 4050 N.
Rockwell St., Chicago 18, Ill., introduces a new hermatically sealed miniature chopper package for
INTERNATIONAL CONGRESS AND EXHIBITION FOR INSTRUMENTATION AND AUTOMATION

INTERKAMA

1960

DUESSELDORF \(19 - 26\) OCTOBER 1960
Nordwestdeutsche Ausstellungs-Gesellschaft mbH. (Nowea)
Düsseldorf, Messegelände • Telex: 08584853 Nowea Dssd.

For Information:
German American Chamber of Commerce
666 Fifth Avenue, New York 19, N. Y.
CIRCLE 311 ON READER SERVICE CARD

There's going to be a meeting

Who's going to get together and what are they going to talk about?
Electronics men are meeting all over the country to talk about everything from ultrasonics to quantum electronics.
electronics tells you where and when “Meetings Ahead” ... gives you the highlights later on.
Another reason why it will pay you to subscribe to electronics (or renew your subscription) right now. Fill in the box on Reader Service Card. Easy to use. Postage free.

FIND WHAT YOU NEED IN...
electronics

SENSITIVE 2 AMP RELAY

for

*15 g to 2000 cps vibration

OPERATING CONDITIONS:
AVERAGE PULL-IN POWER:
SPDT 25 milliwatts at 25°C
DPDT 40 milliwatts at 25°C

CONTACT RATINGS:
Non-inductive — 2 amperes at 29 volts d-c
or 1 ampere at 115 volts a-c
Low level contacts are available on request

VIBRATION:
5-55 cps at 0.12 inch double amplitude
55-2000 cps at a constant 15 g
*20 g available on request

SHOCK:
50 g operational

TERMINALS:
0.2 inch grid spaced

WEIGHT:
1.1 ounce maximum

Write for Bulletin JSH #62

ALLIED CONTROL COMPANY, INC.
2 EAST END AVENUE, NEW YORK 21, N. Y.

August 12, 1960
printed board application. The new lay-down package has features for low level signal application in both military and commercial equipment. It can be either directly soldered into a P.C. board or plugged into standard transistor sockets. Models are available for operating frequencies from 1 to 500 cps. Both MBB and BBM switching configurations are offered. Temperature range is \(-55^\circ\) C to \(125^\circ\) C. These choppers will operate properly with shock to 50 g and vibration of 30 g from 10 to 2,000 cps. Residual noise is less than 15 \(\mu\)V at 400 cps into 1 megohm. The straight through copper leads reduce thermal noise to extremely low levels.

**CIRCLE 456 ON READER SERVICE CARD**

Variable Delay Line

**MAGNETOSTRICTIVE CONTROL ELECTRONICS CO., INC., 10 Stepar Place, Huntington Station, L. I., N. Y., has developed a delay line with a continuous range of delays from 3 to 3,700 \(\mu\)sec. Model VM-1090 features precise calibration and requires 27 turns to cover the full range. The unit is supplied with an impedance range from 50 ohms to 4 K ohms. Insertion loss at the end of the range, 63 db. Maximum number of pulses per sec is 5 Kc. Unit is 3\(\frac{1}{2}\) in. in overall length and has a 9 in. o.d. Weight is 5 lb. Torque is held to a maximum of 2 oz in. The VM-1090 has application as a range calibrator for radar systems and can be supplied to suit customer's particular requirements.**

**CIRCLE 457 ON READER SERVICE CARD**

Sweep Oscillator

**FLEXIBLE UNIT HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model**
682A sweep oscillator is a convenient and flexible instrument for obtaining c-w and swept r-f frequencies, 1,000 to 2,000 Mc. Independent, direct reading frequency, sweep rate and sweep range controls permit fast adjustment and full covering of frequency range. Rates are fast enough for nonflickering trace on any oscilloscope or slow enough for mechanical recording devices. Model 682A maintains output flat to within ±1 db.

CIRCLE 458 ON READER SERVICE CARD

Power Triode

CERAMIC-METAL

ITT COMPONENTS DIVISION, P.O. Box 412, Clifton, N. J. The D-1008 ceramic-metal power triode, designed specifically to withstand environmental extremes, is a water-cooled tube featuring a heavy wall copper anode and mesh type cathode of proven design. Tube is rated at 60 Kw full power input to 50 Mc and reduced input to 110 Mc with maximum anode dissipation rated at 20 Kw. Typical applications include use as a Class C amplifier in commercial service or as an oscillator in dielectric and induction heating service. As a hard-tube radar modulator, this tube is capable of switching 220 amperes at voltages up to 18 Kv at rated cathode voltage. The D-1008 is available for immediate shipment and priced at $380.

CIRCLE 459 ON READER SERVICE CARD

TWT Amplifiers

X-BAND, C-BAND

MICROWAVE ELECTRONICS CORP., 4061 Transport St., Palo Alto, Calif., announces ttw amplifiers in X-band and C-band designed for serrodyne, amplitude or phase modulation applications. The M2204-A operates in the 7,000-12,400 Mc

---

stable
ac power
INVERTRON
from
Behlman

From a wide variety of “meet your needs” models, off the shelf or on special order, you can choose an electronically tailored INVERTRON for research, development and testing. Total harmonic distortion 1% max. with lower distortion on special order. Voltage regulation: 1% no load to full load standard; to .01% available on special order. Standard output voltage on single, two and three phase models, 0-130 variable. Response time: 20 milliseconds.

POWER RATINGS AVAILABLE:

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>POWER</th>
<th>MODEL NO.</th>
<th>POWER</th>
<th>MODEL NO.</th>
<th>POWER</th>
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<tbody>
<tr>
<td>23</td>
<td>20 VOLT AMPERES</td>
<td>43</td>
<td>40 VOLT AMPERES</td>
<td>63</td>
<td>60 VOLT AMPERES</td>
</tr>
<tr>
<td>41</td>
<td>40 VOLT AMPERES</td>
<td>82</td>
<td>80 VOLT AMPERES</td>
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<td>83</td>
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<td>150 VOLT AMPERES</td>
<td>502</td>
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<td>1503</td>
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<td>6002</td>
<td>6000 VOLT AMPERES</td>
<td>2003</td>
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<td>1500 VOLT AMPERES</td>
<td>10002</td>
<td>10000 Volt AMPERES</td>
<td>3003</td>
<td>3000 VOLT AMPERES</td>
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<td>2001</td>
<td>2000 VOLT AMPERES</td>
<td>20002</td>
<td>20000 Volt AMPERES</td>
<td>6003</td>
<td>6000 VOLT AMPERES</td>
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<td>3000 VOLT AMPERES</td>
<td>30002</td>
<td>30000 Volt AMPERES</td>
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<td>15001</td>
<td>15000 VOLT AMPERES</td>
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OUTPUT FREQUENCIES AVAILABLE:

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<tr>
<th>MODEL LETTER</th>
<th>FREQUENCY ACCURACY</th>
<th>FREQUENCY ACCURACY</th>
<th>FREQUENCY ACCURACY</th>
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<tr>
<td>A</td>
<td>60 FIXED</td>
<td>x x x x x x</td>
<td>60-1350 VARIABLE</td>
</tr>
<tr>
<td>B</td>
<td>50-75 VARIABLE</td>
<td>x x</td>
<td>55-65 VARIABLE</td>
</tr>
<tr>
<td>C</td>
<td>40-250 FIXED</td>
<td>x x x x x</td>
<td>200-2000 VARIABLE</td>
</tr>
<tr>
<td>D</td>
<td>250-450 VARIABLE</td>
<td>x x x x</td>
<td>200-2000 VARIABLE</td>
</tr>
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<td>300-500 VARIABLE</td>
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<tr>
<td>F</td>
<td>150-150 VARIABLE</td>
<td>x</td>
<td>SF/SH</td>
</tr>
</tbody>
</table>

Frequency Accuracy Code: 1=0.5%; 2=0.8%; 3=0.1%; 4=0.05%; 5=0.01%; 6=0.001%; 7=0.0001%; 8=0.00001%.
HIGH QUALITY
CONSTRUCTION
Assures
DEPENDABLE
PERFORMANCE
OF
HICKORY BRAND
Coaxial Cables

Hickory Brand RF Cables consist entirely of high-quality components fabricated to uniformly high standards.

