

August 12, 1960

electronics

WESCON SPECIAL — *Technical and business growth in the West, p123*
New approach to engineering recruitment at the convention, p 49
Views expressed by manufacturers exhibiting at the show, p 51

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Typical Miniature Audios

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



Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. OC in Pri. MA	Response 2 db (Cvc.)	Max. level dbm
H-1	Mike, pickup. line to grid	TF4RX10YY	50, 200CT, 500CT	50,000	0	50-10,000	+ 5
H-2	Mike to grid	TF4RX11YY	82	135,000	50	250-8,000	+18
H-5	Single plate to P.P. grids	TF4RX15YY	15,000	95,000 CT	0	50-10,000	+ 5
H-6	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	95,000 split	4	200-10,000	+11
H-7	Single or P.P. plates to line	TF4RX13YY	20,000 CT	150/600	4	200-10,000	+21
H-8	Mixing and matching	TF4RX16YY	150/600	600 CT	0	50-10,000	+ 8
H-14	Transistor Interstage	TF4RX13YY	10K/2.5K, Split	4K/1K split	4	100-10,000	+20
H-15	Transistor to line	TF4RX13YY	1,500 CT	500/125 split	8	100-10,000	+20

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. OC in Pri. MA	Response + 2 db (Cvc.)	Max. level dbm
H-20	Single plate to 2 grids, can also be used for P.P. plates	TF4RX15YY	15,000 split	80,000 split	0	30-20,000	+12
H-21	Single plate to P.P. grids, DC in Pri.	TF4RX15YY	15,000	80,000 split	8	100-20,000	+23
H-22	Single plate to multiple line	TF4RX13YY	15,000	50/200, 125/500	8	50-20,000	+23
H-23	P.P. plates to multiple line	TF4RX13YY	30,000 split	50/200, 125/500	8 BAL.	30-20,000	+19
H-24	Reactor	TF4RX20YY	450 Hys.-0 DC, 250 Hys.-5 Ma. DC, 6000 ohms 65 Hys.-10 Ma. OC, 1500 ohms				
H-25	Mixing or transistors to line	TF4RX17YY	500 CT	500/125 split	20	40-10,000	+30



Typical Compact Audios

RC-50 Case
1-5/8 x 1-5/8 x 2-5/16
8 oz.

Typical Subminiature Audios

SM Case
1/2 x 11/16 x 29/32
.8 oz.



Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	Unbal. OC in Pri. MA	Response + 2 db (Cvc.)	Max. level dbm
H-31	Single plate to 1 grid, 3:1	TF4RX15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF4RX13YY	10,000	200	3	300-10,000	+13
H-33	Single plate to low imp.	TF4RX13YY	30,000	50	1	300-10,000	+15
H-35	Reactor	TF4RX20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF4RX15YY	25,000 (DCR800)	1,000 (DCR110)	.5	300-10,000	+10
H-39	Transistor Interstage	TF4RX13YY	10,000 CT (DCR600)	2,000 CT	2	300-10,000	+15
H-40A	Transistor output	TF4RX17YY	500 CT (DCR26)	600 CT	10	300-10,000	+15

Type No.	HV Sec. CT	OC MA*	Military Rating Fil. Secs.	OC MA*	Industrial Rating Fil. Secs.	Case
H-80	450	120	6.3V,2A	130	6.3V,2.5A.	FA
H-81	500/550	65/55	6.3V,3A-5V,2A	75/65	6.3V,3A-.5V,2A.	HA
H-82	540/600	110/65	6.3V,4A-.5V,2A.	180/100	6.3V,4A-.5V,2A.	JB
H-84	700/750	170/110	6.3V,5A-.6.3V,1A.,5V-3A.	210/150	6.3V,6A-.6.3V,1.5A-.5V,4A.	KA
H-89	850/1050	320/280	6.3V,8A-.6.3V,4A.,5V-6A.	400/320	6.3V,8A-.6.3V,4A-.3V,6A.	OA

Typical Power Transformers

Pri: 115V 50/60 Cvc.
*Choke/Cond. Inp.

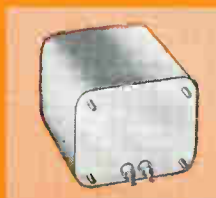


Type No.	Sec. Volts	Amps.	Test Volts	Case	Type No.	Sec. Volts	Amps.	Test Volts	Case
H-121	2.5	10(12)	10 KV	JB	H-131	6.3 CT	2(2.5)	2500	FB
H-122	2.5	20(26)	10 KV	KB	H-132	6.3 CT	6(7)	2500	JA
H-125	5	10(12)	10 KV	KB	H-133	6.3 CT	7(8)	2500	HB
H-130	6.3 CT	.6(.75)	1500	AJ	H-134	6.3 CT	10(12)	2500	HA

Typical Filament

Pri: 105/115/210/220V
except H-130 (115) and H-131 (115/220) 50/60 Cvc.

Typical Filter Reactors



Type No.	MIL Type	Ind. @ MA Hys.	Ind. @ MA OC	Ind. @ MA Hys.	Ind. @ MA OC	Ind. @ MA Hys.	Ind. @ MA OC	Res. Ohms	Max. DCV Ch. Input	Test V. RMS	Case		
H-71	TF1RX04FB	20	40	18.5	50	15.5	60	10	70	350	500	2500	FB
H-73	TF1RX04HB	11	100	9.5	125	7.5	150	5.5	175	150	700	2500	HB
H-75	TF1RX04KB	11	200	10	230	8.5	250	6.5	300	90	700	2500	KB
H-77	TF1RX04MB	10	300	9	350	8	390	6.5	435	60	2000	5500	MB
H-79	TF1RX04YY	7	800	6.5	900	6	1000	5.5	1250	20	3000	9000	7x7x8

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BUSINESS

Looking Ahead to Wescon. Features 200 papers, 989 booths
 Designers Vie for Wescon Prizes. Industrial arts on display
 New Look in Recruiting. Show isn't 'body exchange' mart
 What Wescon Exhibitors Are Saying. Our industry speaks
 Lab Reveals Lunar Reflection Results. Air Force issues report
 Airborne Tv Plans Take Form. First big contract goes out

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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

COVER

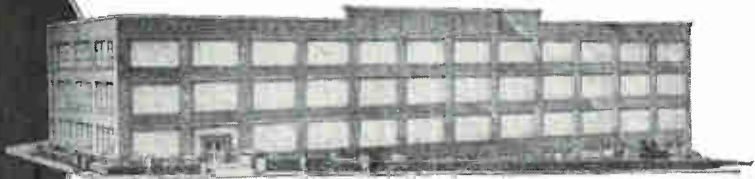
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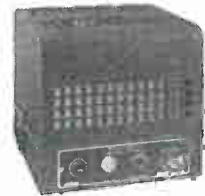


Size 1½" dia. x 4½" H. Wght. 8 oz.
Frequencies: 200 to 4000 cycles
Accuracies:—
Type 2003 ($\pm .02\%$ at -65° to 85°C)
Type R2003 ($\pm .002\%$ at 15° to 35°C)
Type W2003 ($\pm .005\%$ at -65° to 85°C)
Double triode and 5 pigtail parts required.
Input, Tube heater voltage and B voltage
Output, approx.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

PRECISION FREQUENCY STANDARDS

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Frequencies:
50 to 400 cycles (Specify)
Accuracy:
 $\pm .001\%$ from 20° to 30°C
Output, 10 Watts at 115V
Input, 115V. (50 to 400 cy.)

TYPE 2007-6



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Size 1½" dia. x 3½" H. Wght. 7 ozs.
Frequencies: 360 to 1000 cycles
Accuracies:
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R2007-6 ($\pm .002\%$ at $+15^{\circ}$ to $+ 35^{\circ}\text{C}$)
W2007-6 ($\pm .005\%$ at -65° to $+ 85^{\circ}\text{C}$)
Input: 10 to 30 Volts, D. C., at 6 ma.
Output: Multitap, 75 to 100,000 ohms

TYPE 2121A

*Size
8¾" x 19" panel
Weight, 25 lbs.*



Output: 115V
60 cycles, 10 Watt
Accuracy:
 $\pm .001\%$ 20° to 30°C
Input,
115V (50 to 400 cy.)

TYPE 2001-2



Size 3¾" x 4½" x 6" H., Wght. 26 oz.
Frequencies: 200 to 3000 cycles
Accuracy: $\pm .001\%$ at 20° to 30°C
Output: 5V. at 250,000 ohms
Input: Heater voltage, 6.3 - 12 - 28
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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:
($\pm .002\%$ at 15° to 35°C)
Output: 115V, 75W.
Input: 115V, 50 to 75 cy.

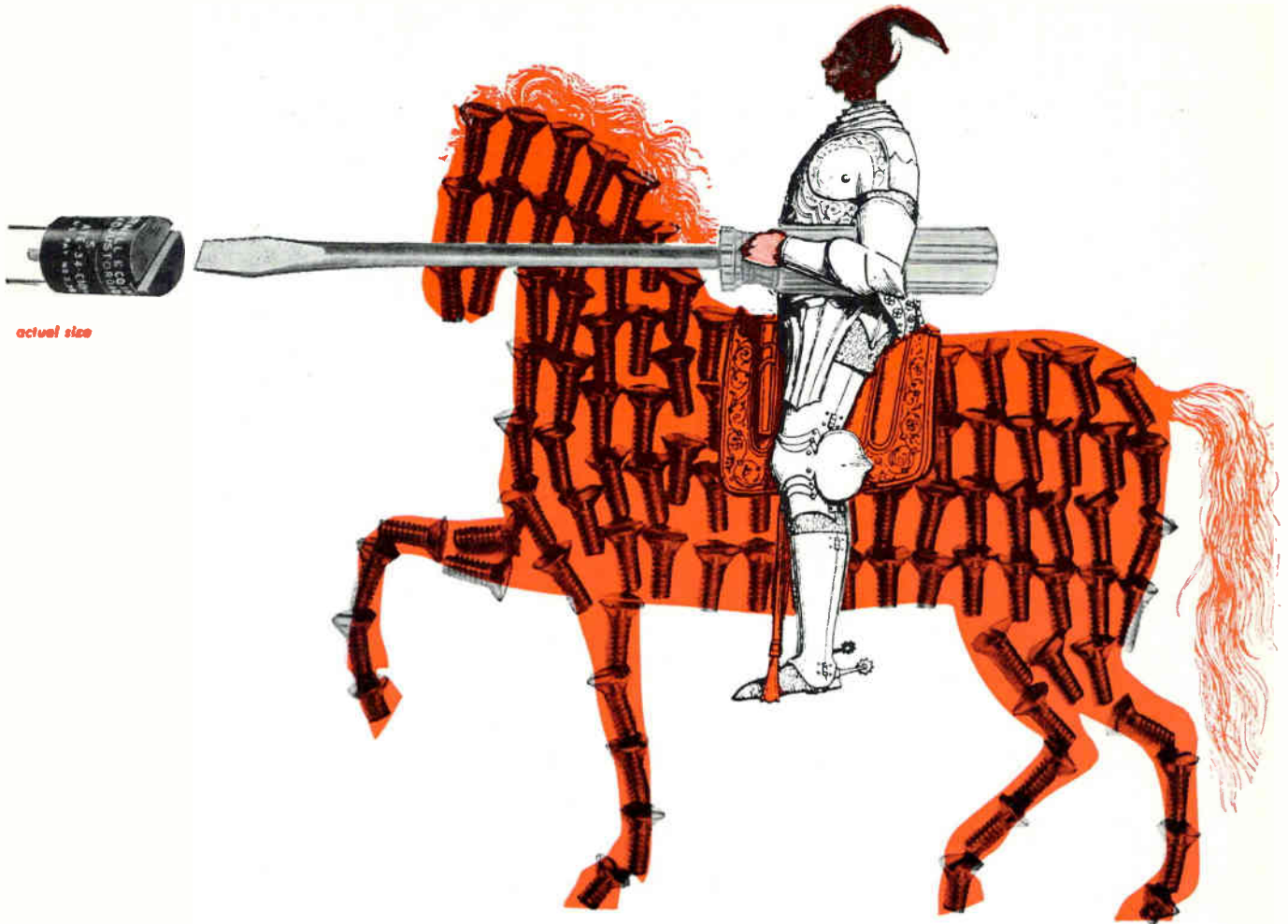
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ACCESSORY UNITS FOR 2001-2



- L—For low frequencies multi-vibrator type, 40-200 cy.
- D—For low frequencies counter type, 40-200 cy.
- H—For high freqs, up to 30 KC.
- M—Power Amplifier, 2W output.
- P—Power supply.

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TAMING OF THE SCREW

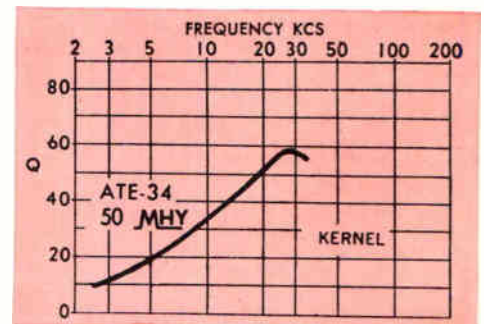
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CHALLENGE AT WESCON. As the world's second largest electronics show and convention gets underway a week from next Tuesday in Los Angeles, manufacturers will be learning to live in a changing economic climate. The changes affect largely the military 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 undersea 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.

W W Mac Donald

EDITOR

WESTERN ELECTRONICS. When you are packing your bag for the Wescon 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 123). Included in Hood's coverage are: A cryogenic gyroscope 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 tenfold the range 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 electrostatically 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.

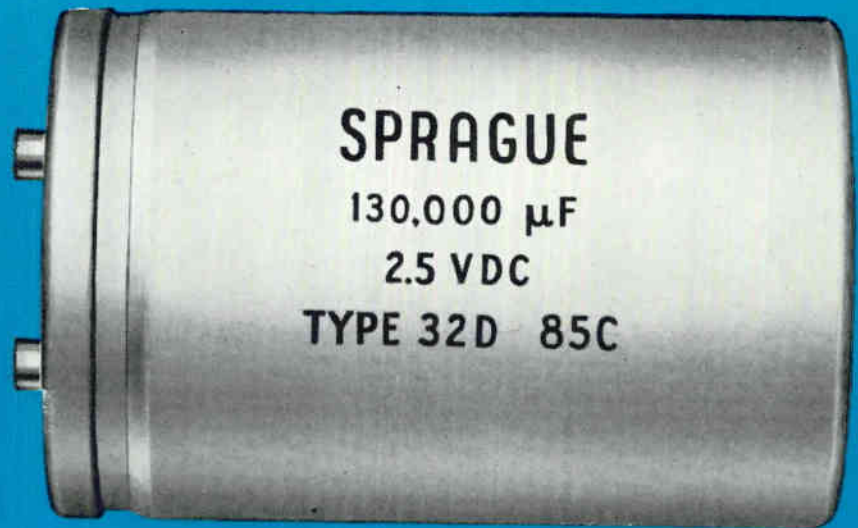
Other items include: Varian's electronic indicator that hunts metallic contamination in lubricating oil; Convair's Autotrack analyzer that can differentiate between vibrations one cps apart over a 5 to 2,500-cps range; investigations by Stanford University's Radioscience Laboratory, bouncing radar signals 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 Wescon fare also includes: Looking Ahead to Wescon (p 44); New Look in Recruiting (p 49), What Wescon Exhibitors Are Saying (p 51), Designers Vie for Wescon Prizes (p 46), New On The Market at the Wescon Show (p 160), Moore: At Wescon, a numismatist and Exhibitors at the Show (p 254).

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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

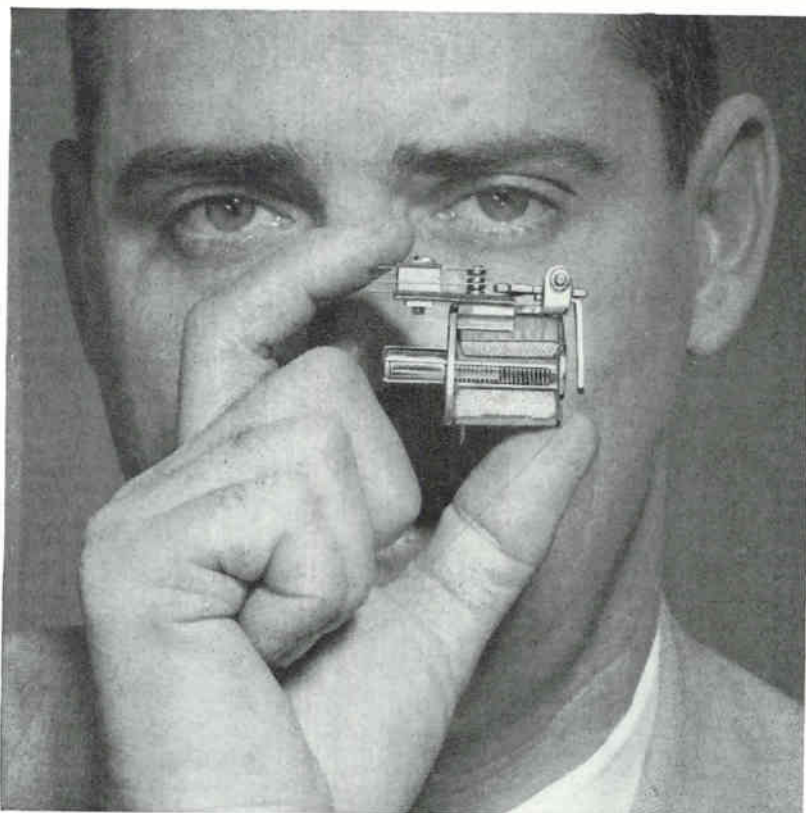
Since the majority rules, we naturally considered that the rejection of the union by a majority of the company's engineers in what was the largest election ever conducted among professional employees by the National Labor Relations Board was a blow to union organizing—which is what we said.

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."