Conductor insulation and dielectric material is polyethylene for maximum operating efficiency, making these cables especially adaptable to applications requiring high, very high and ultra-high frequencies.

Typical examples of Hickory Brand Coaxial Cables:

<table>
<thead>
<tr>
<th>Army-Navy Type No.</th>
<th>Dia. of Dielectric In.</th>
<th>Nom. Imp. OHMS</th>
<th>Attenuation 20/100 Hz</th>
<th>Shielding Braid</th>
<th>Nom. Overall Dia. In.</th>
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</thead>
<tbody>
<tr>
<td>RG-8A/U</td>
<td>.285&quot;</td>
<td>52</td>
<td>6</td>
<td>19</td>
<td>Single Copper</td>
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<tr>
<td>RG-9B/U</td>
<td>.280&quot;</td>
<td>50</td>
<td>6.1</td>
<td>21.8</td>
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<tr>
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<td>5.7</td>
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<tr>
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<td>9</td>
<td>30</td>
<td>Single Copper</td>
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<tr>
<td>RG-74A/U</td>
<td>.370&quot;</td>
<td>50</td>
<td>4.3</td>
<td>14</td>
<td>Double Copper</td>
</tr>
</tbody>
</table>

All Hickory Brand Electronic Wires and Cables are quality-engineered and precision-manufactured to meet the exacting requirements of the industry.

Write for complete information on the full line of HICKORY BRAND Electronic Wires and Cables

Manufactured by
SUPERIOR CABLE CORPORATION, Hickory, North Carolina

frequency range and the M2203-B operates in the 4,000-8,000 Mc range. Either tube will provide greater than 20 db gain and at least 10 mw of power output. The sideband suppression at a modulation rate of 150 Kc is at least 35 db. A grid is provided for linear amplitude modulation. The tubes are solenoid focused, of metal-ceramic construction and use low temperature oxide cathodes. They are priced at $1.10 each.

CIRCLE 460 ON READER SERVICE CARD

D-C Amplifier
MEETS MIL-E-5272

TEMCO ELECTRONICS, a division of Temco Aircraft Corp., P. O. Box 6191, Dallas 22, Texas. Model 100A d-c amplifier is designed to convert low level d-c input to ±2.5 d-c output. Unit has continuously adjustable gain between steps of 10-100 and 100-500. Features include: 0.5 percent best straight line linearity, gain stability of 0.5 percent full scale of 25 C value, less than 5 K output impedance, and 20 mv peak-to-peak ripple (carrier). Frequency response filters are interchangeable, and the unit will meet applicable portions of MIL-E-5272. Unit measures 5 by 2½ by 1½ in. It is designed for application in strain gages and thermocouples.

CIRCLE 461 ON READER SERVICE CARD

Precision Pots
HIGH RELIABILITY

CARTER MFG. CORP., 23 Washington St., Hudson, Mass., announces new 1½ in. high reliability precision electronic components.
pots. All standard resistance values are manufactured with 20 ppm resistance wire and can dissipate 2 w at 125 C for more than 2,000 hr. Two basic models, type 136F (bronze bearings) and type 136H (ball bearings) are available as stock items. All models feature a drum design which permits conformities to 0.1 percent for all resistance values, up to 16 taps to +0.25 deg and precision machined metal housings. Environmental specifications include 1,000 meg ohms insulation resistance after 10 day humidity test and less than 100 ohms resistance between contact and winding (equivalent noise resistance) during and after vibration and shock test.

CIRCLE 462 ON READER SERVICE CARD

Proportional Controller
FOR TEMPERATURE
HARREL, INC., 1788 First Ave., New York 28, N. Y. The TC-203 has efficiency in excess of 90 percent and gives smooth proportional control of temperature. At the same time, the output is free of all switching transients which characterize most high efficiency proportional controllers. Unit is particularly applicable for use with gyro test stands or other equipment where noise output on the heater can be objectionable. It is completely solid state and is furnished hermetically sealed and potted to meet applicable military environmental conditions. Standard power capabilities are 100 or 200 w, in either 60 or 400 cps models.

CIRCLE 463 ON READER SERVICE CARD

Tapered Transitions
WIDE RANGE
DEMORNY-BONARDI, 780 Arroyo Parkway, Pasadena, Calif., announces a complete line of tapered

NEW "SILDISC" 500 mW SILICON DIODE FOR PRINTED CIRCUITS

Only 3/16" dia. x 1/16" thick

New double-cup design saves space, dissipates heat more efficiently. Plug it in ... clip it in . . . solder it in or pressfit. Can be mounted many ways.

LOW LEAKAGE "SILDISC" DIODES

<table>
<thead>
<tr>
<th>CC Part Number</th>
<th>PIV</th>
<th>Reverse De Current at Rated PIV mA</th>
<th>Max. Rectified De Output Current mA</th>
<th>Forward De Volt. Drop at Rated De Current Volts</th>
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</thead>
<tbody>
<tr>
<td>CC-5 15</td>
<td>15</td>
<td>.010</td>
<td>500</td>
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<tr>
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<td>.010</td>
<td>500</td>
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<td>.010</td>
<td>500</td>
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<td>CC-5 75</td>
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<td>.015</td>
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<td>.020</td>
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<td>.025</td>
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DOUBLE ANODE TWIN ZENER "SILDISCS"

<table>
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<tr>
<th>CC Part Number</th>
<th>ZENER VOLTAGE RANGE</th>
<th>TYPICAL IMPEDANCE</th>
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<tr>
<td></td>
<td>E1 (Min) Volts</td>
<td>E2 (Max) Volts</td>
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<td>CCSD-1.5</td>
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<td>CCSD-1.8</td>
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<td>CCSD-2.2</td>
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<td>CCSD-2.7</td>
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<td>CCSD-3.3</td>
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<td>CCSD-18</td>
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</tr>
<tr>
<td>CCSD-33</td>
<td>29.5</td>
<td>36.2</td>
</tr>
</tbody>
</table>

A few mounting possibilities and configurations. Consult us about your special problems.

Offset "Sildisc" allows contact at any angle.

"Sildisc" with one center lead vertical to board.

Double offset "Sildisc" inserted in terminal strip.

Press-fitted into 2-sided board for dip soldering.

Press-fitted into 1-sided board for dip soldering.

Riveted into 2-sided printed circuit board.

2-sided lead terminal "Sildisc" on 1-sided board.

* * * Miniature is the watchword with this new CC silicon diode. The "Sildisc" fits tightest requirements. New double-cup design has maximum heat dissipation. Ask about CC's complete line of silicon rectifiers and Zener diodes available in low, medium, and high power. Call or write for catalog and engineering data.

CTOOLS COMPANY OF AMERICA
ELECTRON DIVISION
811 W. Broadway, P.O. Box 937, Tempe, Arizona

CIRCLE 231 ON READER SERVICE CARD
transitions covering the frequency range from 3,950 to 140,000 Mc. Units are available in any one of 60 combinations of input and output sizes. Thus it is possible to transfer energy from one size waveguide to any other size waveguide within the range, using only a single transition. The DB-918 transitions feature outstanding power-carrying capacity and an intrinsically good match over a wide frequency band. High mode purity is provided for applications where the frequency coverage of two waveguides overlap. Units are designed with the shortest insertion length consistent with low VSWR and mode purity. All units are plated nickel over silver over copper. Standard UG-n/U cover flanges are supplied unless otherwise specified. Prices range from $50 to $270, depending on size and quantity.

**CIRCLE 464 ON READER SERVICE CARD**

**Power Supply**

**TRANSISTORIZED**

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. Model 722A supplies fully regulated d-c output voltages to 60 v at 2 amperes. It has a three-terminal output so that either positive or negative terminal may be grounded. Features include a circuit which limits the output current to a value determined by a front panel switch, thereby preventing damage to transistors under test.

**CIRCLE 465 ON READER SERVICE CARD**

**Silicon Chopper**

**HIGH VOLTAGE**

SOLID STATE ELECTRONICS CO., 15321 Rayen St., Sepulveda, Calif. Model 150 high voltage silicon transistor chopper is a solidly encapsulated unit designed to alternately connect and disconnect a load from a signal source. It may also be used as a synchronous demodulator to convert an a-c signal to d-c. Linear switch-
work in Southern California on the

EAGLE

ADVANCED OPPORTUNITIES FOR SENIOR ENGINEERS

Bendix-Pacific Division, North Hollywood, California, as a member of the Bendix Corporation "EAGLE" Development Team, is a major contributor to the Navy's newest air-to-air Missile "EAGLE." This weapon system is a second generation air-to-air Fleet Defense System and offers challenging design opportunities to the creative engineer.

ADVANCED POSITIONS ARE OPEN TO MEN WITH BACHELOR, MASTER AND DOCTOR DEGREES IN ELECTRICAL AND MECHANICAL ENGINEERING WITH EXPERIENCE IN ELECTRONIC CIRCUIT DESIGN AND MECHANICAL PACKAGING. OTHER HIGH-LEVEL ELECTRONIC ENGINEERING POSITIONS AVAILABLE

Please send resume to
W. C. WALKER, Bendix-Pacific Division
ENGINEERING EMPLOYMENT MANAGER
NORTH HOLLYWOOD, CALIFORNIA

WHAT'S BEST IN HIGH VACUUM MEASUREMENT?

Do you know the specific advantages and disadvantages of 11 different vacuum gages? Improved electronic gage designs are extending measuring range to \(10^{-14}\) mm Hg. Measurement and control are keys to the success of many production and test applications — electronics has the story! (See issue of October 16th, 1959.) Another reason to subscribe to electronics (or renew your subscription). Fill in box on Reader Service Card now. Easy to use. Postage free.

FIND WHAT YOU NEED IN...

electronics

August 12, 1960
Mr. Ramsey*

Why is the original capacitor design still the best?

...because of this seal

...this shoulder and curl design (Pat. No. 2,744,217) ... which creates the only leakproof seal possible for a tantalum capacitor.

Here's why it does: it forms a steady downward pressure all the way through the capacitor's operating temperature range. It leaves a "dead air" space to guard against capillary action. As you can see, it also integrates perfectly the top gasket and the case curl. These are just 3 of the reasons why the Fansteel original capacitor has been used in millions of applications ... with utmost reliability

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

*Glen Ramsey ... Vice President of Fansteel, General Manager of the Rectifier-Capacitor Division, developer of the porous tantalum anode in 1936 ... the achievement which made today's miniature tantalum capacitors possible.

High-Gain Tetrode METAL-CERAMIC

GENERAL ELECTRIC CO., Schenectady 5, N.Y. Type GL-7399 is a metal-ceramic tetrode designed for r-f pulsed amplifier service in L-band radar transmitters. Features are long pulse width, broad band capabilities, high peak power, high gain and long life. In plate-and-screen pulsed service, the tetrode is rated for 50 Kw of peak power at 500 Mc, with a power gain of 20 and a pulse width of 15 μsec. The tube is capable of providing useful output up to approximately 1,500 Mc. It has a life history of 3,000 hr average (minimum) over a seven-year period.

Rugged Delay Line MAGNETOSTRICTION TYPE

FERRANTI ELECTRIC INC., 95 Madison Ave., Hempstead, L.I., N.Y. Type
5912 is designed for military or industrial use where severe environments may be encountered. Designed originally for digital storage applications, it has a capacity of over 2,000 bits at a 1 Mc (RZ) digit rate or 4,000 bits at 2 Mc (NRZ). To permit operation over a useful temperature range without the use of any temperature control facilities and with this large storage capacity a very close control of the delay temperature characteristic is required and the type 5912 can be supplied with a temperature coefficient of delay of 0.5 ppm per deg C.

CIRCLE 468 ON READER SERVICE CARD

VHF Amplifier
3-OCTAVE BANDWIDTH

APPLIED RESEARCH INC., 76 S. Bayles Ave., Port Washington, N. Y. Model HFW-5(C)-326 amplifier provides better than 3-octave coverage, 20 db gain, and low noise figure. It combines ruggedness, simplicity, and power economy, and is supplied on a panel for standard rack mounting. Synchronous tuning, low source and output impedance and optional power supply are features. Frequency range is 30 Mc to 265 Mc, overall noise figure less than 8 db. Using only five tubes, the power requirements are 22½ w anode power, 9½ w tube heater power. Dimensions of the unit, without power supply, are 19 in. long by 3½ in. high by 6½ in. deep; weight is 7½ lb.

CIRCLE 469 ON READER SERVICE CARD

Power Supply
VERSATILE UNIT

ANDERS ELECTRIC PRODUCTS INC., Brook Road, Needham Heights 94, Mass. Model F1002A contains four regulated power supplies which are isolated and may be connected in many combinations for computers or transistorized equipment in the laboratory or shipable equipment. Available voltages: 1 to 15 v d-c

CIRCLE 235 ON READER SERVICE CARD
This is the new Union Crystal Case Relay

The UNION 2-PDT General Purpose Crystal Case Relay is designed to consistently meet the requirements of MS 24250, Mil-R-25018, Mil-R-5757C. Use it where minimum size and optimum reliability are essential—in control systems, computers, airborne and guided missile electronic equipment.

To provide vibration immunity, we have incorporated a unique feature in this relay’s armature suspension system. A torsion wire is anchored to the armature and backstrap. It acts as a biasing spring; supports the armature and eliminates end play. The relay uses the rotary principle of operation, found in the entire line of extremely reliable Union Switch & Signal miniature relays.

The 2-pole, double throw, bifurcated contact structure increases reliability and efficiency in dry circuit applications. UNION Crystal Case Relays are designed for continuous operations in the —65°C to +125°C range.

Union Switch & Signal's manufacturing capabilities and experience make it possible to provide these quality relays in quantity. Manufacturing techniques make it possible to provide the ultimate in reliability.

The new UNION Crystal Case Relay is available with the 0.2" grid-spaced header or “S” type header, with solder lugs, plug-in terminals, or 3-inch leads, and for various operating voltages.

Contact Union Switch & Signal for additional information about this new Crystal Case Relay. Write for bulletin 1064.

Vibration: 20 G—2,000 cps
Shock: 50 G
Temperature Rating: —65°C to +125°C
Contact Rating: Dry circuit to 2 amp., 28-volt DC resistive load.

See the new UNION General Purpose Crystal Case Relay at the WESCON Show, Memorial Sports Arena, Los Angeles, California, August 23-26, 1960, Booth 2828-2829.

“Pioneers in Push-Button Science”

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY—PITTSBURGH 18, PENNSYLVANIA

for each output in current ranges of 2, 4, and 8 amperes. Regulation is better than 0.1 percent for line and load. Ripple is better than 1 mv rms. Remote sensing and short circuit proof. Input range from 105 to 125 v, 50 to 400 cps, 1 phase. Size 19 in. wide, 101 in. high and 171 in. deep, adaptable for relay rack mounting. Operation up to 50 C ambient.