August 12, 1960

COMPACT, 3-OUNCE TIME DELAY RELAY

with silicone-controlled
delay from 1/4 to 120 seconds



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

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

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

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

BRIEF SPECS

Time Delays: from 1/4 to 120 seconds

Overall Dimensions: 2-1/16" x 2" x 1-9/16"

Contact Capacity: 3 amps at 120V AC, 1.5 amps at 240V AC (non-inductive load), 1 amp at 50V DC, 0.5 amp at 125V DC.

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

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ELECTRIC COMPANY

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SEE US AT WESCON BOOTH 445-455



S.A. 1878

CIRCLE 7 ON READER SERVICE CARD

7

Now, with one instrument, you can

1 mv

at

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, $\pm 3\%$ of full scale; 50 MC to 150 MC, $\pm 6\%$ 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.

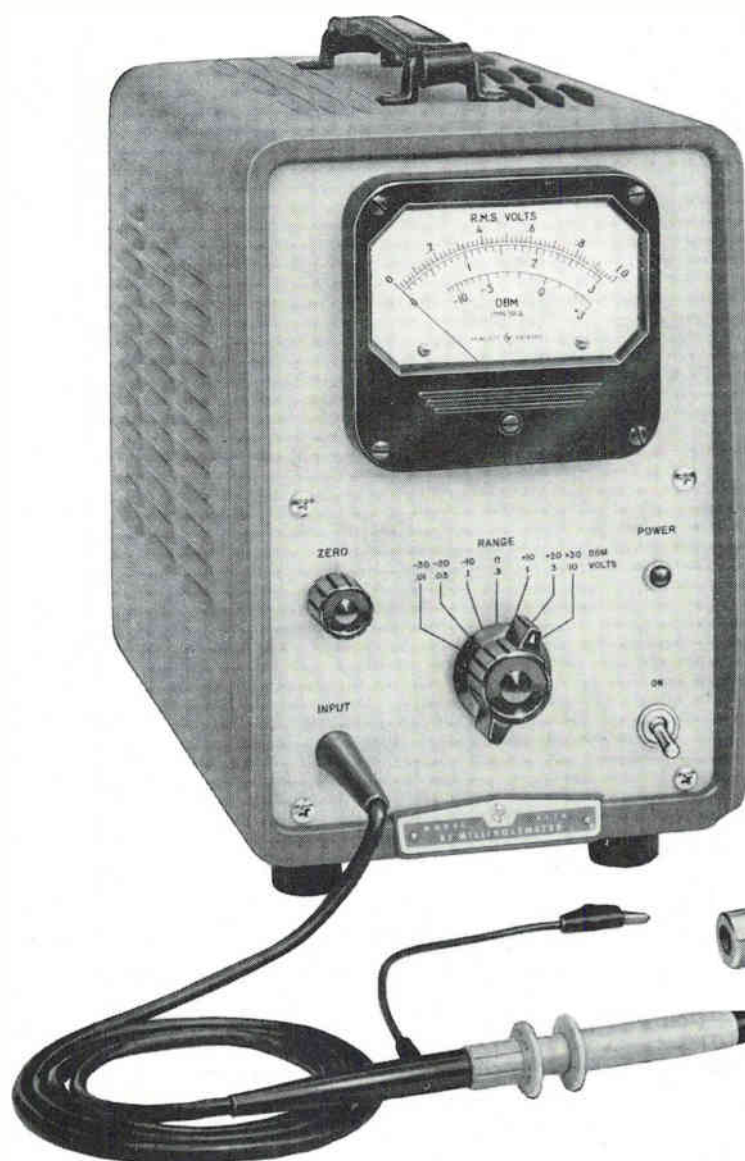
Type N "Tee" Probe Tip, 500 KC to 1,000 MC. SWR less than 1.15 when terminated in 50 ohms.

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

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

Power: 115/230 volts $\pm 10\%$, 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 Φ 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, Φ -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 Φ 411A Data Sheet) or better yet, call your Φ 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) Φ -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!



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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.

GENERAL CHARACTERISTICS			Max. Operating Temp.	Filament Voltage	Filament Current	Frequency for Max. Ratings	Max. Plate-Diss. Rating
EIMAC 3CX10,000A3	Height	Diameter					
CERAMIC TRIODE	8.25"	7.0"	250°C.	7.5	102 amp.	110 Mc.	10,000 watts

EITEL-McCULLOUGH, INC.
San Carlos, California



ELECTRONICS NEWSLETTER

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 Wescon.

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 photovoltaic 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 icpickers 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 RUMPUS 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.

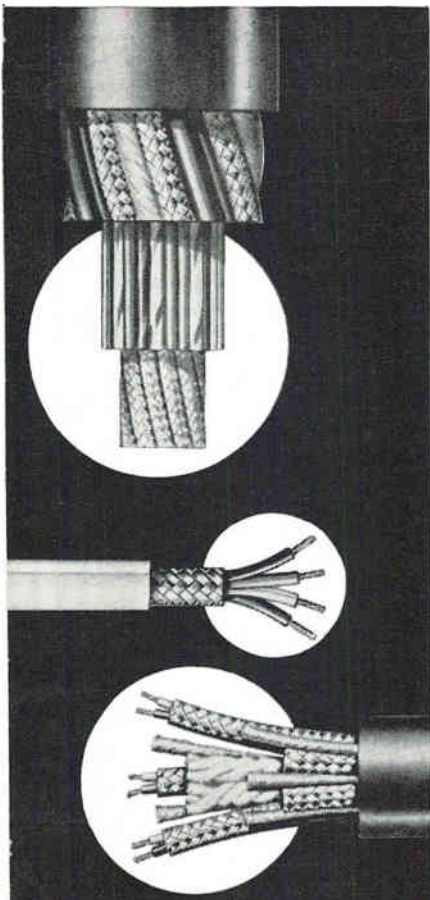
Purpose was to outline causes of the delays, explain the Pentagon's new centralized management of the program, and to give contractors "a greater sense of urgency" about the program.

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.



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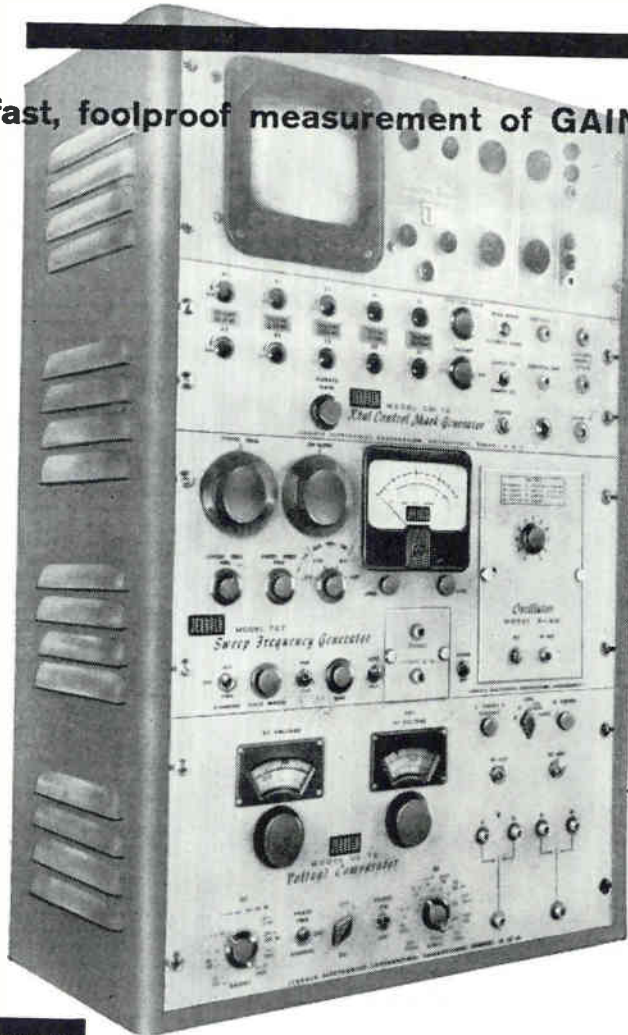
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Model CM-10—A 10-crystal unit producing any selected fundamental and/or harmonic frequencies. Each oscillator has its own independent amplitude control. Features built-in scope pre-amplifier and VSWR filter.

Precision Sweep Generator

Model 707—The heart of the test set. Features an extremely flat RF output ($\pm 5/100$ 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)

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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.

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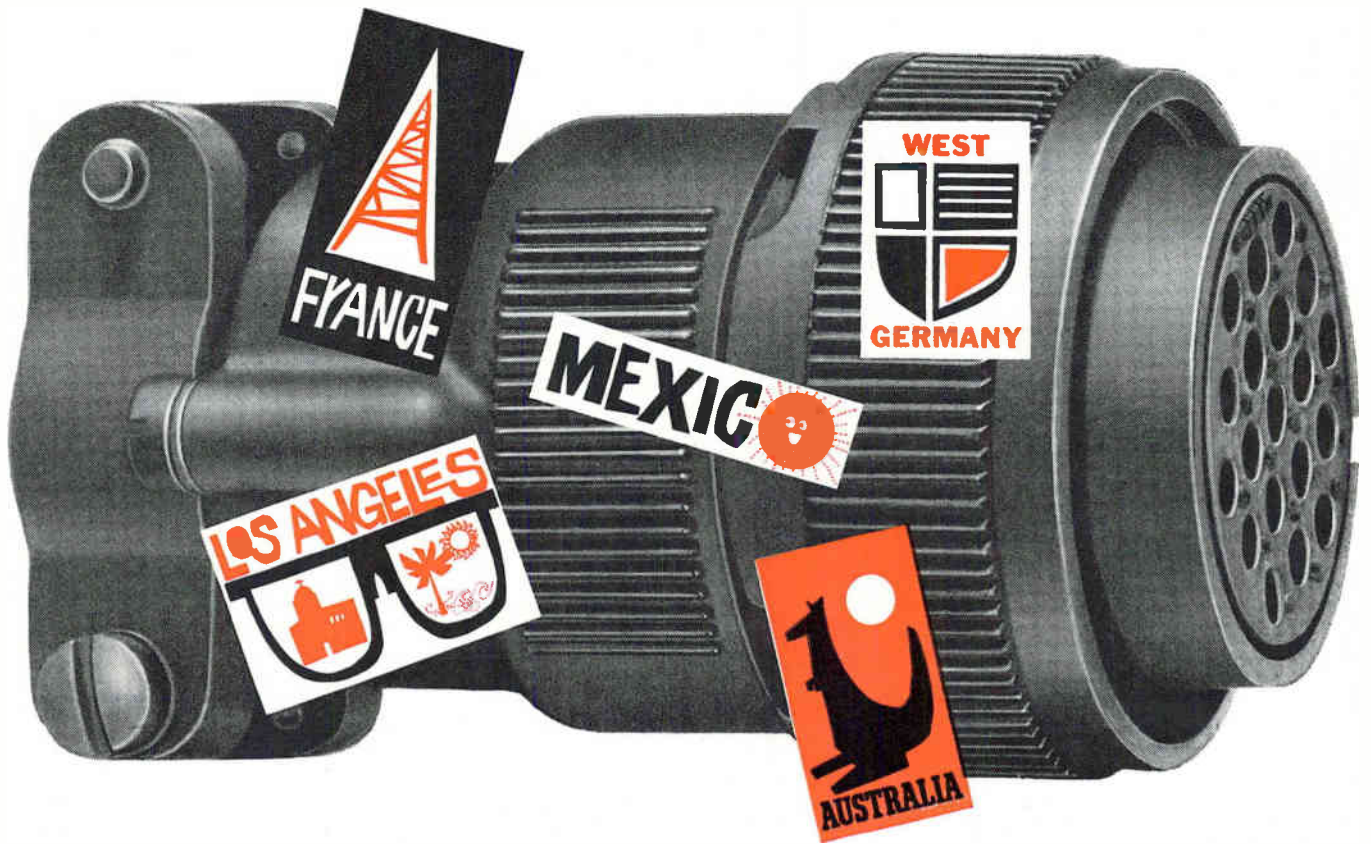
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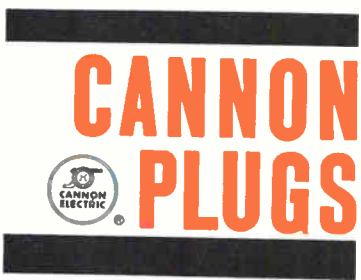


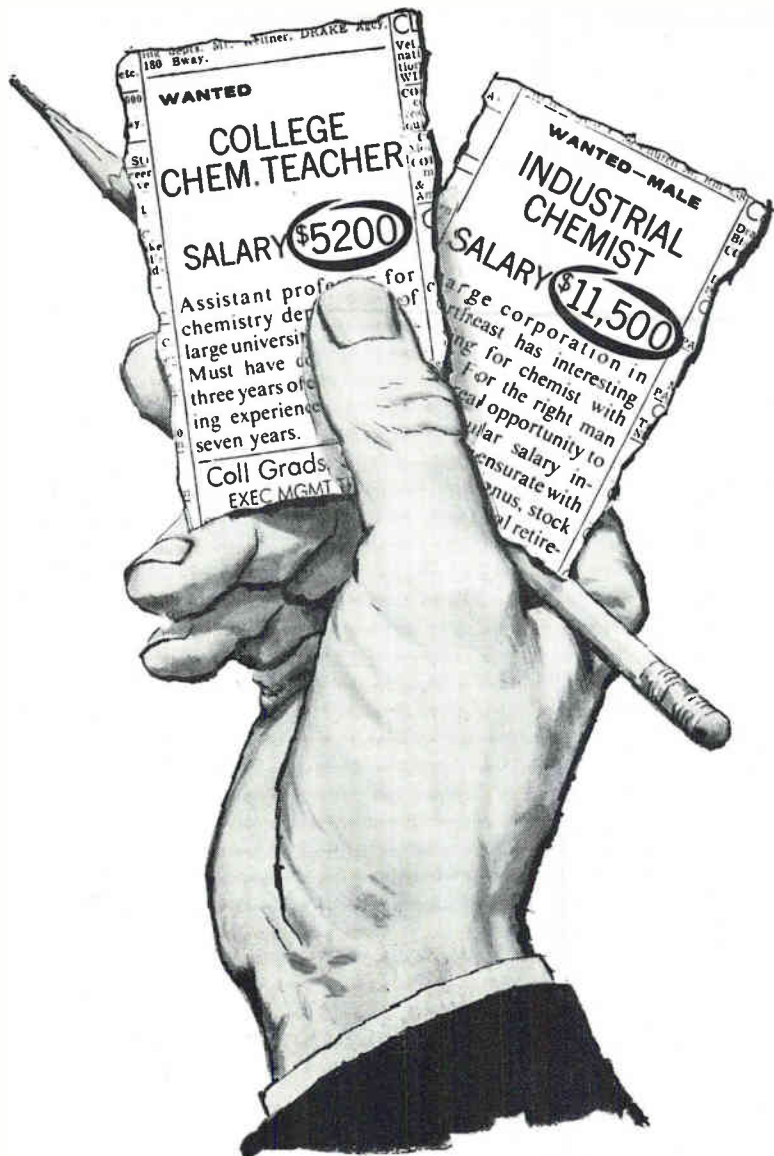
THROUGHOUT THE WORLD

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:

CANNON ELECTRIC COMPANY, 3208 Humboldt Street, Los Angeles 31, Calif.





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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

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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.



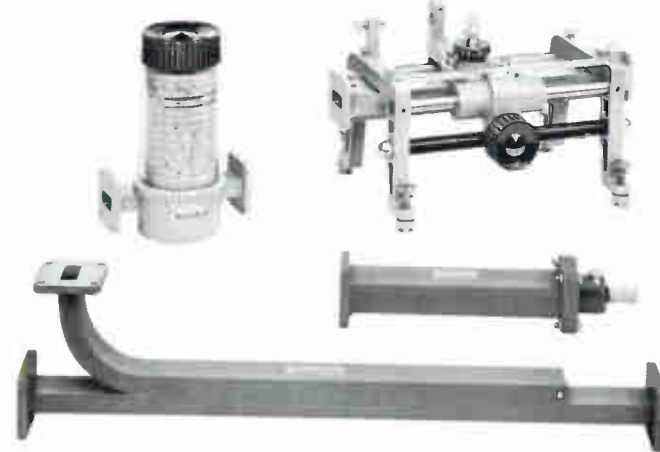
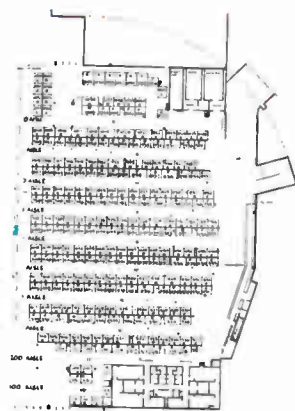
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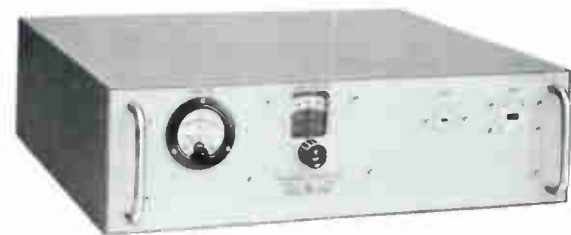
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NEW! hp 938A/940A Frequency Doubler Sets

Extend your signal generator or sweep oscillator frequency to 40 KMC!



Now, have convenient, inexpensive, dependable signal generation to 40 KMC, using your present signal generators and these new doubler sets. Operating on harmonic generation principle, hp 938A (18 to 26.5 KMC output) and hp 940A (26.5 to 40 KMC) can be driven from hp 626A or 628A (or similar) Signal Generators, or electronic sweep oscillators. The 938A/940A contain a power monitor and a precision 100 db attenuator for accurate power setting. Output power 0.5 to 1 mw approx. with hp 626A or 628A. Input power 10 mw (design center), 200 mw (maximum). Output monitor accuracy ± 1 to ± 2 db depending on model and frequency; output attenuator accuracy $\pm 2\%$ of reading or 0.2 db (whichever is greater). Attenuator range 100 db; output SWR approx. 2:1 at full output. hp 938A, \$1,500.00; hp 940A, \$1,500.00.

M-Band Components, 10 to 15 KMC!

Tool now for swift, sure measurement in the significant microwave communications band (WR75). New hp microwave equipment includes many popular hp waveguide units specifically engineered for precise work between 10 and 15 KMC. Check this list: M375A Variable Attenuator, M382A Precision Variable Attenuator, M421A Crystal Detector Mount, M487B Thermistor Mount, M532A Direct Reading Wavemeter, M752 Directional Couplers (3, 10 and 20 db models), M810B Slotted Line, M870A Slide Screw Tuner, M914B Moving Load, M920B Adjustable Short. All fitted with flat cover flanges for WR75 waveguide. See your hp catalog for general description of this equipment as supplied for other bands; call your hp representative for details, prices.



NEW! hp 344AR Noise Figure Meter—Monitors noise figure directly, continuously and automatically on operating radars.

Simple front panel calibration. Militarized, transistorized for reliability in extreme environments. High sensitivity permits decoupling noise source up to 20 db from main transmitter line to minimize system degradation. Provision for automatic alarm; output for monitoring noise figure with remote meter; noise source and modulator may be installed remotely on antenna. Several meter scale/excess noise options; 30 MC input frequency, 1 MC bandwidth, 75 ohms input impedance. Approx. \$1,600.00, depending on options, modifications.



NEW! hp 362A Low Pass Waveguide Filter

Increase accuracy of SWR measurements! New hp 362A Low Pass Waveguide Filter is useful for suppressing harmonics in slotted line measurements, receiver measurements and other measurements where a pure signal is required. The compact hp 362A features low insertion loss and the stop band is more than one octave wide. Harmonics and higher order modes suppressed at least 40 db. hp M362A (10 to 15.5 KMC, WR75) \$125.00; hp N362A (15 to 21 KMC, WR51) \$125.00.



NEW! hp 682A Sweep Oscillator, 1 to 2 KMC, featuring flat output!

Maximum flexibility, simplicity, convenience for obtaining cw and swept rf frequencies, 1 to 2 KMC, are yours with the hp 682A Sweep Oscillator. Special internal electronic circuit compensates for tube variations and maintains output flat to within ± 1 db! Independent, direct reading Frequency, Sweep Rate and Sweep Range controls permit fast adjustment and full coverage of frequency range. Sweep rates are fast enough for non-flickering trace on an oscilloscope or slow enough for mechanical recording devices. RF sweep linear with time; concurrent linear sawtooth sweep-voltage output. 50 mw minimum rf output. Internal amplitude modulation, external amplitude or frequency modulation possible (other 680 series sweep oscillators for frequencies 2 to 18 KMC, 10 mw minimum). hp 682A (cabinet) \$3,090.00; hp 682AR (rack mount) \$3,075.00.

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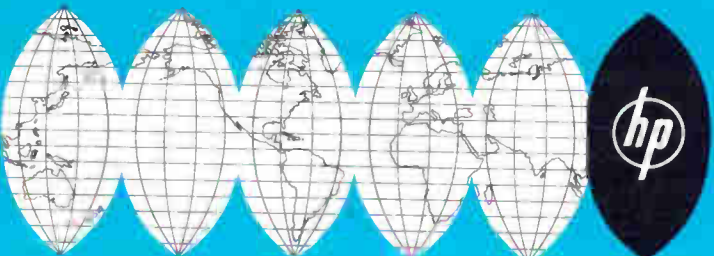
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Montreal, Quebec
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HUNter 9-8495 and 8496

Ottawa, Ontario
Atlas Instrument Corporation, Ltd.
77 Danforth Street
PARkway 2-7668

Toronto 10, Ontario
Atlas Instrument Corporation, Ltd.
50 Wingold Avenue
RUSsell 1-6174

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106-525 Seymour Street
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+ Indicates Instrument Repair Stations.

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Telecomunicaciones
Carlos Calvo 224, Buenos Aires
Tel. 30-6312-34-9087

Australia
Geo. H. Sample & Son
(Electronics) Pty. Ltd.
17-19 Anthony Street, Melbourne, C.1.
Tel: FJ 4138 (3 Lines)

Belgium
International Electronic Company
"INELCO S. A."
20-24 rue de l'Hopital, Brussels
Tel: 11-22-20 (5 Lines)

Cuba
Caribbean Electronics, S.A.
Calle L 353, Vedado, Habana
Tel: F-3274

Denmark
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Centrumgården, Room 133
6D, Vesterbrogade, Copenhagen V.
Tel: Palae 1369 and Palae 1343

Finland
INTO O/Y
11 Meritullinkatu, Helsinki
Tel: 62 14 25 and 35 125

France
Radio Equipements
65 rue de Richelieu, Paris 2ème
Tel: RICHelieu 49-88

Germany
Hewlett-Packard S.A.
Sophienstrasse 8
Frankfurt am Main
Telefon 77-31-75
and 77-94-25

Greece
K. Karayannis
Karitsi Square, Athens
Tel: 23-213 (9 Lines)

India
The Scientific Instrument
Company, Ltd.
6, Tej Bahadur Sapru Road
Allahabad 1

The Scientific Instrument
Company, Ltd.
240, Dr. Dadabhai Naoroji Road
Bombay 1

The Scientific Instrument
Company, Ltd.
11, Esplanade East, Calcutta 1

India (Continued)
The Scientific Instrument
Company, Ltd.
B-7, Ajmeri Gate, Extn.
New Delhi 1

The Scientific Instrument
Company, Ltd.
30, Mount Road, Madras 2

Israel
Electronic & Engineering Ltd.
6 Feieryberg St., Tel-Aviv
Phone 4288

Italy
Dott. Ing. Mario Vianello
Via. L. Anelli 13, Milano
Telef. 553-081

Japan
Seki & Company, Ltd.
Daini Taihei Building
No. 1 Kanda Higashi-Fukudacho
Chiyoda-Ku, Tokyo
Tokyo (866) 3136-8

Netherlands
C. N. Rood N.V.
11-13 Cort Van Der Lindenstraat
Rijswijk (Z.H.)
Tel. The Hague-98-51-53 (6 Lines)

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Geo. H. Sample & Son (N.Z.) Ltd.
431 Mount Albert Road
Mount Roskill S.1, Auckland
Tel: 89-439

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Morgensterne & Co.
Colletts Gate 10, Oslo
Tel. 60 17 90

Portugal
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Rua do Alecrim, 46-S/Loja
Lisbon
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36 86 43 - Gerencia

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Buitencingle Street, Cape Town
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57 84 51

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Erik Ferner AB
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Tel: (031) 65 36 44

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Far-Eastern Company
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31868

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PRIMARY FREQUENCY/TIME STANDARD SYSTEMS



103AR Frequency Standard

A completely transistorized oscillator, achieves stability of 5 parts in 10^{10} per day. Provides 1 MC and 100 KC sine wave output. \$2,500.00.

113AR Frequency Divider and Clock

Permits adjustment of system for maximum absolute accuracy, simplifies obtaining detailed records of drift rates or time/frequency differences. Precise time comparisons between 103AR Frequency Standard and WWV (or other) standard time signals average out errors due to propagation path variations. Also suitable for VLF comparisons. \$2,500.00.

724AR Standby Power Supply

Powers 103AR and 113AR. Standby 20 amp-hr. battery "floats" across regulated power supply, instantly assumes load, continues system operation in case of ac power failure. Built in alarm circuits, 724AR, \$750.00 with battery, \$450.00 without battery.

120AR Oscilloscope

200 KC triggered oscilloscope used as indicator for time comparisons. \$435.00.

NEW COUNTER RANGE, VERSATILITY



NEW! Measure to 500 MC with counter accuracy!

Now precision electronic counters offer measurement to 500 MC with the versatile new 525C plug-in. Used with the 524C Counter, for example, high $\frac{1}{2}$ KMC range is achieved at no sacrifice of $3/10^8$ stability, measuring ease, big, bright, in-line readout.

The 524C reads frequencies to 10.1 MC directly; also measures time interval 1 μ sec to 100 days or period 0 cps to 100 KC. Maximum resolution 0.1 μ sec; stability $3/10^8$ short term and $5/10^8$ per week long term. 525C plug-in also is usable with 524D or 524B Counters.

Just order the measuring capability you need now, later add other plug-ins to expand the daily utility of your 524B/C/D.

525C Plug-In Frequency Converter, \$425.00. Model 524C (cabinet) \$2,300.00; 524CR (rack mount) \$2,275.00.

The new primary frequency and time standard consists of the following four basic instruments (plus receiver not supplied or shown). Failsafe, compact, rugged. Basic capability of the system can be extended with addition of auxiliary equipment.

OSCILLOSCOPES



160B 15 MC Militarized Oscilloscope

Model 160B is a reliable, extra rugged, general purpose oscilloscope built to meet performance requirements of MIL-E-16400B specifications. In addition to vertical amplifier plug-ins, a second series of time axis plug-ins (which also fit the 170B) provide great flexibility, eliminate possibility of obsolescence. 24 calibrated sweep times are provided, 0.1 μ sec/cm to 5 sec/cm, $\pm 3\%$ accuracy. Sever. range magnifier increases fastest sweep to 0.02 μ sec/cm. Horizontal sensitivity 0.1 v/cm to 10 v/cm.

With 162A Dual Trace Amplifier plug-in (above, installed), maximum sensitivity is 20 mv/cm; amplifier features differential input, 1 MC electronic chopping. High stability tube-transistor circuitry; regulated DC filament voltages throughout. 162A \$350.00; 160B \$1,850.00.

166C Display Scanner — for automatic permanent recording of a CRT trace! (see photo at right)

This plug-in unit for 160B and 170A Oscilloscopes provides outputs to duplicate, with an X-Y recorder, any repetitive waveform appearing on CRT trace. Instrument permits permanent, large scale records of repetitive waveforms; resolution is higher than either scope CRT or photograph. Observe scope trace while records are made.

Unit performs a time transformation on high speed signals, converting them to slower signals having the same waveshape.

Scanning speed is arranged to keep Y output within bandwidth of conventional recorders. Unique pen speed stabilizer minimizes recording time by operating recorder at maximum writing rate. Outputs: Y-axis approximately +0.5 v to -0.5 v, X-axis +50 v to -50 v approximately. Oscilloscope sweep speeds from fastest scope speed to 5 msec/cm (Signal rep rate greater than 20 cps). 166C \$300.00.



NEW! 170A 30 MC Militarized Oscilloscope!

Maximum reliability, versatility characterize this rugged militarized 30 MC instrument. Featuring conventional controls, the general purpose 170A is simple to use, gives big, bright presentation on a 5" CRT. Other features include the new beam finder and unique dual plug-in system (vertical and time axis plug-ins), increasing versatility. 170A, \$2,150.00.

166D Sweep Delay Generator

This plug-in (above, in 170A), is the most useful sweep delay available. Usable with 160B 15 MC Scope or 170A, the 166D delays main sweep for detailed examination of a complex signal or pulse train. In addition, offers a unique mixed sweep feature to show an expanded segment of delayed waveform while still retaining a presentation of earlier portions of waveform. Use for accurate measurement of pulse-to-pulse intervals on a train of pulses, time-jitter measurements, observation of low speed and high speed phenomena on same trace. Delay time 1 μ sec to 10 sec. Delaying sweep 18 ranges. Delayed length 0 to 10 cm. Delay functions, trigger main sweep, arm main sweep, mixed sweep. 166D, \$325.00.



Model 166C in 160B Oscilloscope.

AUDIO-VIDEO INSTRUMENTATION

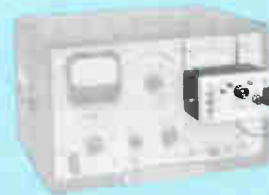


NEW! 722AR Transistorized Power Supply — 2 amp output!

Now! Have new power output capability from this compact (5 1/4" high), dependable transistorized power supply. 722AR, similar

to the popular 721A, supplies fully regulated dc output voltages from 0 to 60 v, at 0 to 2 amps. Ideal for safe transistor investigation, it has a three-terminal output for either positive or negative grounding. Special circuit limits output current to pre-set value, preventing costly damage to transistors under test. Load regulation less than 5 mv change for 0 to 2 amp current change.

Two panel meters monitor output voltage and current, minimizing the need for other equipment. Additional convenience is provided by the 722AR's small size, low power consumption and easy-to-use controls. 722AR (rack mount) \$450.00.



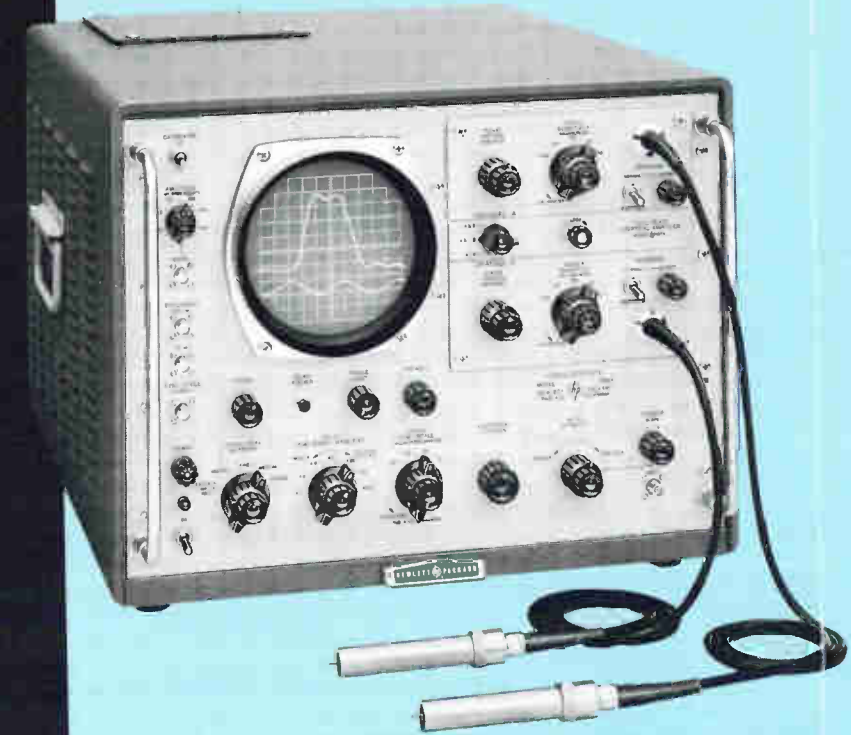
AC-97C Sweep Drive for 302A Wave Analyzer

Now! Convert your 302A Wave Analyzer to a sweep oscillator-tuned voltmeter for automatic frequency response measurements, even in noisy

systems. Make automatic plots of harmonics or intermodulation products with an X-Y recorder.

New AC-97C motor accessory allows you to sweep the entire frequency range of 302A. Mounts on 302A, or on adjustable bench stand. Facilitates distortion measurements, permits you to sweep all or any part of the 302A range automatically. Fast sweep for covering frequency spectrum rapidly, slow sweep for high resolution plot. X-axis output. AC-97C \$275.00; 302A (cabinet) \$1,750.00; 302AR (rack mount) \$1,735.00.

NEW! 1,000 MC SCOPE



Easy to use as a 10 M
Try it yourself at WES

185A 1,000 MC Oscilloscope

Now the 185A Oscilloscope design, is usable to 1,000 — conventional controls is the scope to use anywhere offering a big, bright "10" duty cycles. Special features: low jitter, wide dynamic range of small voltages, even 100 ns plateau. Full 10 cm v/cm for waveform analysis. One channel input, five modes. 0.1 nanosecond/cm. High resolution for waveforms. Extreme resolving capability for external circuits. Jitter within 3 db to at least 80 MHz. Unique, the 185A with impedance operation 10 to 1,000 MHz. \$2,000.00; (Requires 1000 for operation, \$1,000.00.)

NEW! 1,000 MC 1 mv VTVM



Measure 1 mv at rf fr

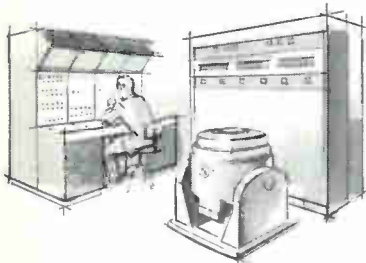
411A 1 mv to 10 v VTVM

NOW! For the first time, measure 1,000 MC with the ease, convenience, accuracy, resolution; high resolution; high probe for freedom from recalibration. Seven meter includes db scale. Accuracy $\pm 3\%$, 1 MC ± 1 db, 0.5 MC to 1,000 MHz. Usefulness. Output for galvanometer. Eliminates contact noise.

The important advances in environmental testing come from MB



NEW MB automatic spectrum equalizer to revolutionize random vibration testing



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.

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.

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CIRCLE 25 ON READER SERVICE CARD

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FOR ALL
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AS WELL AS
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TRANSDUCER ASSEMBLIES
FOR MOST APPLICATIONS,
SUCH AS UNDERWATER
SOUND AND
VARIOUS ORDNANCE AND
MISSILE DEVICES.**



Sprague-developed mass production and quality-control techniques assure lowest possible cost consistent with utmost quality and reliability. Here too, complete fabrication facilities permit prompt production in a full, wide range of sizes and shapes.

Look to Sprague for today's most advanced ceramic elements—where continuing intensive research promises new material with many properties extended beyond present limits.



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35 Marshall Street, North Adams, Mass.