CIRCLE 470 ON READER SERVICE CARD

D-C Voltage Monitor
TRANSISTORIZED

TRIO LABORATORIES, INC., Plainview, L. I., N. Y. Model 203-1 fully-transistorized voltage monitor is a full-time, precision voltage sensing instrument with go/no-go output. It can be used for external alarm, indicator or control circuits. Standard with all units are “inhibit” and “latch” terminals. The “inhibit” terminal prevents operation of the monitor at selected times without disrupting other connections. The “latch” terminal, when connected to the “inhibit” terminal will lock the normally open contacts in the closed position when the input exceeds the pull-in voltage. This instrument is ideal for missile, aircraft and support equipment applications.

CIRCLE 471 ON READER SERVICE CARD

Subcarrier Calibrator
FOR TELEMETRY USE

PANORAMIC RADIO PRODUCTS, 520 S. Fulton Ave., Mt. Vernon, N. Y. Simultaneous discriminator linearity measurements in all 18 IRIG
From 12 to 1200 watts...there's a General Electric soldering iron to do your job...

...AND GENERAL ELECTRIC WILL HELP YOU CHOOSE THE EXACT IRON YOU NEED

Whatever your soldering requirements may be—from complex miniature electronic sub-assemblies to heavy-duty industrial uses—one of the high-speed soldering irons in General Electric's complete line will do the job. The G-E irons shown above include (left to right):

MINIATURE for production-line soldering of sub-miniature assemblies.

MIDGET for pinpoint soldering of hard-to-reach joints.

EXTRA HEAVY-DUTY for industrial high-wattage soldering.

LIGHTWEIGHT for soldering of most electronic components.

INDUSTRIAL for general industrial soft-solder applications.

For expert assistance in choosing the exact iron you need, contact your General Electric distributor or local G-E Apparatus Sales Office; or write Section 758-03, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

August 12, 1960
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.

PROTECT VITAL MAGNETIC TAPES

When accidentally exposed to unpredictable magnetic fields, presto! — your valuable data is combined with confusing signals or even erased.

For complete, distortion-free protection of valuable magnetic tapes during transportation or storage. Single or multiple reel Rigid Netic Enclosures available in many convenient sizes and shapes.

Write for further details today.

Crystal Filters

PRECISION UNITS

SYSTEMS INC., 2400 Diversified Way, Orlando, Fla. Typical of the broad range of crystal filters now being offered is the new 10 Mc band-pass filter No. BP-1000-40. Developed for application in transistorized i-f amplifiers, it is manufactured to meet applicable MIL specifications, operates from -55 C to 65 C in salt laden atmosphere. The hermetically sealed unit is capable of withstanding 50 g shock. Ripple is 0.5 db. Dimensions are 1/2 in. by 1/4 in. by 2 in.

Photoconductive Cells

LOW RESISTANCE

CLAIREX CORP., 19 W 26th St., New York 10, N. Y. Type L low resist-
The power supply is designed to meet the needs of various electronic applications. It is a separable regulator, which means it is not connected to the unit proper and can be used independently. The regulator is designed to operate without a feedback system, and it is suitable for a variety of applications, including long-range sampling and programming.

For quality, performance, and reliability, C-A-C can supply the following toroids:

- **Hermetically Sealed** for use on the roughest, toughest jobs in missiles, airborne equipment, extreme conditions, and temperatures.
- **Molded Plastic**. C-A-C's complete line is available in plastic encapsulation.
- **Sub-Miniatures** to meet all requirements. Molded plastic or hermetically sealed for chassis mount or printed circuits.
- **Open Coil** for commercial applications or sub-assemblies.
- **Special Core Types** in a variety of permeabilities and sizes, including temperature stabilized. Many are carried in stock.

**NEW at C-A-C**

"Poker Chips"

Thin shaped, easily stocked, plastic packaged, saturable reactors, pulse transformers, DC to DC converters and 400 cycle power transformers. Can be sub-miniaturized. Terminals to meet requirements. Mill specs. Fast delivery. Send your specifications. See us at Wesccon Booth 764

**Hitch Your Breadboard to this Wagon!**

For quality, performance, and reliability, C-A-C can supply the following toroids:

- **Hermetically Sealed** for use on the roughest, toughest jobs in missiles, airborne equipment, extreme conditions and temperatures.
- **Molded Plastic**. C-A-C’s complete line is available in plastic encapsulation.
- **Sub-Miniatures** to meet all requirements. Molded plastic or hermetically sealed for chassis mount or printed circuits.
- **Open Coil** for commercial applications or sub-assemblies.
- **Special Core Types** in a variety of permeabilities and sizes, including temperature stabilized. Many are carried in stock.

**ELECTROMECHANICAL SWITCHES FOR TELEMETRERING SYSTEMS!**

Specifications, performances, applications for typical electromechanical commutators for long-range sampling, programming. Quick comparisons let you know what’s going on... see October 2nd, 1950 issue (did you miss it?). Another reason to subscribe to electronics (or renew your subscription). Fill in Reader Service Card box. Easy to use. Postage free.

**FIND WHAT YOU NEED IN...**

**electronics**
Pressure Transducer
EXPANDED-SCALE

WIANKO ENGINEERING CO., 255 N. Halstead, Pasadena, Calif. For applications where interest lies primarily in the upper end of a pressure transducer's rated range, the P2-1253 pressure transducer functions on specific portions of range; for example, 475 to 550 psi. Full 0-5 v d-c output is provided for this portion of the range rather than dissipating the output in areas of no interest and accuracy increases proportionally. Features: high output—no amplification needed; exceptional resistance to acceleration and vibration; no friction effects; constant output impedance and continuous resolution. Accuracy: combined linearity and hysteresis—better than 0.15 percent of pressure.

PACKAGED OSCILLATORS
CRYSTAL CONTROLLED

VALPEY CRYSTAL CORP., Holliston, Mass. Available in tube type or transistorized circuitry, and operating over a frequency spectrum of 60 cps to 10 Me, these oscillators are available with stabilities from...
High Voltage Breakdown

Leakage Current Measurement

of Assemblies, Components and Materials

HYPOT® High Potential Test Sets provide accurate, direct-reading measurement of insulation leakage current for over-potential tests to applicable commercial and military specifications. Available are models supplying test potentials to 150 kv and higher. Optional features include automatic control for rate of test voltage rise, audio- and cycling and provisions to meet every application.

10 kv Insulation Testing . . . Portable HYPOT® Jr.

Insulation testing at a-c potentials with separate indication of leakage current and insulation breakdown. Optional features including audible "squealer" leakage current indicator with provision for external control circuits, meet needs of high production and automated test installations.

Model 404 HYPOT® Jr. is designed for insulation testing of components, assemblies, and cables. Output variable 0 to 4000 v a-c, read on a 100 volt meter. Leakage limit light adjustable from 0.3 to 3.0 ma. Arcing and corona signalled by separate indicator lights. Operates from 110-120 v, 50/60 c outlet. Measures 6" x 9" x 8½". Weight is 20 lbs. Net, complete $150.00

Insulation Leakage .02 mma to 10 ma . . . Potentials to 30 kv

Bench HYPOT® Test Sets, a-c and d-c models, have outputs to 30 kv. Separate 0-10 kv meters for test voltage and leakage current. Wide selection of models to meet specific applications.