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THE MARK OF RELIABILITY

FINANCIAL ROUNDUP

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 \$3,208,000 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: \$5,200,000 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 Waltham, Mass. firm, coming this year to a figure of \$55,000. Sales this

25 MOST ACTIVE STOCKS

	WEEK ENDING JULY 29, 1960			
	SHARES (IN 100'S)	HIGH	LOW	CLOSE
Avco Corp	1,292	151/8	141/4	151/8
Gen Tel & Elec	1,262	291/4	277/8	291/4
Int'l Tel & Tel	1,070	403/4	361/2	403/4
RCA	991	607/8	58	60
Gen Electric	882	847/8	801/8	845/8
Collins Radio	857	605/8	561/8	605/8
Sperry Rand	838	231/8	215/8	223/4
Ampex	739	353/8	321/2	337/8
Westinghouse	702	56	507/8	56
Gen Inst	630	427/8	38	42
Varian Assoc	554	58	50	58
Standard Kollsman	549	237/8	22	233/8
Int'l Resistance	497	32	273/4	32
Litton Ind	475	841/8	761/8	833/4
Beckman	463	851/8	78	843/8
Transitron	456	481/4	445/8	48
Zenith	450	1163/4	1083/4	1163/4
Philco Corp	370	261/8	241/8	261/8
Univ Controls	364	153/8	141/8	153/8
Gen Dynamics	349	437/8	411/4	43
Fairchild Camera	331	174	1623/4	174
Burroughs	328	347/8	331/8	343/4
Raytheon	318	40	371/2	393/8
Elec & Mus Ind	318	7	61/2	7
Texas Inst	278	2251/2	2131/2	2251/2

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

year are up 20 percent at \$6,079,000, while sales backlog is up about \$1 million from the same period in 1959.

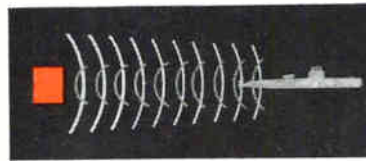
Combined net earnings of ACF Industries and its wholly owned SHPX group of companies were \$5,166,000, equivalent to \$3.64 per share of common stock, for the year ended April 30, 1960. In fiscal 1959, combined earnings were \$2,720,000 or \$1.92 a share. Of fiscal 1960's earnings, ACF accounted for \$2.77 a share, SHPX for 87 cents a share. Board chairman W. T. Taylor laid emphasis on the important role of Avion 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.

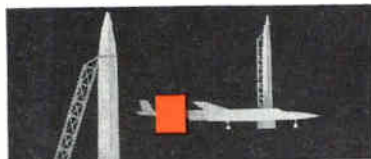
National Research Corp., Cambridge, Mass., reports net profits of \$99,290, equal to 19 cents a share, for the first half of 1960. This compares with a net loss of \$100,534 after tax recovery of \$67,000 in the corresponding period last year, and a net profit of \$17,356 in the full year 1959.

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.

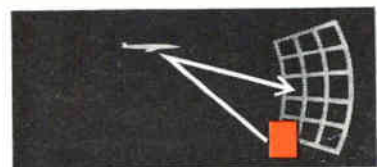
NEW FROM WESTINGHOUSE: STATIC POWER SUPPLIES FOR SPACE AGE PROJECTS



for Sonar



for G.S.E.



for Radar

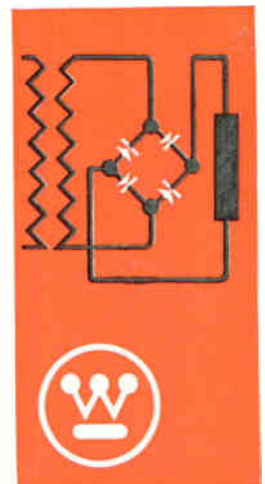


for Aircraft/Missiles

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 868, Pittsburgh 30, Pa. *You can be sure . . . if it's Westinghouse.*

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MATCH YOUR REQUIREMENTS FROM AMONG THESE 2,020 STANDARD RAYTHEON REGULATORS

The RAYTHEON 2020 is an advanced series of voltage regulators, power supplies, filament regulators, and filament transformers. It is designed to meet the needs of a wide range of users. It is available in a wide range of sizes and ratings. It is designed to meet the needs of a wide range of users. It is available in a wide range of sizes and ratings.

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HOW TO USE THE SELECTION GUIDE

1. Determine the required output voltage and current. 2. Determine the required input voltage and current. 3. Determine the required power rating.

STEP 1

1. Determine the required output voltage and current. 2. Determine the required input voltage and current. 3. Determine the required power rating.

STEP 2

1. Determine the required output voltage and current. 2. Determine the required input voltage and current. 3. Determine the required power rating.

±1% Line Voltage Regulators

Output voltage constant to ±1% over full load range. Input voltage range 100-130V. Output current up to 100A. Input current up to 100A.

±1% Filament Voltage Regulators

Output voltage constant to ±1% over full load range. Input voltage range 100-130V. Output current up to 100A. Input current up to 100A.

±1% Power Supply Voltage Regulators

Output voltage constant to ±1% over full load range. Input voltage range 100-130V. Output current up to 100A. Input current up to 100A.

RAYTHEON VOLTAGE REGULATORS STANDARD MODEL SELECTION GUIDE LINE VOLTAGE REGULATORS

Output Voltage (V)	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500
100V	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500

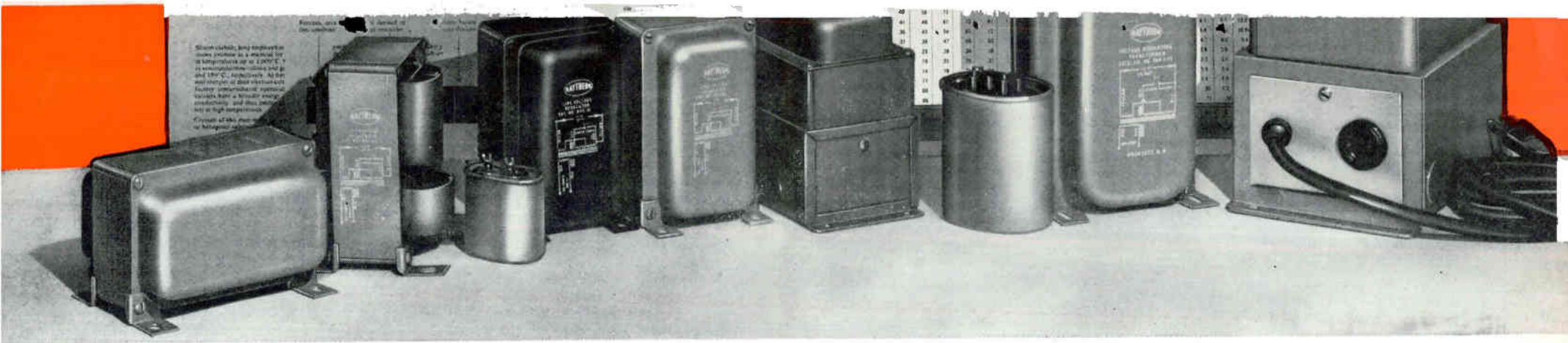
FILAMENT VOLTAGE REGULATORS

Output Voltage (V)	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500
100V	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500

POWER SUPPLY VOLTAGE REGULATORS

Output Voltage (V)	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500
100V	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500





NEW RAYTHEON STANDARD VOLTAGE REGULATOR MODELS INCLUDE COMPONENT STYLE UNITS WITH EXTERNAL CAPACITORS FOR CONVENIENT UPRIGHT OR HORIZONTAL INSTALLATION ON ELECTRONIC EQUIPMENT CHASSIS • APPARATUS STYLE UNITS FOR USE WHERE A COMPLETELY SELF-CONTAINED INSTALLATION IS DESIRED • OPEN STYLE UNITS (WITHOUT END BELLS) • GRID AND RECEPTACLE FOR LINE APPLICATIONS...REGULATOR SELECTION GUIDE LETS YOU CHOOSE FROM 2,020 DIFFERENT UNITS.

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 appli-

cations, 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 $\pm 1\%$ for line voltage variations of $\pm 15\%$.

Fill in the coupon and receive your copy of our VOLTAGE REGULATOR SELECTION GUIDE AND CATALOG No. 4-265.

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Please send by return mail my copy of Raytheon's
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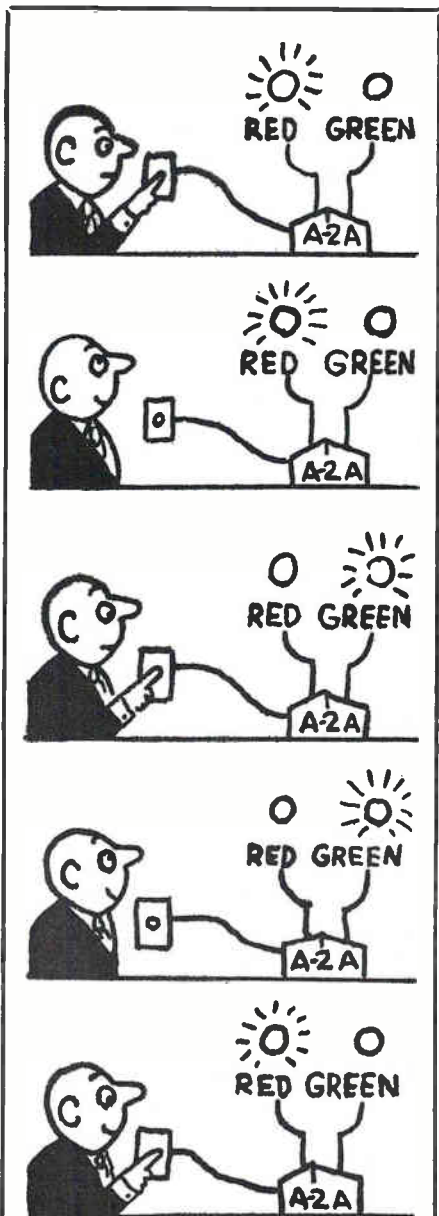
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After each command pulse, the Astromics A-2A Latching Relay locks in position mechanically and remains locked until a new pulse is applied. No magnets. Holds contact under severe environmental conditions. Handles a 20 amp. load at 26.5 V DC.

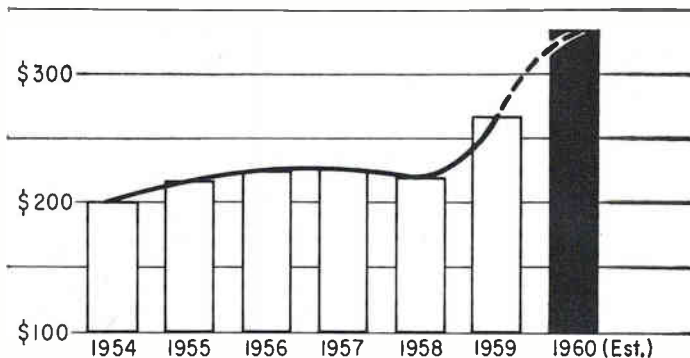
See it at Wescon—Space 838A
For Technical Data Write:



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MILLIONS OF DOLLARS
\$400

CAPACITOR SALES



SOURCES: 1954-1959, EIA
1960 Estimate, ELECTRONICS

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.)

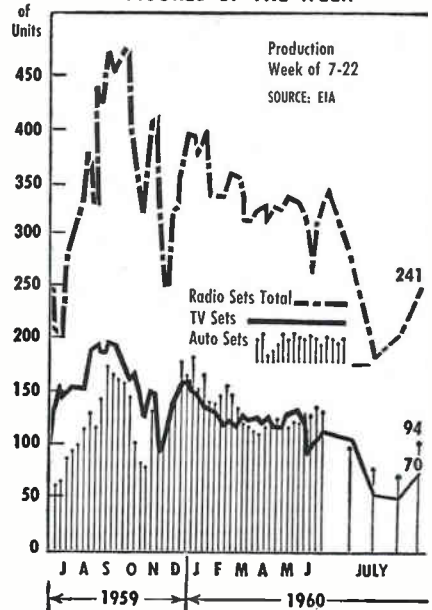
Capacitor sales growth has been quite moderate in the period 1954 through 1958, with sales rising about 10 percent for the period—from \$200 million to a peak of \$225 million in 1957 and slipping slightly to \$218 million in 1958. Picture started to brighten in 1959 when sales increased 22 percent to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

FIGURES OF THE WEEK

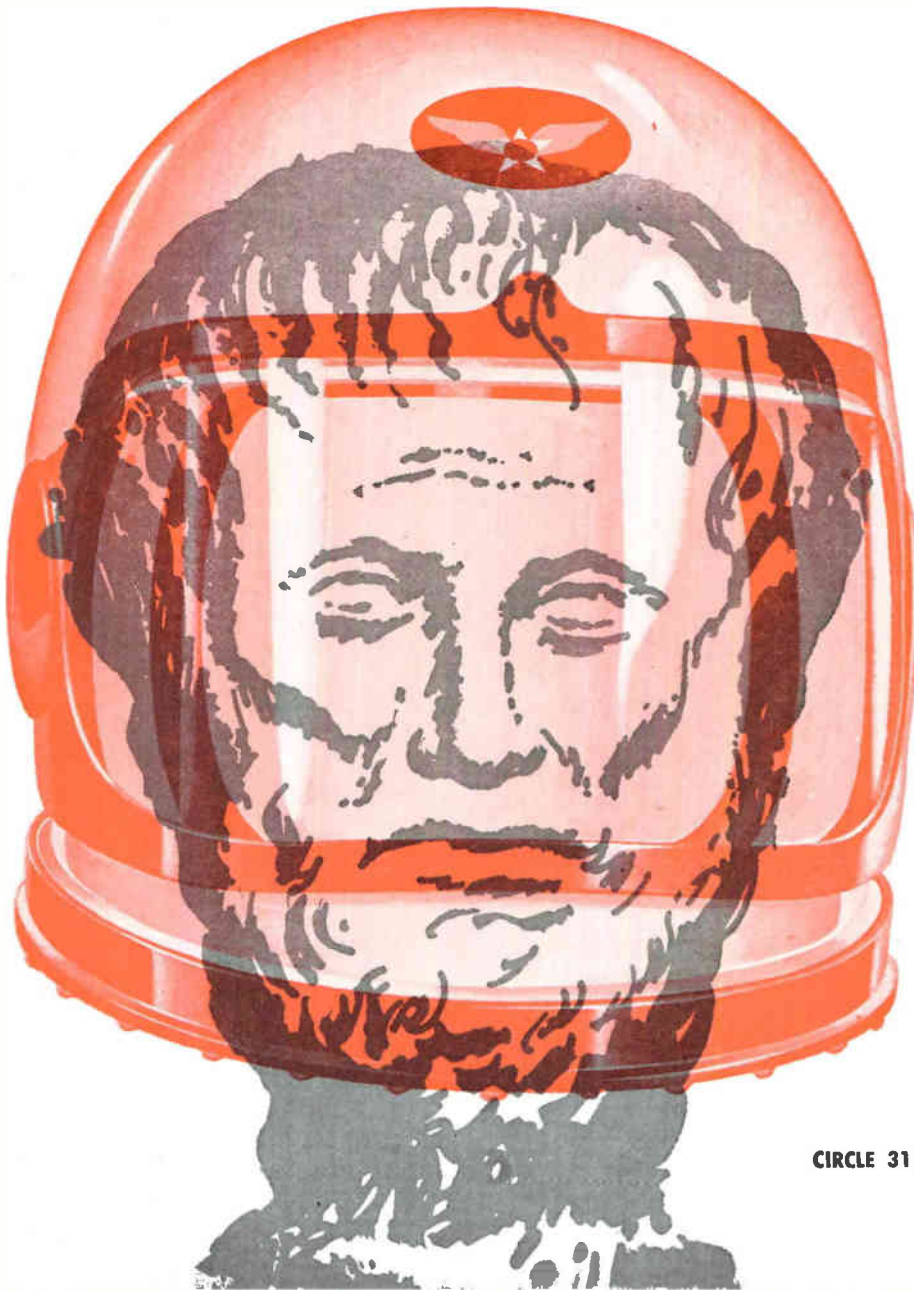


Giannini Controls Corporation

A NAME TO PLAN WITH

HETEROGISTICS

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.



CIRCLE 31 ON READER SERVICE CARD

THESE AND DOZENS OF OTHER MEASUREMENT AND CONTROL SUBSYSTEMS IN DAILY OPERATION HAVE BUILT THE GIANNINI REPUTATION FOR FAST, KNOWLEDGEABLE DEVELOPMENT OF SYSTEMS

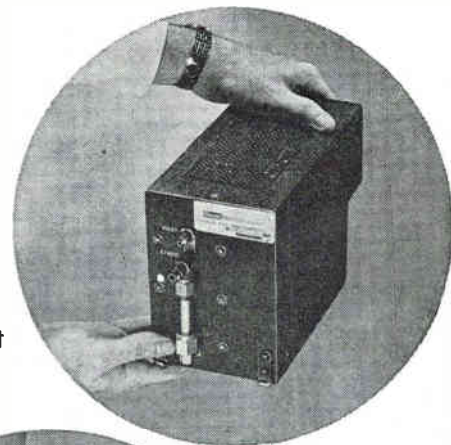


A "GUN BARREL" HALF-A-MILE LONG

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.

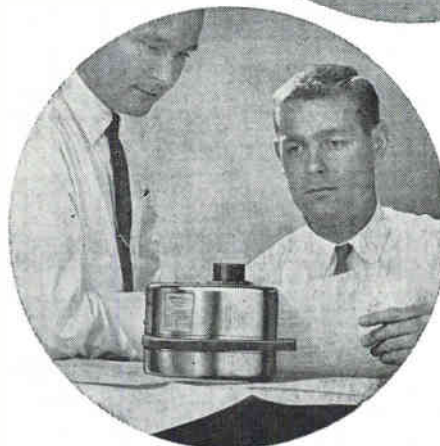
PITCH TRIM COMPENSATOR FOR DC-8 JETLINER

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



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

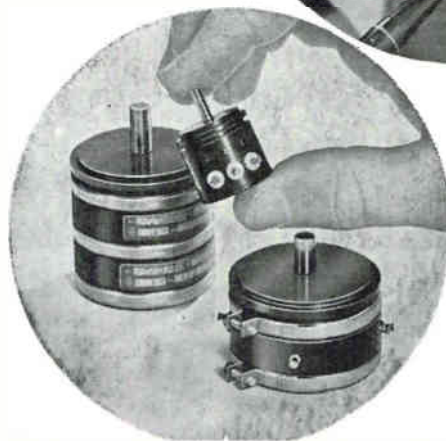
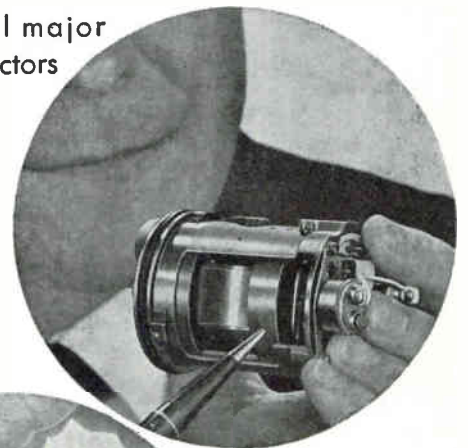
Giannini Air Data Instruments offer you the widest choice in the industry. For years they have set avionic standards and served as building blocks for control and flight test subsystems. The Air Data line includes: **Absolute, Differential and Gage Pressure Transducers — Servoed Pressure and Pressure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

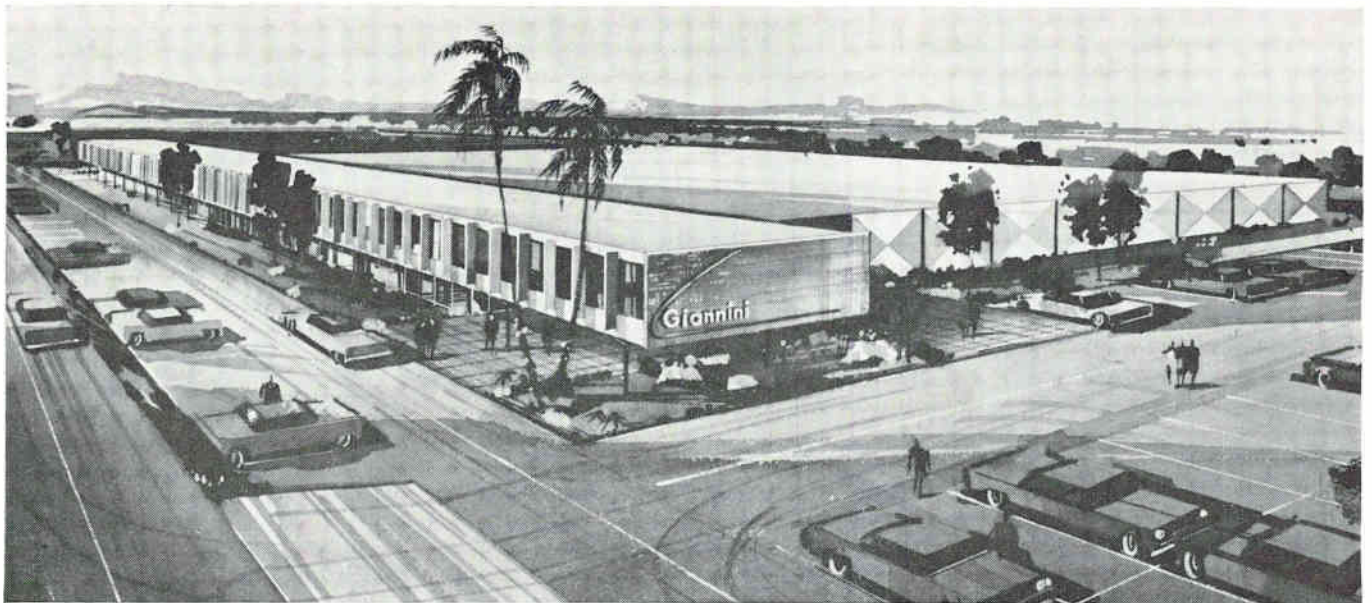
SERVO COMPONENTS

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.





FACILITIES . . . A PLANNED FLEXIBILITY

Every Giannini product is designed to solve a specific problem. Often, a problem never before solved. This calls for utmost flexibility. In design. In manufacture.

At Giannini, flexibility is management-planned and management-guided with emphasis on these basics: Qualified personnel. Continuous training. A core of proved principles and procedures. Awareness of

schedules. Control of critical processes. Responsibility with authority.

These basics guide the work of all Giannini departments and echelons. You benefit from them when you choose Giannini as your contractor for advanced subsystems management and creative development programs.

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Like a parabolic antenna to the space pilot, case studies and other Giannini technical literature focus valuable information and guidance for those with advanced design and project responsibilities. Please order by title or number.

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1. Trim Compensator for Jet Liner
2. Stall Warning System for Douglas Cargomaster
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4. Voltage Monitor for Telemetry System

5. Engine Pressure Ratio System for Jet Aircraft
6. Variable Inlet Controller for Supersonic Fighter

Component Data

7. Air Data Instruments
8. Inertial Instruments
9. Servo Components

Monthly Mailing

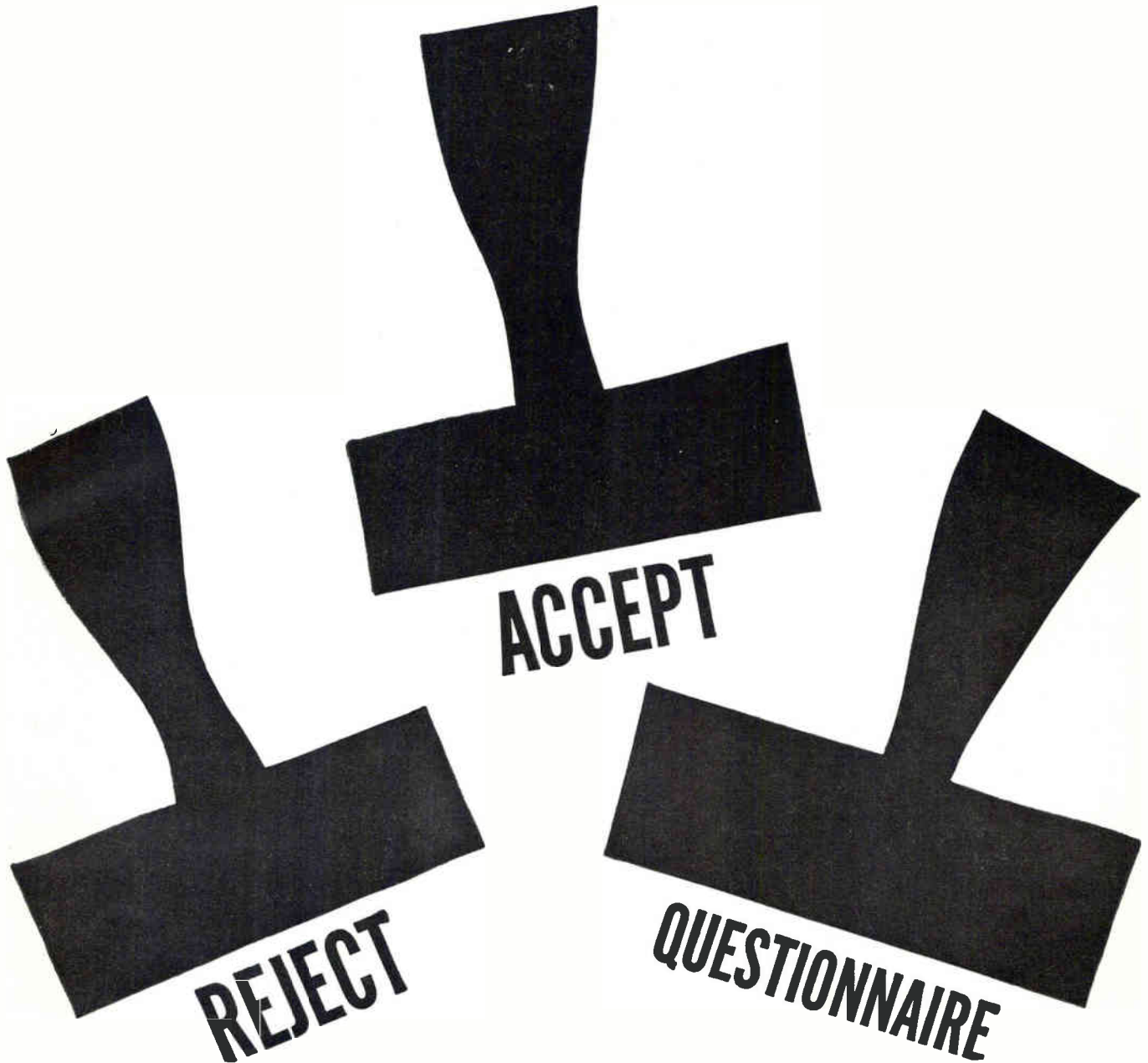
10. Giannini Technical Notes

Giannini Controls Corporation

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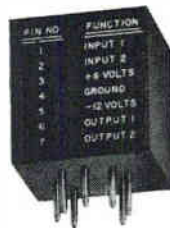
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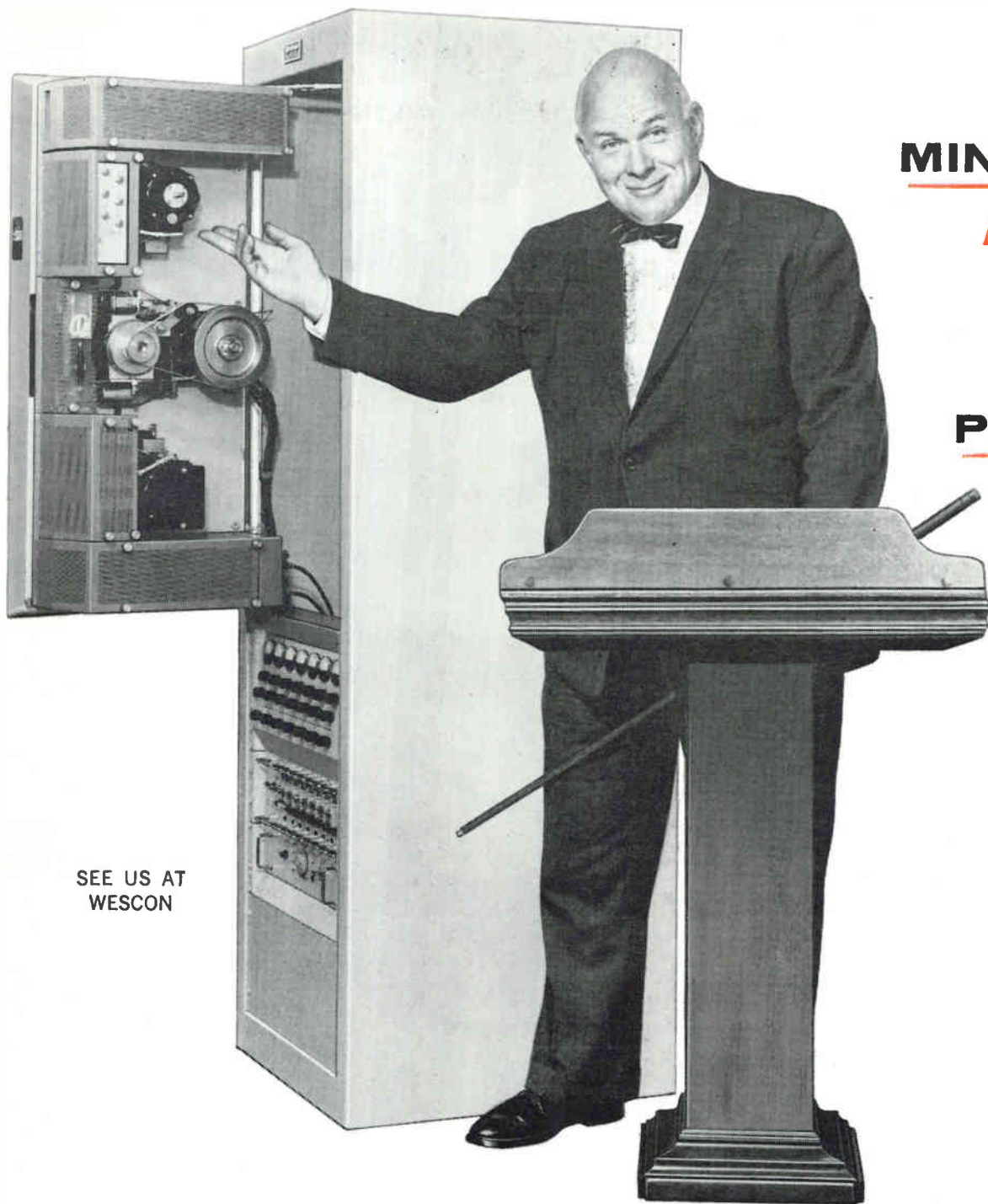
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TYPE MW UNCOVERED PLASTIC	stranded or solid tinned copper, thermoplastic insulation. 80°C	1000	12-24 (stranded) 16-22 (solid)	*1-30	1550-1567
TYPE MW SHIELDED	stranded tinned copper insulation, tinned copper shield overall. 80°C	1000	12-24	Conductors 16-24 Colors *1-10 Conductors 12-14 Colors *1-3	1350-1356
TYPE MW NYLON JACKET (SHIELDED)	stranded tinned copper, thermoplastic insulation tinned copper shield overall, jacket over shield. 90°C	1000	16-22	*1	1371-1374
TYPE MW NYLON JACKET	stranded tinned copper, medium wall thermoplastic insulation, clear nylon jacket overall. 90°C	1000	12-22	Conductors 16-22 Colors *1-10 & *14-22 Conductors 12-14 Colors *1-6	1504-1509
TYPE MW GLASS BRAID	stranded tinned copper, thermoplastic insulation, lacquered glass braid overall. 80°C	1000	12-22	Conductors 16-22 Colors *1-19 Conductors 12-14 Colors *1 & *14-22	1590-1595
TYPE MW GLASS BRAID SHIELDED	stranded tinned copper, white thermoplastic insulation, lacquered glass braid tinned copper shield overall. 80°C	1000	12-22	*1	1361-1366
TYPE HW UNCOVERED PLASTIC	stranded tinned copper, heavy wall thermoplastic insulation. 80°C	2500 (22-14) 600 (12-6)	6-22	Conductors 6-16 Colors *1-3 Conductors 18-22 Colors *1-10	1571-1579 & 1561-1567
TYPE HW GLASS BRAID	stranded tinned copper, heavy wall thermoplastic insulation, lacquered glass braid overall. 80°C	600	6-10	*1, 14, 15	1598-1599/6

- | | | | | |
|-------------|---------------------|------------------|-----------------------|------------------------|
| 1. White | 7. Brown | 13. Dark Blue | 19. White/Brown | 25. White/Black/Yellow |
| 2. Black | 8. Orange | 14. White/Black | 20. White/Orange | 26. White/Black/Blue |
| 3. Red | 9. Gray (slate) | 15. White/Red | 21. White/Gray | 27. White/Black/Brown |
| 4. Green | 10. Violet (purple) | 16. White/Green | 22. White/Violet | 28. White/Black/Orange |
| 5. Yellow | 11. Tan | 17. White/Yellow | 23. White/Black/Red | 29. White/Black/Violet |
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CIRCLE 38 ON READER SERVICE CARD

CIRCLE 39 ON READER SERVICE CARD →

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BINISTOR

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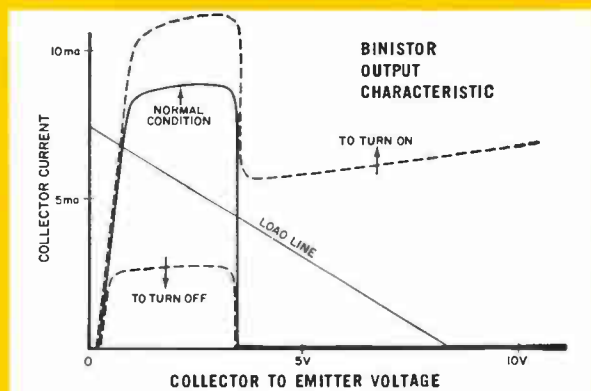
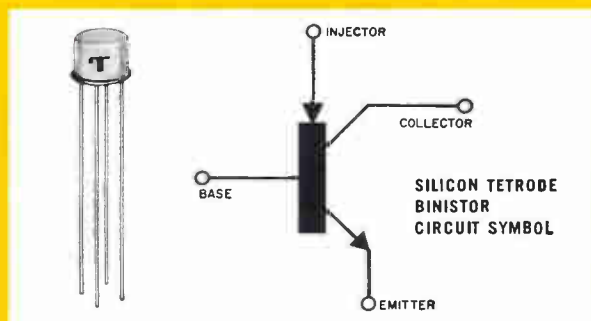
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To learn more of this important new development — THE BINISTOR — and how it works — write for Bulletin No. TE-1360.

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Operating Collector Current Range	$50\mu\text{a}$ to 15ma
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... and they wasted Five Billion Dollars!