Model 424 Bench HYPOT® provides 0-5000 v d-c. For testing cables, transformers, coils, transformers, motors and complete assemblies. Measures leakage current from 0.1 microampere to 100 microamperes over four scale ranges. Rapid testing of capacitors with output of 2 milliamperes under short circuit. Operates from 110-120 v 50/60 c outlet with long-life selenium high-voltage supply. Net complete $497.50

Test Potentials 150 kv and up

Mobile HYPOT® Test Sets offer potentials to 150 kv and higher. Power source and metering circuits in a single, mobile cabinet. Write for new HYPOT® Catalog.

Insulation Materials Tester . . . ASTM Specs.

Fixtures for Tape, Film, Liquids and Solids

Dielectric strength of materials determined to laboratory accuracy . . . net speed and simplified operation meet needs for production and quality control applications. Transparent test cube with safety interlocks is optional as well as automatic rate of rise control. Interchangeable fixtures available for varnishes, porcelain, oils, solid filing compounds, paper, tape, acetal sheets, film, tubing and drums. Prices start at $1725.00. Write for bulletin describing the Model 4301 HYPOT® Materials Tester.

NEW!

Complete Catalog

Write today!

Write today for new “Manual on Insulation Testing” describing the complete range of HYPOT® Test Sets and VIBROTEST® Resistance Measuring Instruments.

CIRCLE 319 ON READER SERVICE CARD

ASSOCIATED RESEARCH, Incorporated

“Electrical Testing Instruments Since 1936”

3781 W. Belmont Avenue

August 12, 1960

CHICAGO 18, ILLINOIS

CIRCLE 241 ON READER SERVICE CARD
Systems Concept

IN THE DESIGN OF HIGH RELIABILITY ELECTRO-MAGNETIC PRODUCTS

Wheeler electro-magnetic products are more than just "high reliability components." They are engineered, designed and manufactured as integral parts of entire systems...as the core of a system's reliability. Wheeler's experience in systems work assures complete compatibility of the electro-magnetic components with the system requirements.

Wheeler has complete engineering, design and manufacturing facilities for producing transformers, power supplies, voltage regulators, magnetic amplifiers, current regulators and communications equipment for such systems as Countermeasures, Missiles, Ground Checkout and Test Equipment, Communications, Missile Beacons, Navigation and Early Warning Radars.

Wheeler's team of exceptionally well-qualified engineers will skillfully interpret and develop your specifications, and will translate your special needs into efficient production methods constantly keeping in mind the vital part each component will play in the system.

All of these skills, plus the constant test and inspection procedures used at Wheeler, assure you of the highest reliability components and products.

±0.1 percent to ±0.001 percent as standard. Custom units with stabilities to ±5 parts in 10⁶ are also available. The units can be designed to specification over any temperature range from −65 C to +125 C. Standardized pulse and squarewave, or stable sinewave outputs are available, with load impedances from 50 ohms and up. Standard packaged units can be furnished for plug-in or stud mounting and custom configurations can be supplied, including sealed units and plug-in printed circuit boards for computer and other modular systems.

CIRCLE 477 ON READER SERVICE CARD

Gearheads

NO BACKLASH

ELLISON ENGINEERING CO., 4580 San Fernando Road, Glendale 4, Calif. Elimination of backlash makes these gearheads especially suitable for driving potentiometers, synchros, indicators, or other low torque devices. Standard ratios are available from 11.27/1 to 2,254/1 with other ratios on special order. Starting torque is held to approximately 0.05 in. oz depending on the ratio and usable output torque is 2 in. oz minimum. Ball bearings are provided in either aluminum or stainless steel housings.

CIRCLE 478 ON READER SERVICE CARD

Attenuator

CONTINUOUSLY VARIABLE

ANTENNA & RADOME RESEARCH ASSOCIATES, 27 Bond St., Westbury, N. Y., has introduced a miniature S-band continuously variable at-
WHAT HAPPENS
WHEN A NATION
SPENDS MORE
ON GAMBLING
THAN IT SPENDS FOR
HIGHER EDUCATION?

If you can find any Romans around, ask them. They lived pretty high on the hog in their day. That is, until some serious-minded neighbors from up North moved in. The rest is ancient history.

You'd think their fate would have taught us a lesson. Yet today we Americans spend twenty billion dollars a year for legalized gambling, while we spend a niggardly four-and-a-half billion for higher education. Think of it! Over four times as much! We also spend six-and-a-half billion dollars a year for tobacco, nine billion dollars for alcoholic beverages, and billions more on other non-essentials.

Can't we read the handwriting on the wall?

Our very survival depends on the ability of our colleges and universities to continue to turn out thinking men and women. Yet today many of these fine institutions are hard put to make ends meet. Faculty salaries, generally, are so low that qualified teachers are leaving the campus in alarming numbers for better-paying jobs elsewhere.

In the face of this frightening trend, experts estimate that by 1970 college applications will have doubled.

If we are to keep our place among the leading nations of the world, we must do something about this grim situation before it is too late. The tuition usually paid by a college student covers less than half the actual cost of his education. The balance must somehow be made up by the institution. To meet this deficit even the most heavily endowed colleges and universities have to depend upon the generosity of alumni and public spirited citizens. In other words, they depend upon you.

For the sake of our country and our children, won't you do your part? Support the college of your choice today. Help it to prepare to meet the challenge of tomorrow. The rewards will be greater than you think.

It's important for you to know what the impending college crisis means to you. Write for a free booklet to HIGHER EDUCATION Box 36, Times Square Station, New York 36, New York.
Here are the advantages you can expect when you specify Midwest Foam —
- All types of polyester or polyester foams
- Quality with economy
- Customized service
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Representatives—we still have some choice territories available. If you would like to represent the finest plastic foam producer in the United States, contact us immediately.

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1901 Marquette Avenue, North Chicago, Illinois • Dexter 6-4540
CIRCLE 321 ON READER SERVICE CARD

Waveguide Components
LARGE SELECTION

SCHUTTER MICROWAVE CORP., 80 E. Montauk Highway, Lindenhurst, N. Y., has available a large selection of precisely engineered and constructed large waveguide transmission lines and components. Units are designed to meet the requirements of multimegawatt radar systems and other high power microwave applications. Twists, elbows and highly complex bends are available on a prompt delivery schedule.

CIRCLE 480 ON READER SERVICE CARD

Curve Display Set
FOR TRANSISTOR TEST

THE MASCAS CO., 6547 E 27th St., Tulsa 14, Oklahoma. Function of this instrument is to display the characteristic voltage-current characteristics of transistors in a simple and direct manner.
Although ice cubes can be used to keep transistors cool enough to operate at full rated load, there are those who maintain that ice cubes serve a better purpose in a long cool drink. This is the school of thought that leans toward Birtcher Heat Radiators for preventing thermal runaway and for getting maximum performance from semiconductor devices. If you would like to investigate before choosing sides in this debate, write for the Birtcher Transistor Radiator Catalog... it comes complete with all sorts of test reports and other technical looking papers.

Address your inquiry to: Charles F. Booher, Secretary, There's a Better Way Society of America, Inc.

THE BIRTCHER CORPORATION
Industrial Division
4371 Valley Boulevard
Los Angeles 32, California

Sizes available for every commonly used transistor. If we don't have what you want, we'll probably make one.

Cool!
Write for new Transistor Radiator Catalog

CIRCLE 322 ON READER SERVICE CARD

August 12, 1960

curves on an oscilloscope to facilitate the testing and matching of transistors. It was designed to meet the need for a low cost test set which is suitable for the design engineer's work bench. It may be employed with most oscilloscopes though a d-c scope is desirable in order that the d-c reference may be preserved. Provision is made for switching to any one of six transistor sockets so that the transistors under test may be rapidly compared. An integral scope calibration circuit in conjunction with a calibrated dial allows direct measurement of the approximate current gain of the transistor. Both pnp and npn transistors may be tested. Unit price is slightly under $100.

CIRCLE 481 ON READER SERVICE CARD

Transformer
CONSTANT VOLTAGE

FREED TRANSFORMER CO., INC., 1718 Weirfield St., Brooklyn 27, N. Y., is offering a 60 cycle 500 va constant voltage transformer with an input of 96 to 130 v and an output of 115 v. This unit has a line regulation of ±1.4 percent. It can be hermetically sealed for military applications.

CIRCLE 482 ON READER SERVICE CARD

Analyzer
TRANSFER FUNCTION

AD-YU ELECTRONICS LAB., INC., 249 Terhune Ave., Passaic, N. J. This

A familiar shape to DC amplifier devotees

WIDELY RECOGNIZED...
WIDELY ACCEPTED...
K2 OCTAL PLUG-INS FROM PHILBRICK

FAST DC: K2-W is an efficient, foolproof high-gain operational unit for all feedback applications, fast and slow. The K2-W features balanced differential inputs for low drift, high input impedance, low output impedance, and economy of operation. Its range of operation is from d-c to above 100 kc depending on external circuitry. $24*

SLOW DC: K2-P gives to other dc amplifiers, such as K2-W and K2-XA, drift stability well under 1 millivolt, long term. This chopper stabilized unit has the same case structure and octal base as the K2-W and sells for $60*

HOT DC: K2-XA, a new amplifier of improved reliability, is primarily useful in operational circuits where an output voltage range from minus to plus 100v (at 3 milliamperes) is required. Its pass band extends to beyond 250 kc depending on external circuitry. $28*

* Military equivalents available
# OEM's: write wire or phone for quantity prices
+ 24 page Applications Manual available on request

GEORGE A.
PHILBRICK
RESEARCHES, INC.
283 Columbus Avenue, Boston 16, Mass.
COMMONTOWN 5-5735

CIRCLE 24S ON READER SERVICE CARD
a reliable signal source for microwave measurement

The AIL Type 124C Power Oscillator is applicable as a signal source over the wide range of 200 to 2500 Mc. Its range, power and stability make it an essential element of microwave component test systems. It is often used in measurements relating to antenna design. Facilities for both internal and external modulation are provided. Relative power output is indicated directly on panel meter.

Detailed literature is available on request.

Four Crystal Oven SNAP ACTION
OVENAIRE, INC., Charlottesville, Va. New snap action oven will accommodate 4 HC-6/U crystals. Unit is 1 in. wide by 2 in. long by 1 1/4 in. seated height and is mounted on a standard octal plug. A maximum power drain of only 9 W will warm up the crystals from -55°C in ten minutes. With this new oven, power requirements and oven cost can be cut considerably in crystal controlled communications equipment using multiple channels. The four crystal oven is available in a wide range of temperatures and voltages.

CIRCLE 483 ON READER SERVICE CARD

Capacitors METALLIZED MYLAR ELECTRON PRODUCTS, 430 N. Halstead St., Pasadena, Calif., an-

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The BUYERS' GUIDE tells who makes it. Gives detailed catalog-type product information and specs. Gives choices in mechanical and electrical characteristics. Gives more choices in terms of materials and design. Also objective and authoritative facts about markets...materials...design...in an exclusive 64-page reference section.

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CIRCLE 246 ON READER SERVICE CARD
3 steps to using the BUYERS' GUIDE

locate products
In product listings

find product specifications
In the advertising pages

buy products
From local office in manufacturers' listings

FIND WHAT YOU NEED IN THE electronics BUYERS' GUIDE

HOW FAST CAN YOU TEST
Circuit Design Reliability?

<table>
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<tr>
<th>Circuit Parameters</th>
<th>Tests</th>
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<tr>
<td>16</td>
<td>65,538</td>
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<tr>
<td>8</td>
<td>4,096</td>
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<tr>
<td>4</td>
<td>256</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
</tr>
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</table>

Yes, you can test all combinations of high and low values of as many as 16 circuit parameters in less than 11 minutes! Write today for informative 8-page Brochure.

ULTRA-LOW-FREQUENCY BAND PASS

ACTIVE FILTERS

TUBES
Plug in amplifier feedback network pairs for use as filters or band-pass amplifiers. Widely used where LC filter sections are impractical. Available with tuned circuit or band-pass response with center frequency .02 to 500 cps.

TRANSISTORS
Integral transistor-network units with tuned circuit response from 1 cps to 5 kc with Q values to 20, requiring no external components.

Write for comprehensive literature on filter, amplifier, and network performance and application. Active Filters (above), bulletins 212, 252, 272.


Toroidal Wave Filters, LC filters with stable toroidal inductors. Low, high, band-pass models available over wide impedance and frequency ranges. Ask for LC Bulletins.

Network Notes contain articles on use, performance, and problems of networks and filters.
When there's NO SUBSTITUTE for PRECISION TIMING

When the emphasis is on accuracy in timing, the wise choice is STANDARD precision elapsed time indicators. Units are synchronous motor driven... electric clutch controlled by manual or automatic switch or output of electronic tubes... available with manual or electric zero reset, a-c or d-c clutch.

<table>
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<th>Model</th>
<th>Scale Divisions</th>
<th>Totalizes</th>
<th>Accuracy</th>
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<tr>
<td>S-100</td>
<td>1/5 sec.</td>
<td>6000 sec.</td>
<td>± .1 sec.</td>
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<tr>
<td>S-60</td>
<td>1/2 sec.</td>
<td>40 min.</td>
<td>± .1 sec.</td>
</tr>
<tr>
<td>SA-60</td>
<td>1/100 min.</td>
<td>60 min.</td>
<td>± .002 min.</td>
</tr>
<tr>
<td>S-10</td>
<td>1/10 sec.</td>
<td>1000 sec.</td>
<td>± .02 sec.</td>
</tr>
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<td>S-6</td>
<td>1/1000 min.</td>
<td>10 min.</td>
<td>± .0002 min.</td>
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<td>S-1</td>
<td>1/100 sec.</td>
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<td>1/1000 sec.</td>
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<td>± .001 sec.</td>
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<tr>
<td>MST-500</td>
<td>1/1000 sec.</td>
<td>30 sec.</td>
<td>± .002 sec.</td>
</tr>
</tbody>
</table>

This is not an offer of these securities for sale. The offer is made only by the Prospectus.

120,000 Shares
Edgerton, Germeshausen & Grier, Inc.
Common Stock
($1.00 par value)

Price $14.50 per Share

Copies of the Prospectus may be obtained in any State in which this announcement is circulated from any of the undersigned, including the undersigned, as may lawfully offer these securities in such State.

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nounces a new line of metallized Mylar capacitors encased in rectangular epoxy tubes, combining high insulation resistance, dielectric strength and reliability in a space saving package. Series DE are available as standard from 0.001 to 0.68 µf in 200, 400 and 600 v d-c models. Operating temperature is -55 to +85 C... higher with derating. Insulation resistance is 10,000 meg x µf minimum at 25 C, but need not exceed 30,000 except to special order; dissipation factor is less than 1.0 percent at 25 C; test voltage is 1.5 times rated voltage. Standard tolerance is ±20 percent... 10, 5, 3, 2 and 1 percent tolerances are available. The 0.001 to 0.033 µf models measure only 0.57 by 0.29 by 0.17 in.