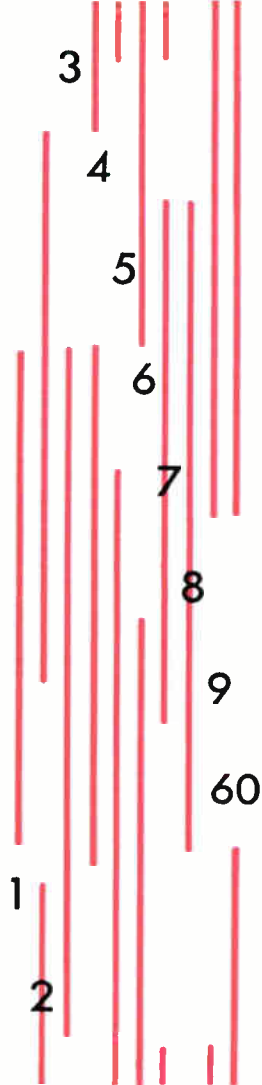
Traffic accidents' human toll is so tragic we sometimes overlook their staggering economic waste. Five Billion Dollars in lost wages, medical expenses, insurance costs and property damage! Your business—every business—shares in this loss. So you have a double interest in helping reduce traffic accidents. 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!*



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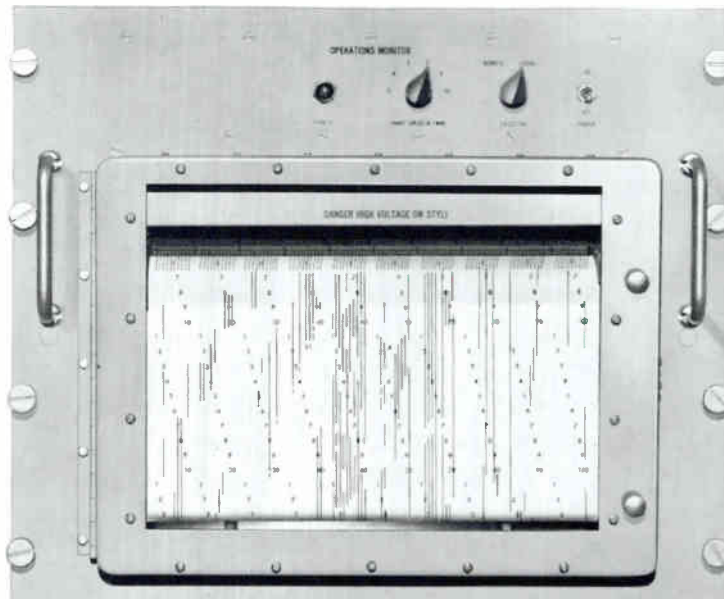
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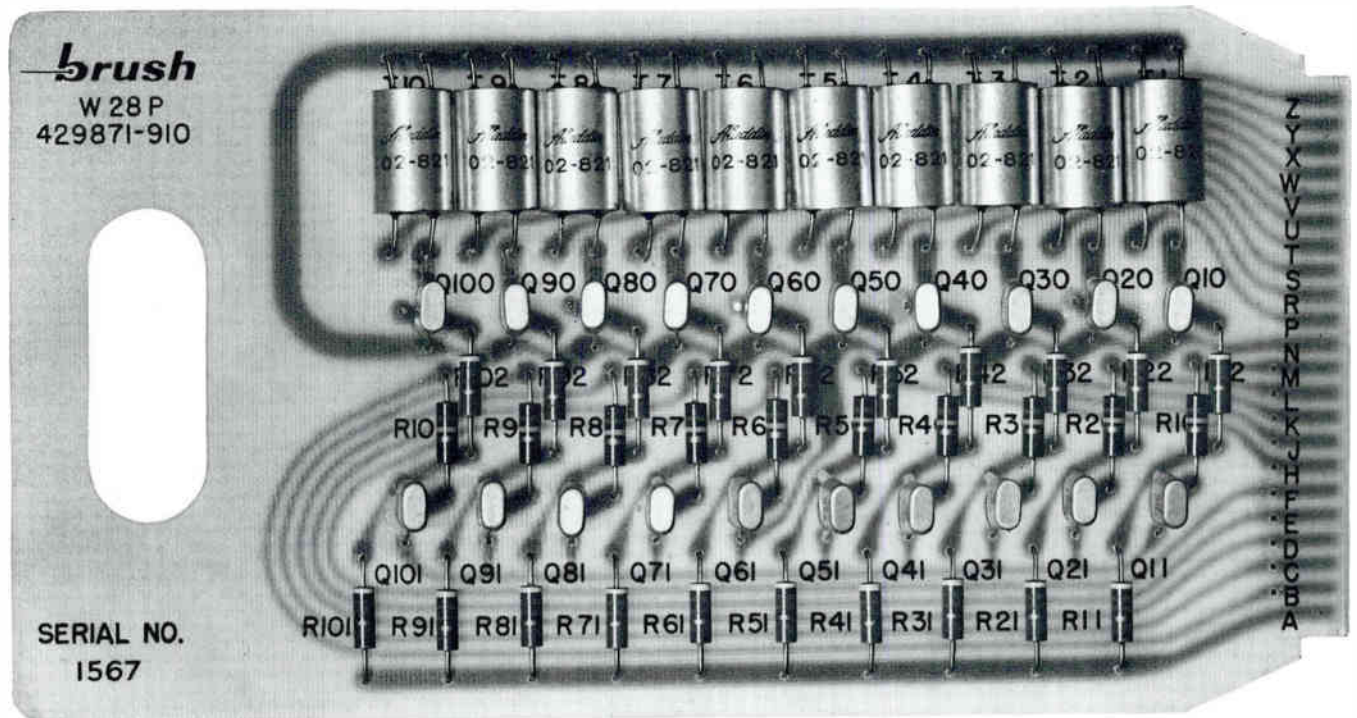
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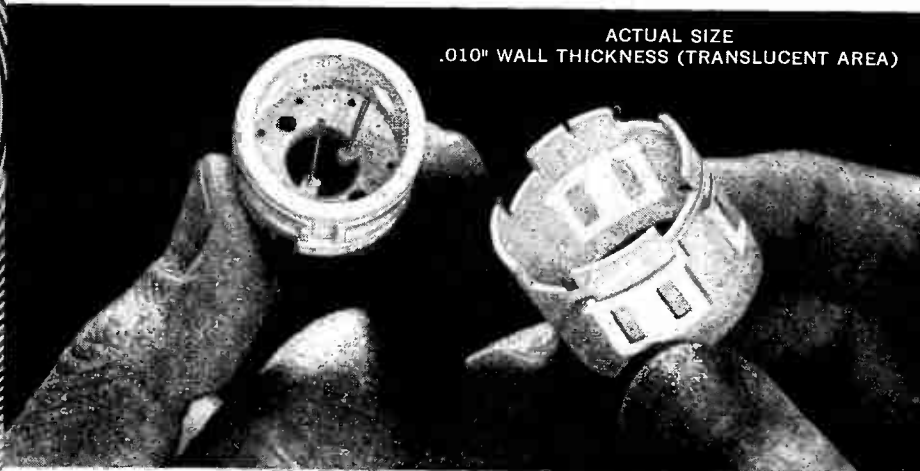
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from the family of the world's
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helps to maintain peak gyro efficiency

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.

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

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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



As in previous years, exhibits share the spotlight with technical sessions

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.

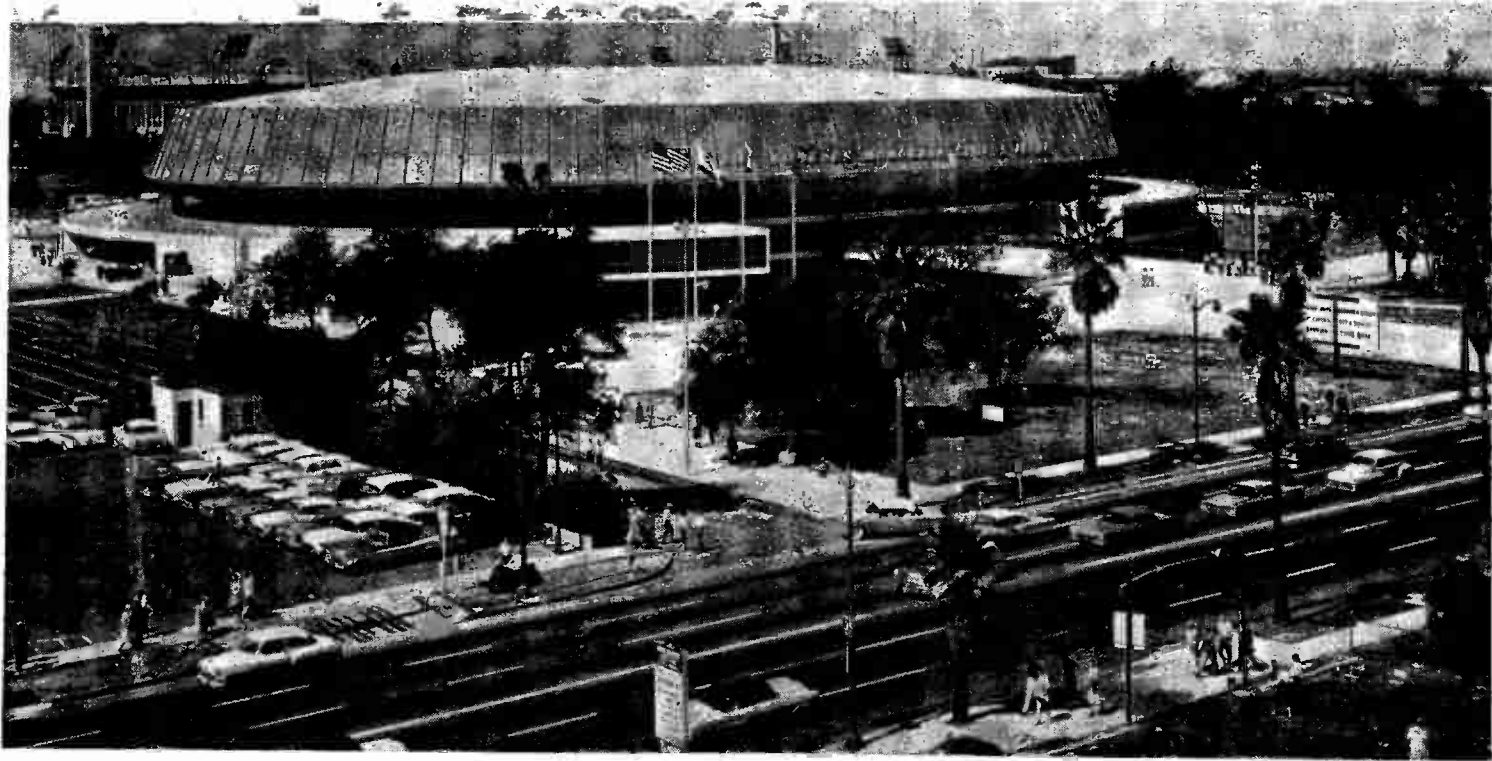
Importance of distributors and manufacturers reps will be stressed in an all-day session the day before the convention opens. Following a breakfast at the Ambassador Hotel on Aug. 22, 20 work sessions will provide an opportunity for factory people and reps to put their heads together to plan sales strategy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



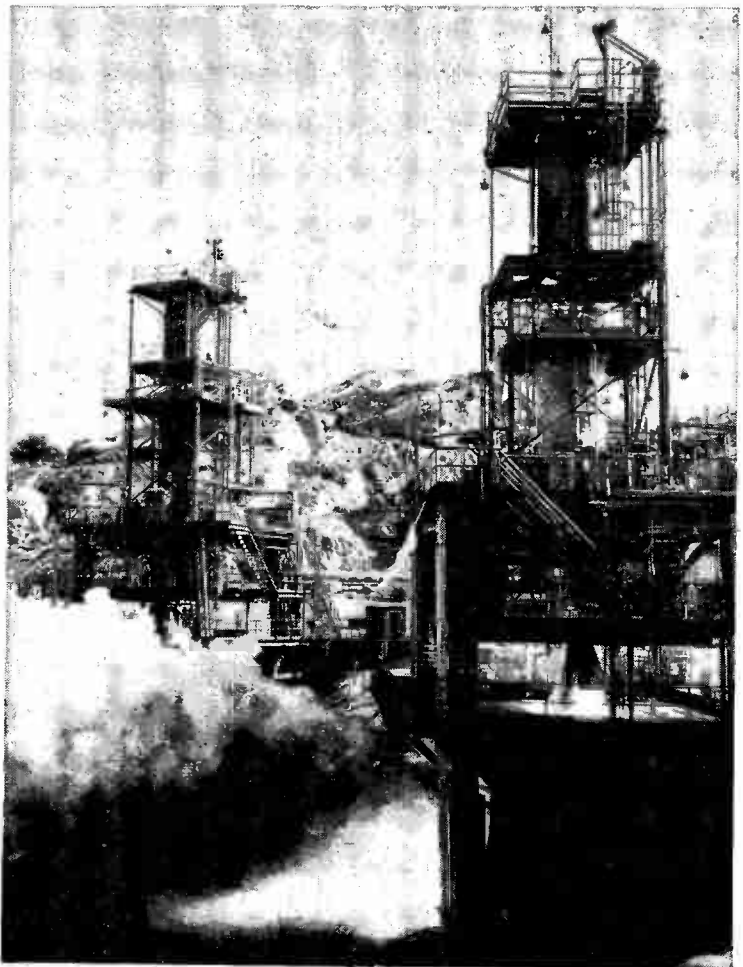
Sports Arena's 138,000 sq ft will be augmented by 56,000 sq ft in a specially constructed air-conditioned annex

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.

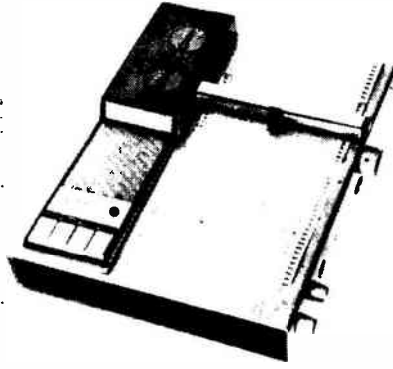
Industrial Design Awards program last month selected 25 products from the drawingboards of companies throughout the nation. Five of these will be selected for prizes prior to the opening of the show; the entire group will be on display in an exhibition hall on the arena's glass-walled concourse.



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



This power triode is submitted by Eitel-McCullough



Potentiometric recorder entered by Beckman Instruments



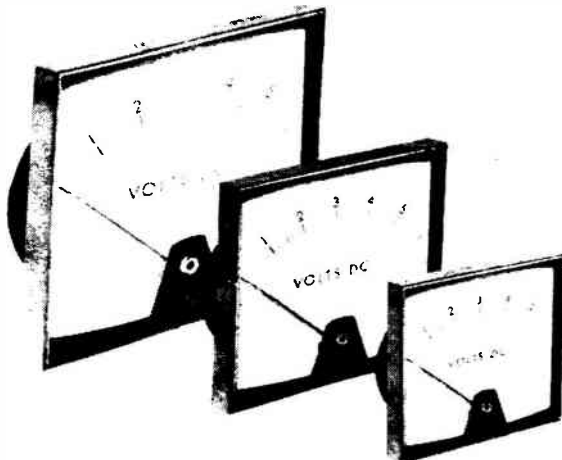
Variable attenuator designed for Hewlett-Packard

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



One of 4 measuring instruments designed for Decker Corp.



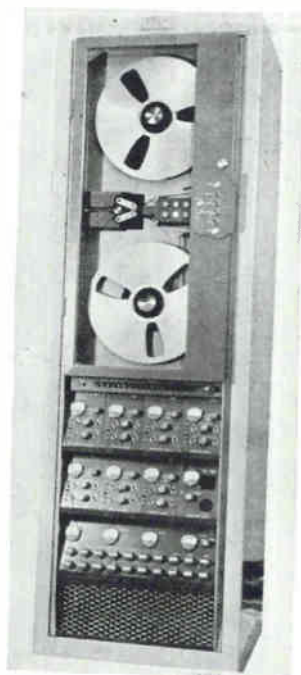
New style for Voltron Products' precision electric meters

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. Slee 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; Bendix 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 Voltron 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.

BIRD

"Termaline" 50 ohm Coaxial Line LOAD RESISTORS



82-A
(500 Watts)

- SERIES 80-82**
- Frequency Range: DC to 4000 mc
 - Power Range: 20 to 2500 Watts
 - Non-Radiating
 - VSWR: 1.1 max. to 1000 mc.

APPLICATIONS

Accurate termination for 50-ohm coaxial systems, as dummy antennas, during adjustment, alignment and testing.



80A
(20 Watts Max.)



81
(50 Watts)



81-B
(80 Watts)

SPECIFICATIONS

MODEL	MAXIMUM POWER (In Still Air)	FREQUENCY RANGE	MAX. VSWR	INPUT CONNECTOR	WEIGHT	MAXIMUM DIMENSIONS		
						HEIGHT	LENGTH	WIDTH
80-A	20 W	0-1000 mc	1.1	"N" Female	2 lbs.	4 1/4"	4 3/16"	1 1/2"
81	50 W	0-4 kmc	1.2	"N" Female	4 lbs.	4 1/2"	9 3/4"	2 1/32"
81-B	80 W	0-4 kmc	1.2	"N" Female	4 lbs.	6 1/32"	9 3/4"	3 1/16"
82-A	500 W	0-3.3 kmc	1.2	Coplanar Adapter to UG-21 B/U Supplied. RG-17, RG-19 cable assemblies available.	17 lbs.	8 7/16"	18 1/2"	5 1/16"
82-AU	500 W	0-3.3 kmc	1.2	LC Jack mates with UG-154/U plug on RG-17/U cable.	17 lbs.	8 7/16"	19 1/8"	5 1/16"
82-C	2500 W Water cooled	0-3.3 kmc	1.2	Coplanar Adapter to UG-21 B/U Supplied. RG-17, RG-19 cable assemblies available.	26 lbs.	8 7/16"	20 1/16"	5 1/16"

OTHER BIRD PRODUCTS



"Thurline"
Directional
RF Wattmeters



Coaxial
RF Filters



Coaxial
RF Switches.



"Termaline"
RF Absorption
Wattmeters



BIRD

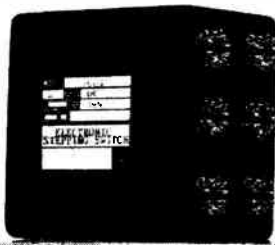
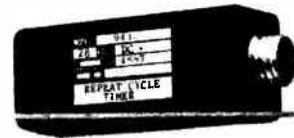
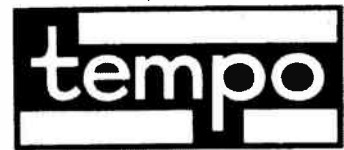
ELECTRONIC CORP.

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30303 Aurora Road, Cleveland 39, Ohio
Western Representative:
VAN GROOS COMPANY, Woodland Hills, Calif.

Advanced missile systems, space-probing research vehicles, high performance avionic and ground

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

ELECTRONIC STEPPING SWITCHES. Operate from pulsed 28 vdc input. Deliver as many as 50 or more output voltages in sequence. Guaranteed life of one million cycles minimum.

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 a complete timing and sequence program covering more than 5000 seconds.

REPEAT CYCLE TIMERS. Provide multi-channel control signals, each with a timing pulse of pre-determined 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

Booth 2419

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 shanghaiing 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 clamp-down 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-pedalled?

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.

Radars Guards Bridge



Raytheon radar atop vertical lift bridge at Duluth, Minn., warns of approaching ships in heavy weather

how
to
split
a

SPLIT SECOND

New HUGHES® nanosecond diodes switch 50 times faster than standard germanium diodes.

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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.