CIRCLE 485 ON READER SERVICE CARD

SSB Receiver
ALL-ELECTRONIC AFC
Kahn Research Laboratories, Inc., 81 S. Bergen Place, Freeport, N. Y.
Model RSSB-55-1A ssb receiver system with all-electronic afc and carrier loss protection is available for h-f military and commercial use. Supplied as a complete ssb receiver or as a separate ssb adapter for use with new or existing a-m communications receivers, the afc system corrects frequency errors of ±2 Kc at the transmitter or in the associated receiver to within one cycle. Carrier loss protection during severe fades is provided by a special magnetic storage device. Reception modes include independent upper and lower sidebands, double-sideband a-m, p-m exalted carrier and completely suppressed carrier ssb. Reconditioned or local carrier operation is selected by front panel switch. Audio response in each of two independent sideband receiving channels provided
dial any output
from 0-1000 volts
with 1% accuracy

Keithley Regulated High-voltage Supply gives you new speed and accuracy for a wide range of tests. Its many uses include calibration of meters and dc amplifiers, supplying voltages for photo-multiplier tubes and ion chambers, as well as furnishing potentials for high resistance measurements.

Three calibrated dials permit easy selection of the desired output in one volt steps, at up to 10 milliamperes. Polarity is selectable. Other features include:

- 1% accuracy above 10 volts.
- Line regulation 0.02%
- Load regulation 0.02%
- Ripple less than 3 mv RMS.
- Stability: within ± 0.02% per day.
- Protective relays disconnect output at 12 milliamperes.
- Price: $325.00.

Send for details about the Model 240 Supply.

There's really not much to custom-designing rotary switches...

It's a matter of routine... when you have talented engineers with lots of experience... first quality materials... and advanced manufacturing techniques.

Fortunately, The Gamewell Company has all three. When customers' specifications come in, our engineers get busy. The precious metal ring, heart of a Gamewell Rotary Switch, is designed with as many segments as required. Brushes are provided which assure smooth, trouble-free action with either make-before-break or break-before-make contacts. Then a highly versatile arrangement of terminals connecting to ring segments is devised for the periphery of the switch housing. And so on, depending on requirements.

The end result is a highly versatile, reliable switching component. Cased in special plastic, it’s inherently fungus resistant and stable at high temperatures. It can be used with confidence over a wide range of environmental conditions.

Gamewell is well qualified to design rotary switches for circuit sampling, programming, digital generators and various electronic data processing systems. Your specs will receive prompt attention.

Write to The Gamewell Company, 1378 Chestnut Street, Newton Upper Falls 64, Massachusetts. A Subsidiary of E. W. Bliss Company.

CIRCLE 249 ON READER SERVICE CARD

Precise Potentiometers
"Integrals of High Performance"
A-C Current Probe

COMPACT UNIT

HEWLETT-PACKARD CO., 275 Page Mill Road, Palo Alto, Calif. Model 456A a-c current probe's 1 mv to 1 ma unity conversion permits direct readings in milliamperes on voltmeters or oscilloscopes. It measures current without direct connection to the test circuit and with no appreciable circuit loading. Typical applications include measurements on transistors, vacuum tubes and logic circuits. The instrument's wide bandwidth (20 cps to 15 Mc) also permits oscilloscopes viewing of complex current waveforms with rise times as fast as 0.08 µsec. Model 456A simplifies a-c current measurements of up to one ampere at frequencies up to 5 Mc and at least 100 ma from 5 Mc to 15 Mc. Unit weight 3 lb. It is priced at $190.

CIRCLE 489 ON READER SERVICE CARD

Drafting Materials

PRESSURE SENSITIVE

APPLIED GRAPHICS CORP., Glenwood Landing, L. I., N. Y. Clearly printed on shrink-resistant durable transparent materials, AG tapes, templet, grid sheets, die cut symbols and numbers and letters (more than 2,000 items) are time savers and produce a clean professional looking job. The tapes and templets are especially suitable for graphs, chart, audio visual presentations and printed circuits. Templets, symbols, letters and numerals are packaged in individually slit strip form. In addition to the regular line special purpose types will be made on special order.

CIRCLE 490 ON READER SERVICE CARD
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9 ANALYSIS AND DESIGN OF FEEDBACK CONTROL SYSTEMS
Just Published—Second Edition. Shows how to apply principles and techniques of analysis to solve design problems, and presents a schedule of design procedures with cases illustrating the design problems are solved. By G. Thaler. U. S. Naval Postgraduate School, Monterey, Calif. Electronics Div., General Motors Corp., 2nd Ed., 610 pp., 172 diagrams, charts, tables, $14.50

10 TWO-WAY RADIO

11 PROFESSIONAL ENGINEER'S EXAMINATION QUESTIONS AND ANSWERS
Just Published—Second Edition. Gives 600 questions and complete answers to help engineers pass state license examinations. Covers mechanical, electrical, civil, and chemical engineering, and includes engineering economics and land surveying. By William S. Lanford, Jr. Newark Coll. of Eng., 2nd Ed. 615 pp., 213 Illus., $7.50

12 FUNDAMENTALS OF SIGNAL THEORY
Just Published. Explains important mathematical techniques used in understanding the behavior of electronic systems. Covers the analysis of waveforms and circuits, the Fourier series, and the theory of linear systems. By J. Stewart, Univ. of Texas, 320 pp., 85 Illus., $8.95

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Literature of

RANDOM-NOISE GENERATOR
General Radio Co., West Concord, Mass., has released a 4-page brochure describing the type 1390-B random-noise generator.

CIRCLE 557 ON READER SERVICE CARD

CHECKOUT EQUIPMENT
Packard Bell Electronics, 12333 W. Olympic Blvd., Los Angeles 64, Calif., has available a brochure of technical data sheets covering a line of automatic electronic checkout equipment.

CIRCLE 558 ON READER SERVICE CARD

ELECTRONIC CABLES
Sequoia Wire & Cable Co., 2201 Bay Road, Redwood City, Calif., has issued a new brochure, DM-S-6015, highlighting its complete specialized electronic wire and cable capability.

CIRCLE 559 ON READER SERVICE CARD

DELAY LINES
Allen Avionics, Inc. 255 E. 2nd St., Mineola, N. Y., has available a new bulletin describing its lumped constant, phase and frequency compensated delay lines.

CIRCLE 560 ON READER SERVICE CARD

ROTARY MULTIPOLe SWITCH
Electro Switch Corp., King Ave., Weymouth, (Boston 88), Mass. Bulletin No. 19 contains complete information on the new type JK rotary switch, manufactured to BUSHips drawing 815-1830913 and MIL-S-21604.

CIRCLE 561 ON READER SERVICE CARD

LOADING MANUAL
Engineered Electronics Co., 1441 E. Chestnut Ave., Santa Ana, Calif. Catalog No. 859, now available, is a loading manual prepared in order to facilitate the use of the T-series germanium transistor circuit modules.

CIRCLE 562 ON READER SERVICE CARD

HOOK-UP LEAD WIRE
Birnbach Radio Co., Inc., 145 Hudson St., New York 13, N. Y., has published a bulletin on a line of hook-up lead wire that offers continuous service at 1,000 F.

CIRCLE 563 ON READER SERVICE CARD

SERVOMOTOR
Helipot Division of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., has released a four-page
the Week

folder showing advance performance data for the model 8SM461 size 8 servomotor which is only 0.840 in. in length and wound for 115-v operation.

CIRCLE 564 ON READER SERVICE CARD

CONTROLLED RECTIFIER
Texas Instruments Incorporated, Semiconductor-Components Division, P. O. Box 312, Dallas, Texas. Theory, parameters, and ratings of the non-precious silicon controlled rectifier are contained in an eight-page Application Note.

CIRCLE 565 ON READER SERVICE CARD

SOLAR ENERGY CONVERTERS
Solar Systems, Inc., 8241 Kimball Ave., Skokie, Ill. Construction and operating principles, design data and applications of solar energy converters are included in brochure No. 60A.

CIRCLE 566 ON READER SERVICE CARD

POWER OSCILLATOR W. L. Maxson Corp., 475 Tenth Ave., New York 18, N. Y. A technical bulletin on model 1141 uhf wideband power oscillator contains complete specifications, performance data and application notes.