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TYPICAL PARAMETER RANGES	
Forward Voltage @ 100mA	.75V to .55V
Reverse Current @ -3V	5μA
Peak Inverse Voltage	1 to 25V
Reverse Recovery**	1.5* to 2.5n sec.
Shunt Capacitance @ zero bias	1.0μfd
Rectification Efficiency @ 100mA	70%
Q @ zero bias	10
Maximum Power Dissipation	90mW

*1.5n sec. limits PIV to 10 volts.
 **Switching 50mA to -6 volts, and recovering to 2KΩ with a 1000 resistance of 100Ω. A sampling scope is used for measuring this recovery.

Creating a new world of ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY

SEMICONDUCTOR DIVISION

What WESCON Exhibitors are Saying



H. L. HOFFMAN
President
Hoffman Electronics Corp.

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 show-

ing more new products than at any previous trade show, and our industrial products division will be represented for the first time.

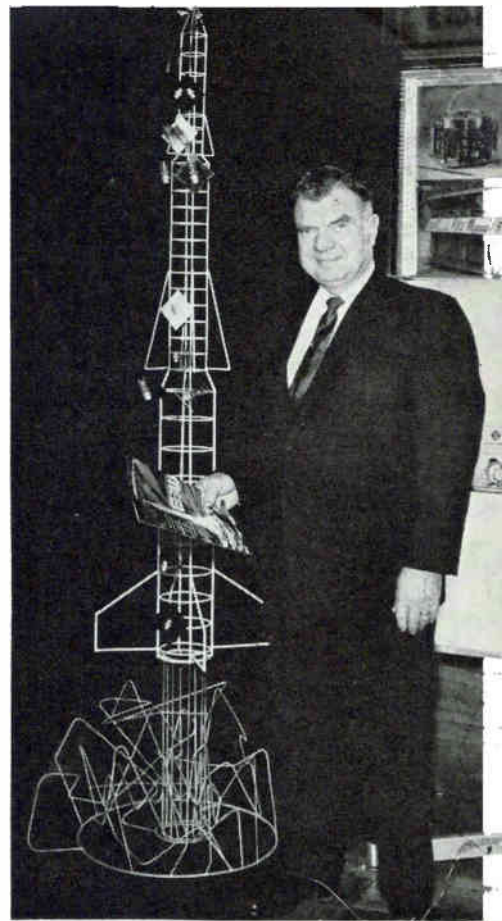


ROBERT ERICKSON
Executive vice president
Beckman Instruments Inc.

WE REGARD WESCON as one of the principal showcases of electronics technology. While the show draws exhibitors from throughout the U. S., it serves each successive year to re-emphasize the expanding role of the West in electronics and the many technologies related to it.

The sheer magnitude of Wescon makes it difficult to predict just where the principal emphasis will lie. However, there are indications that considerable attention will be given to electronics as it applies to space exploration, industrial control and the man-machine systems technology.

In three Beckman exhibits at Wescon we shall concentrate this year on prevision components, advanced test instrumentation and the company's overall development and production capabilities in the broad areas of electronic components, instruments and systems.



LEWIS W. IMM
President, Librascope division
General Precision Inc.

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.

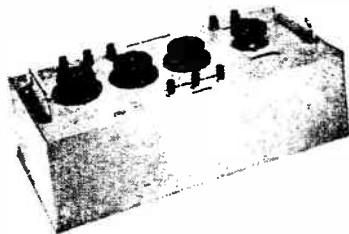
On the engineering side, we are planning heavy participation in the technical sessions. Few actual sales will be consummated during Wescon, but many contracts for future business will be made. For the most part, the show draws serious individuals who are seeking new items and have a genuine interest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

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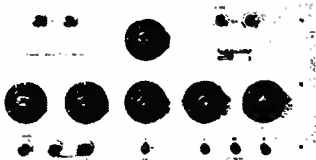
**SYNCHRO & RESOLVER
BRIDGES ACCURACY ± 10 SEC.**



FOR CHECKING POSITIONING
OF SYNCHROS & RESOLVERS

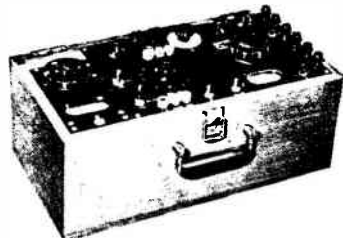
**GUARDED WHEATSTONE
BRIDGE**

ACCURACY $\left\{ \begin{array}{l} \pm 0.015\% \text{ TO } 1 \text{ MEG.} \\ \pm 0.025\% \text{ TO } 100 \text{ MEG.} \end{array} \right.$



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UP TO 1, 110 MEG-OHMS

**PORTABLE POTENTIOMETERS
WITH LABORATORY ACCURACY**
ACCURACY ± 0.01 MV



FOR CHECKING POTENTIOMETRIC
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OR M.V. FROM ANY SOURCE

**GRAY INSTRUMENT
COMPANY**
448 MILL ROAD
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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 emphasized 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.



JOSEPH KLEIMAN
*Executive vice president
Telecomputing Corp.*

WESCON 1960 offers us the opportunity to demonstrate to the indus-

try the strides we have made during the past year.

Some of the divisions of Telecomputing Corp. are exhibiting this year in the Wescon show for the first time. Our exhibit includes several new products which are revolutionary in design concept. Although Telecomputing is obviously interested in obtaining orders at Wescon, our staff will also be available at our booth at all times to discuss these products and concepts on a technical basis.

We believe equipment manufacturers will be displaying new concepts in equipment and systems this year, with increased emphasis on the use of micromodules, printed circuits, and solid-state devices. There will be considerable interest in new devices such as tunnel diodes and traveling-wave tubes, from both the component and the applications viewpoint.

More actual working hardware will be seen at the show than at any previous Wescon, with strong emphasis on commercial applications.



FRANK P. DELUCA JR.
*President
Acoustica 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 Acoustica 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 transistorized 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.



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

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.

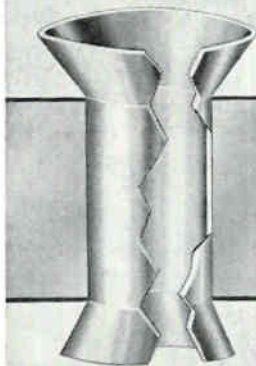
Increasing use of scientific computers by industry is one example of how original military developments can be translated into non-military use. Autonetics industrial products has an operating Recom general-purpose computer on display at this year's Wescon.

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

August 12, 1960

3 Steps TO EXCELLENCE IN PW BOARDS

STEP 1



**FUNNEL FLANGE
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Only the United Funnel Flange Eyelet contributes that greater mechanical strength, improved reliability and uniform circuitry so necessary for achieving a superior PW or Etched Circuit Board. Wide range of sizes and lengths meet all board needs.

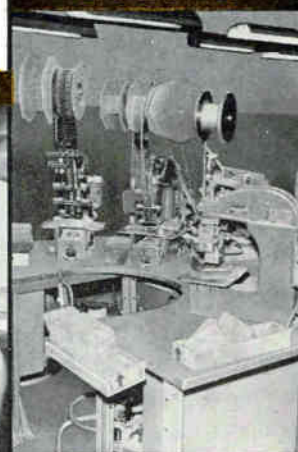
STEP 2



**AUTOMATIC EYELETING
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Only United offers such a complete line of Eyelet Setting Machines. These are backed by more than 50 years' experience in the design and manufacture of precision production machinery for industry. The United Model G Eyeleting Machine feeds eyelets automatically, and is equipped to compensate for variations in board thicknesses for more dependable production.

STEP 3



**COMPONENT INSERTING
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Only from United can you get a complete line of high precision DYNASERT Component Inserting Machines that cut component inserting costs up to 80%! If you insert only a few hundred components a week DYNASERT machines should be considered. DYNASERT Component Inserting Machines automatically feed, trim, bend leads, insert components and clinch with uniform results. Highly engineered single or multi-stage machines available.

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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U8D-42

**CIRCLE 53 ON READER SERVICE CARD
CIRCLE 54 ON READER SERVICE CARD →**

*Sylvania introduces
a new concept in*

MICROMINIATURIZATION

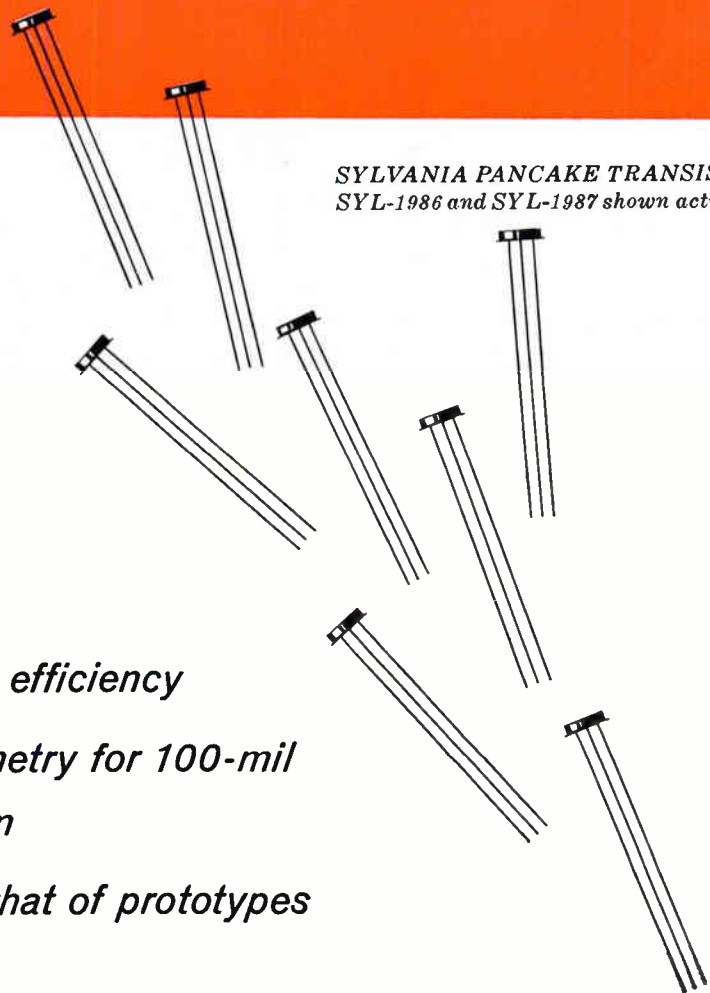
• wafer thin! • feather light!

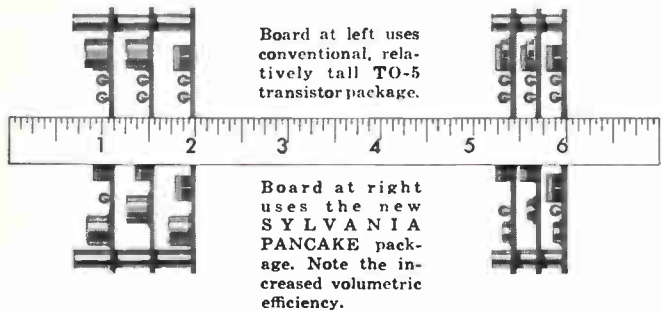
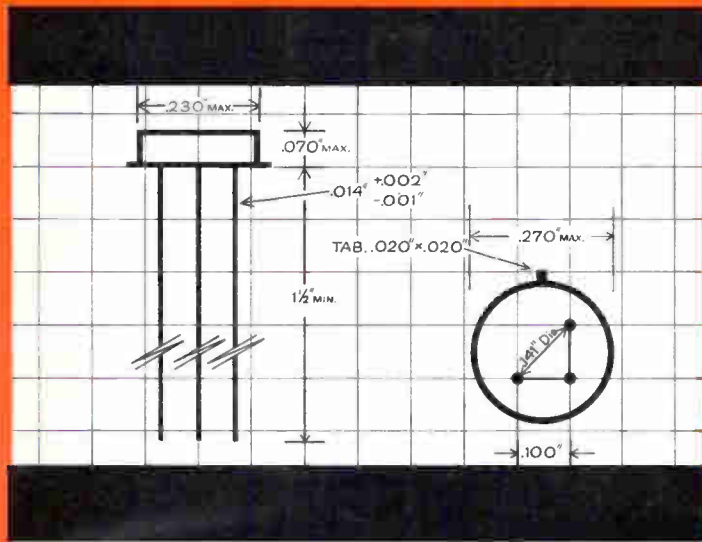
"PANCAKE" TRANSISTORS

*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*

*SYLVANIA PANCAKE TRANSISTORS
SYL-1986 and SYL-1987 shown actual size*





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 1/2-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.

Tentative data

MAXIMUM RATINGS AT 25°C	SYL-1986	SYL-1987
Collector to Base Voltage	-25V	25V
Collector Current	100mA	200mA
Power Dissipation	100mW	100mW
Temperature Range	-55°C to +100°C	-55°C to +100°C
Alpha Cutoff Frequency (min.)*	4Mc	5Mc

* $(V_{cb} = 6V, I_e = 1.0mA)$ $(V_{cc} = 6V, I_c = 1.0mA)$

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS** 

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**A YOKE FOR ANY SCAN
to your Specifications**

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Phone: VICTor 6-0359

Los Angeles: Ash M. Wood Co.
Phone: CUMberland 3-1201

syntronic
INSTRUMENTS, INC.

100 Industrial Road, Addison, Illinois
Phone: KINGSwood 3-6444

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.*

WESCON 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.

Wescon 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. Wescon 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 Wescon 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.

One of a series of advertisements
prepared by the ASSOCIATED
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When you've got big plans for the future — you have good reasons for reading your businesspaper mighty carefully. This is where a man who means business gets facts, news, ideas . . . information he needs to do business. Issue after issue you find meaty stuff to keep your job and your business growing — in both the advertising and editorial pages of . . . your businesspaper.



PHOTO ON LOCATION BY EHRENBERG

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August 12, 1960

do you know
what's expected
from
semi-conductor
materials?

There were more than a dozen articles on semi-conductor materials in **electronics** in recent months. Each was specially edited to give you all key facts, ideas or trends—and there's more coming! Accurate **electronics**' reporting tells you what's happening now... what's expected in materials and components. Don't miss dozens of articles on basic subjects edited to keep you informed, help make your research, development, sales and marketing plans pay off. It pays to subscribe to **electronics** (or renew). Fill in box on Reader Service Card now. Easy to use. Postage free.

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electronics**

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.

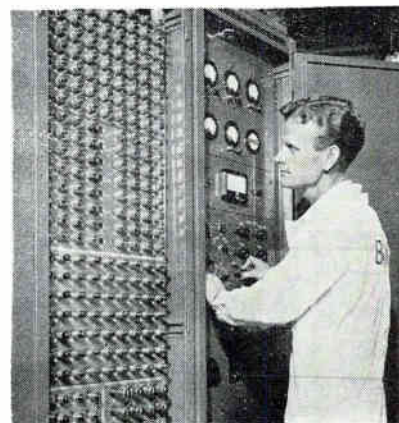
Three broadcast engineers will go on each flight to operate broadcast equipment, monitoring gear, tape recorders. Their jobs will be to place the equipment on the air, change tapes and monitor audio and video output. Tape changes will be made every half hour, the duration of the classroom period.

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.

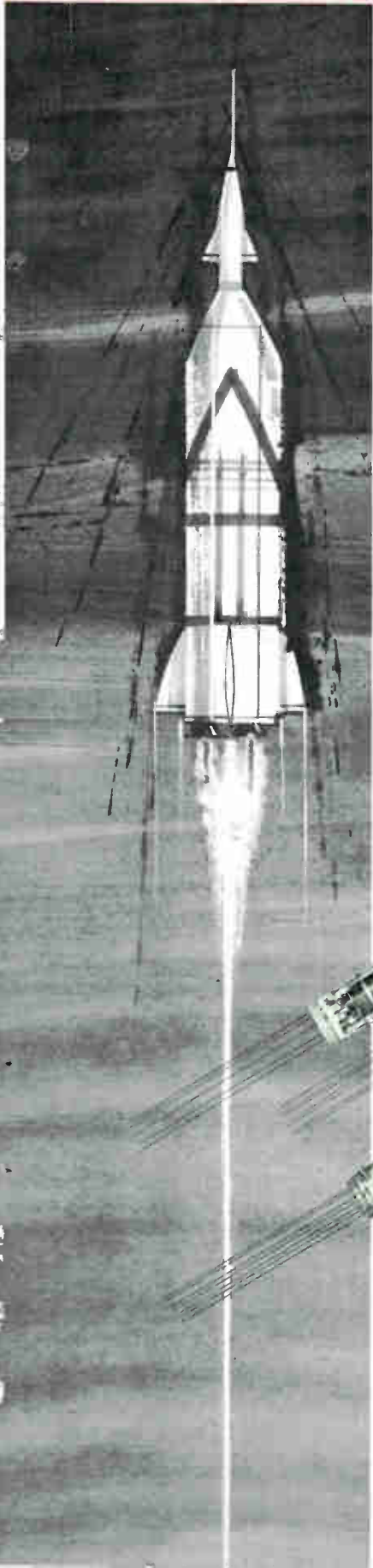
Electron Tube Ager



Tube aging bank at Boeing-Wichita stabilizes new tubes, locates weak units prior to installation

ELECTRON TUBE NEWS

...from SYLVANIA



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

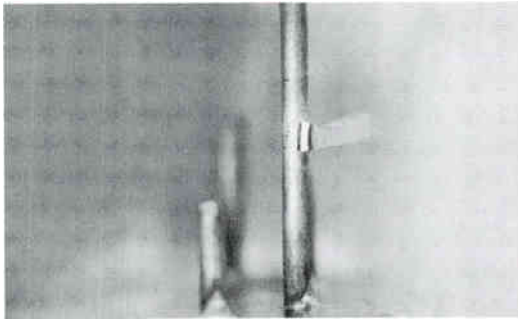
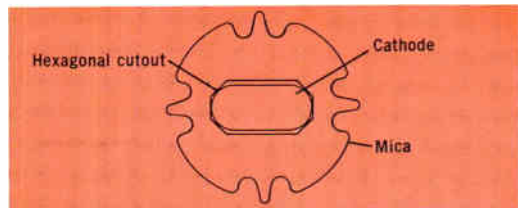


Photo shows the result of Sylvania advanced welding methods. Weld area is extremely rugged and free of weld splatter and oxidation. As a result, catastrophic failures under severe environmental conditions are minimized.