CIRCLE 567 ON READER SERVICE CARD

VARIABLE TRANSFORMERS
The Superior Electric Co., 83 Laurel St., Bristol, Conn. A four-page data sheet explains and illustrates operating principles of the recently introduced H-C series Powerstat variable transformers.

CIRCLE 658 ON READER SERVICE CARD

MICROWAVE PRODUCTS
Bomac Laboratories, Inc., Salem Road, Beverly, Mass., has released a new product catalog containing specifications on over 600 microwave tubes and components.

CIRCLE 569 ON READER SERVICE CARD

MATERIALS CATALOG

CIRCLE 570 ON READER SERVICE CARD

TIME TEAM

EECO'S ALL-STAR LINEUP OF TIME CODE GENERATORS COVERS ALL THESE BASES

From missile base to basic research, in launching-area heat or Dew-Line cold, Electronic Engineering Company answers your project's time code needs with these outstanding time code generators . . . for binary or BCD readouts, coded for Atlantic Missile Range, Eglin Test Range or the new Inter-Range Instrumentation Group (IRIG) format proposed for worldwide use in satellite tracking.

All EECO time code generators can be used with oscillographs, strip chart recorders, magnetic tape or for driving neon flash lamp amplifiers . . . for time-correlation of data recorded by different instruments at one or more sites. All have advance-retard controls for synchronizing internal 1 pps to WWV.

MORE ACCURACY PER DOLLAR
Both time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. Time-correlate data to within ±1 millisecond at a cost of only $7,650 for the ZA-810, $7,050 for the ZA-802. Frequency Stability: 3 parts in 108 per day.

Compact . . . solid-state plug-in circuits . . . sized for standard rack mounting. Complete unit, including power supply, 7" x 19" x 17.5".

GENERATES NEW IRIG FORMAT
These new solid-state time code generators use proposed Inter-Range Instrumentation Group formats. ZA-810 currently being used for National Bureau of Standard broadcasts over WWV.

Both generators have same high accuracy as ZA-801 and 802. Packaged plug-in circuits. Complete unit 7" x 19" x 18". Weight only 35 pounds. Price of either model: $11,180.

WRITE FOR TIME CODE GENERATOR FILE 301. TIMING SYSTEM DESIGN CONSULTATION ON REQUEST.

Electronic Engineering Company of California

CIRCLE 253 ON READER SERVICE CARD
Moore*: At Wescon, a numismatist

CHAIRMAN of the executive committee for 1960 Wescon is methodical Hugh P. Moore, board chairman of Lerco Electronics, Inc., of Burbank, Calif. Moore is an active participant in West Coast industry affairs, has served as a director, vice president, and council chairman for Western Electronics Manufacturers Association, one of Wescon’s two sponsors.

Mild-mannered Midwesterner Moore was born 47 years ago in Carrington, N. D., took a journalism degree from the University of North Dakota, put in a brief stint as news editor of a local newspaper. He moved to California in 1937 and spent three years learning salesmanship as assistant sales manager for a manufacturer of electric shavers. Production methods came next; he went to work for Bendix, started as a production control assistant, in six years rose to the plant managership of Bendix’s Pomona division.

Long-time ambition to own his own business was realized in 1947 when he formed Acme Electronics, began making wave filters and magnetic amplifiers. Acme later became a subsidiary of Aeroxox. In 1955 he bought controlling interest in Lerco, which recently picked up Micro Gee Corp. and Automation Development Co., both specialized electronics companies in the Los Angeles area.

“Hugh has a mind like a computer,” says a close business associate. He likes the challenge of electronics, feels that “increased domestic and foreign competition will force us to exert our very best effort for the future.” He enjoys speculating in the common stocks of promising young growth companies, and is one of the guiding lights of the Matrix Investment Club in Los Angeles.

Moore is also a once-in-a-while numismatist, and when he goes on the search for rare coins, his wife Marian can usually be found in a nearby shop following her hobby—collecting exotic earrings. They both look forward to the time when less pressing duties permit them time for foreign travel. Michael, 16, the eldest of the two Moore sons, is about to leave for Bonn, Germany, as an American Field Service exchange student; his parents hope he will be able to help plan an itinerary for them.

A typical item on Moore’s busy agenda is a five-day trip to Hawaii next week, just prior to Wescon, for a Chicago Parts Show policy meeting. He’s a member of that board, too.

What to See At the Show

THIS YEAR there will be 989 booths at Wescon featuring the wares and capabilities of 805 companies. Last year there were 960 booths of 753 companies.

The exhibits will be on the lower level and concourse of the Los Angeles Sports Arena and in a specially erected annex.

A

AC Spark Plug...........2345-2348
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JOHN FLUKE precision High Voltage Power Supplies offer complete coverage up to 10 KV. In addition to high calibration accuracy, tight line-load regulation, fine voltage resolution, and excellent long term stability; many other plus features are provided the design engineer. For example: difficulties resulting from corona, jitter, bounce or overshoot are non-existent in JF supplies. The capability of the John Fluke Co. to keep pace with industry demand is evidenced by the fact that most of these instruments have been introduced within the past year.

Designed to power photomultiplier tubes and ionization chambers ... for research and development of traveling wave tubes and backward wave oscillators.

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<td>0.00%</td>
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<td>5mv</td>
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<td>5mv</td>
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<tr>
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<td>5mv</td>
<td>10mv</td>
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<tr>
<td>410A</td>
<td>1000-10,010V</td>
<td>0-10 ma</td>
<td>0.01%</td>
<td>0.005%</td>
<td>5mv</td>
<td>10mv</td>
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All prices quoted, F.O.B., Factory, Seattle. Prices and technical data subject to change without notice.
new flexibility

WAUGH FR-500
Frequency-to-D.C. Converter

The new Waugh FR-500 combines in one modular unit five, (or six), rack mounted transistorized frequency-to-d.c. converters. The FR-500 is based on the successful Waugh FR-302 converter that has earned wide acceptance in missile, aircraft and laboratory applications. Modular design allows signals from several sources to be monitored or recorded simultaneously, and attains a measure of converter flexibility and utility never before achieved.

Each converter produces three outputs precisely proportional to the frequency of the a.c. input signal from flow sensors, tachometers, photo cells, electro-magnetic coils, or other transducers. Output may be read directly on the panel meter. D.C. and pulse outputs are also provided to drive oscilloscopes, counters, and a wide variety of other electronic indicators, recorders or controllers.

A power supply for up to 25 converters, and a master calibration oscillator, with an accuracy of ±0.1% of reading, are on a single panel which can be mounted on the same rack as the FR-500. Individual, integral power supplies are also available with each module.

SPECIFICATIONS
Frequency Range 5 cps. to 10 kc. in six overlapping ranges.
Input Amplitude 5 mv. to 100 volts
Linearity ±0.1% of full scale
Ripple ±0.1% full scale peak to peak maximum
Pulse Output 10 milliamperc into 250 ohms
D.C. Output 0 to 5 volts d.c.

Request Bulletin 112 for complete specifications.

---

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<th>DC</th>
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<tr>
<td>1 part per million</td>
<td>10 parts per million</td>
</tr>
<tr>
<td>(0.0001%)</td>
<td>(0.001%)</td>
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<th>Approximate Input Resistance</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50 (A)</td>
<td>200 ohms</td>
<td>1 sec.</td>
</tr>
<tr>
<td>0-1</td>
<td>1400 ohms</td>
<td>¼ sec.</td>
</tr>
<tr>
<td>(A) Power required: 120 volts, 60 cycles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) With 50,000 ohms in external circuit.</td>
<td></td>
<td></td>
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