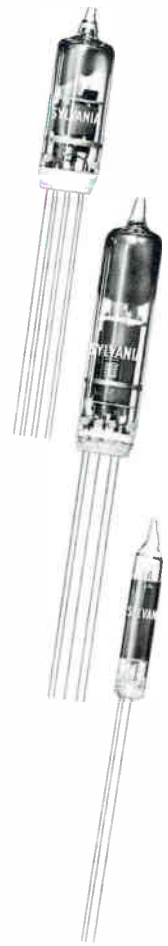


Hexagonal cutout in mica provides firm 6-point contact with cathode, offers increased resistance to shock.

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 1/2" 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.

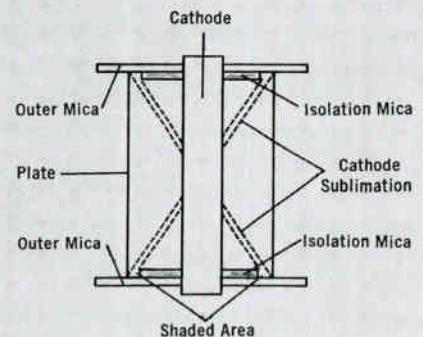


SYLVANIA INCREASES LIFE TESTS TO 1000 HOURS! NEW CONTROLS ADDED TO 100-HOUR TEST!

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.

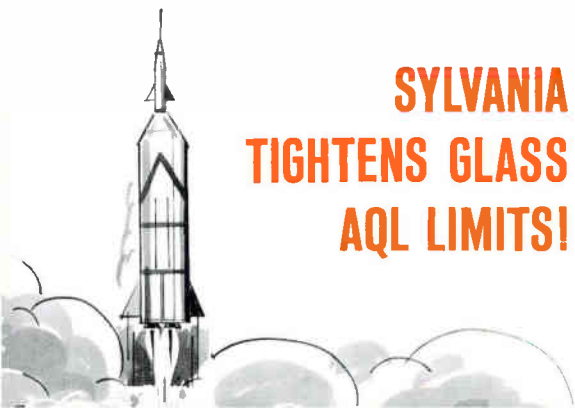
Further controls are included in the 100-hour life test to assure early-hour stability. For example, new specifications are added for grid current, heater-to-cathode leakage and insulation resistance. The 100-hour life test is performed at room temperature—a critical level for cathode sublimation and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



Isolation mica "shades" outer mica from sublimation, forms laminated path and greatly increases dc resistance of leakage paths.

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 withstanding operating temperatures of 250°C, electrolysis caused by heat is virtually eliminated.



HEATER TEST AT ELEVATED VOLTAGE ASSURES FAST WARM-UP TIME!

SYLVANIA ADDS INTENSE RADIATION TESTS

SYLVANIA "GLEAM PROJECT" INCREASES TUBE RELIABILITY

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 $\pm 5\%$ to $\pm 10\%$.

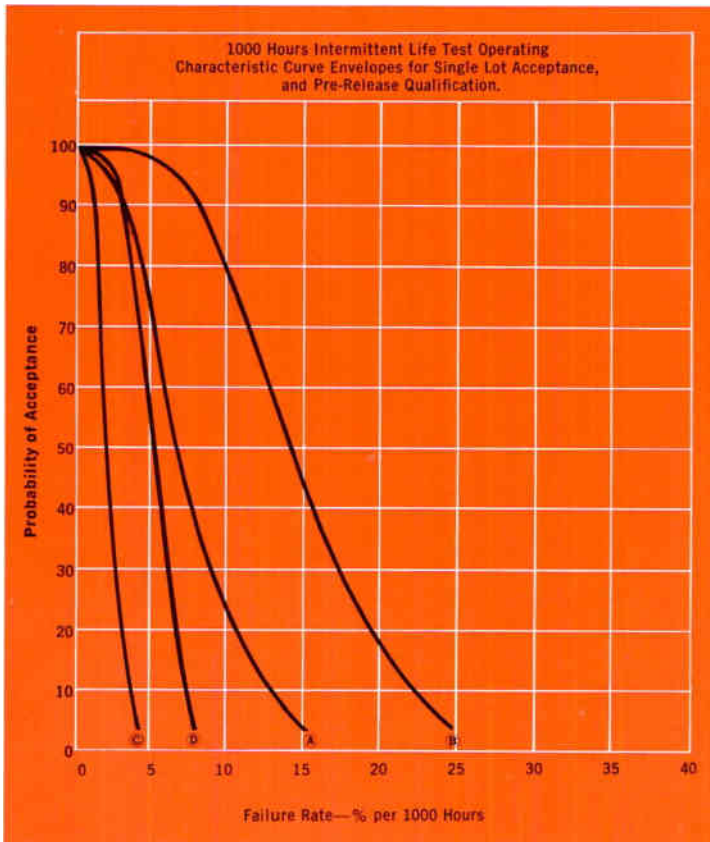
Gold Brand Subminiature Tubes are capable of withstanding radiation dose rates (fast neutrons) of 10^{12} NV and accumulated radiation of 10^{16} NVT—further proof of Gold Brand reliability under the most severe environmental conditions.

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 INITIATES NEW SURVIVAL RATE CRITERIA ON GOLD BRAND SUBMINIATURE TUBES!

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.



Acceptance Numbers for all Sample Sizes

	Inoperatives	Total incl. Inops.
Single Lot	2	5
Five-Lot Moving Sum	5	14
Pre-Release at 500 Hours:		
Five-Lot Moving Sum at 1000 Hours	4	12
Current Lot at 500 Hours	1	2

Base Scale for Exemplary Curves Shown Relates to

Single Lot Acceptance	AFR	IFR	RFR
(A) Single Lot for Inops.: n=40, c=2	2.0	6.5	13
(B) Single Lot for Total: n=40, c=5	6.6	14.0	22
Pre-Release Qualification			
(C) Five-Lot Moving Sum for Inops. at 1000 hours and current lot at 500 hours: n=200, c=4 and n=40, c=1	.80	2.0	3.3
(D) Five-Lot Moving Sum for Total at 1000 hours and current lot at 500 hours: n=200, c=12 and n=40, c=2	2.4	5.0	7.2

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.

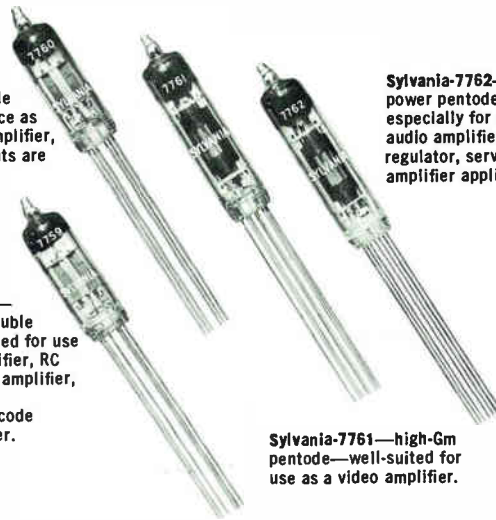
Average Characteristics and Typical Operation	7759 (Each Section)	7760 (Each Section)	7761 Class A Video Amplifier	7762 Class A1 (Single Tube)	Unit
Plate Voltage	100	26.5	—	110	Vdc
Plate Supply Voltage	—	—	200	—	Volts
Cathode Resistor	0.15	—	0.1	0.27	Megohms
Grid Resistor	—	2.2	0.47	—	Megohms
Plate Current	6.5	3.0	—	—	mAdc
Transconductance	5400	5000	—	—	μ mhos
Amplification Factor	35	20	—	—	—
Grid Voltage for $I_b=100\mu$ Adc Max.	-6.5	—	—	—	Vdc
Grid Voltage for $I_b=50\mu$ Adc	—	-3.5	—	—	Vdc
Grid #2 Voltage	—	—	100	110	Volts
Signal Voltage (rms)	—	—	1.6	6.4	Volts
Zero Signal Plate Current	—	—	19	30	mAdc
Max. Signal Plate Current	—	—	18.5	29	mAdc
Zero Signal Grid #2 Current	—	—	4.0	2.2	mAdc
Max. Signal Grid #2 Current	—	—	4.5	5.5	mAdc
Voltage Output (Peak to Peak)	—	—	135	—	Volts
Load Resistance	—	—	4.7	3.0	Megohms
Power Output	—	—	—	1	Watts
Total Harmonic Distortion	—	—	—	10	%

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

Sylvania-7759—medium- μ double triode—designed for use as a UHF amplifier, RC coupled audio amplifier, low frequency oscillator, cascade amplifier, mixer.

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.



GOLD BRAND PREMIUM SUBMINIATURE TYPES for 26.5-Volt Applications

Type	Description
5903	UHF Double Diode
5904*	UHF Medium-Mu Triode
5905*	UHF Sharp Cutoff Pentode
5906	UHF Sharp Cutoff Pentode
5907*	UHF Remote Cutoff Pentode
5908*	UHF Pentode
5916	Dual-Control
7759	Medium-Mu Double Triode
7760*	Medium-Mu Double Triode
7761	High Gm Video Pentode
7762	Beam Power Pentode

GOLD BRAND PREMIUM SUBMINIATURE GUIDED MISSILE TYPES

Type	Description
6943	Sharp Cutoff RF Pentode
6944	Semi-Remote Cutoff RF Pentode
6945	AF Beam Power Pentode
6946	Medium-Mu Triode
6947	Medium-Mu Double Triode
6948	High-Mu Double Triode
6788	Sharp-Cutoff AF Pentode

GOLD BRAND PREMIUM SUBMINIATURE TYPES

Type	Description
5636	Dual Control Pentode
5639	Video Pentode
5641	Diode
5643	Tetrode Thyratron
5644	Cold Cathode Diode
5647	UHF Diode
5718	UHF Medium-Mu Triode
5719	High-Mu Triode
5840	UHF Sharp Cutoff Pentode
5896	UHF Double Diode
5899	UHF Semi-Remote Cutoff Pentode
5902	Beam Power Pentode
5977	Medium-Mu Triode
5987	Low-Mu Power Triode
6021	Medium-Mu Double Triode
6110	UHF Double Diode
6111	Medium-Mu Double Triode
6112	High-Mu Double Triode
6205	UHF Sharp Cutoff Pentode
6206	UHF Semi-Remote Cutoff Pentode
6308	Cold Cathode Diode
6352	Double Diode
6814	Medium-Mu Triode
7327	Medium-Mu Double Triode (Pulse Tube)
7550	Medium-Mu Double Triode (Pulse Tube)

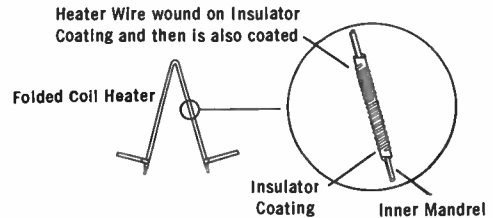


Diagram shows enlarged view of rugged new 26.5-Volt heater for Gold Brand Subminiature Tubes.

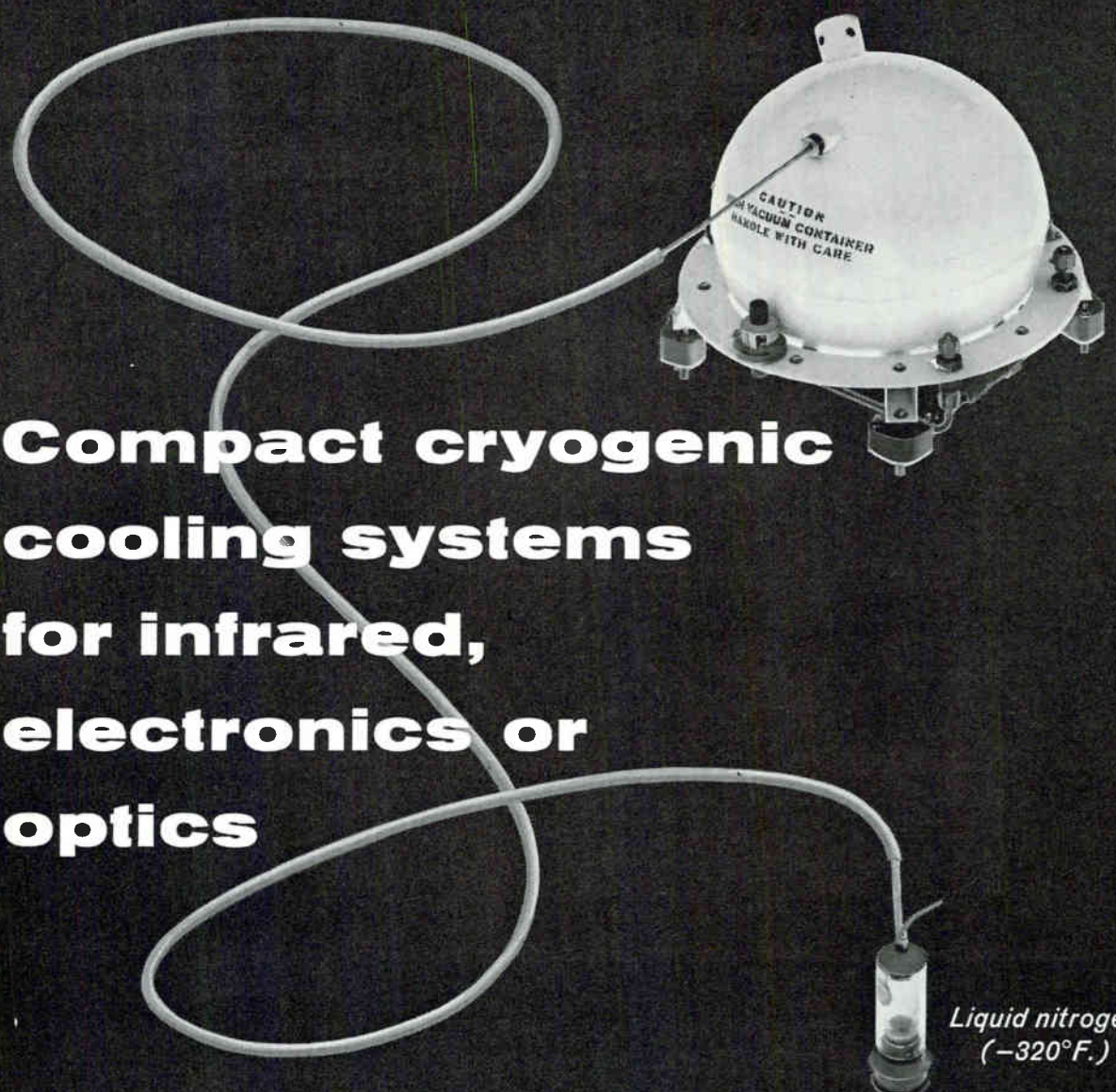
Gain the benefits of Gold Brand Subminiature Tubes in your military and industrial designs. Call your nearest Sylvania Field Office for the new specifications and delivery information. For data on individual types, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. H, 1100 Main St.,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

See the Sylvania Exhibit at Wescon—Booth #2009-2011, 2058-2061, 2108-2111.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**





**Compact cryogenic
cooling systems
for infrared,
electronics or
optics**

*Liquid nitrogen
(-320°F.)*

**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 liquefier.

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

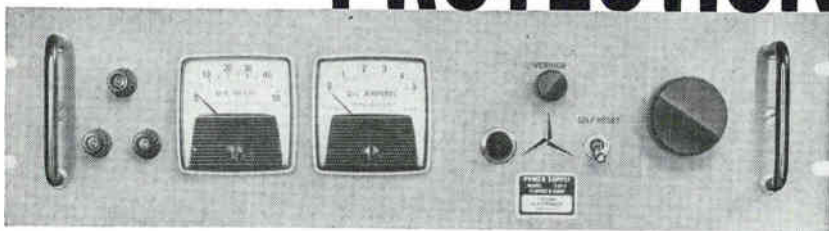
Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

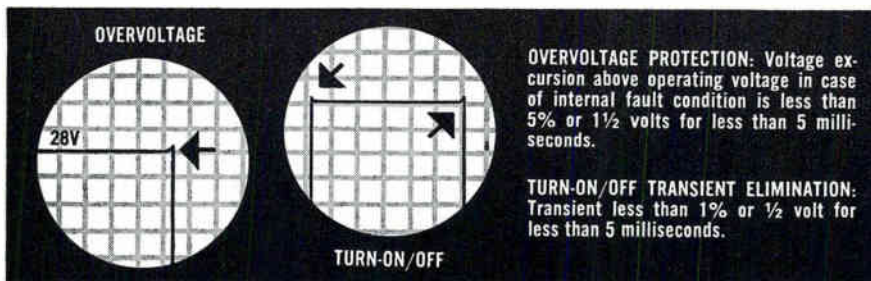


Exclusive

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.



MODEL	DC OUTPUT		PANEL HEIGHT (in inches)	REGULATION		RIPPLE RMS (max.)
	VOLTS	AMPS		LOAD	LINE	
S36-2.5	0-36	0-2.5	3½	0.01%	0.01%	1 mv
S36-5	0-36	0-5	5¼			
S36-10	0-36	0-10	7			
S36-15	0-36	0-15	7			
S60-2.5	0-60	0-2.5	5¼	0.02%	0.02%	3 mv
S60-5	0-60	0-5	7			
S60-10	0-60	0-10	10½			
S60-15	0-60	0-15	14			
S300-200	110-325	0-0.2	3½			
S300-400	110-325	0-0.4	3½	0.05%	0.05%	.5 mv
S300-800	110-325	0-0.8	3½			
S300-1500	110-325	0-1.5	5¼			
T45-600	0-45	0-0.6	Bench Supply			
T20-1	0-20	0-1				

All units available with remote programming

TRYGON ELECTRONICS, INC.
111 Pleasant Ave. Roosevelt, L. I., N. Y.
Freeport 8-2800



MEETINGS AHEAD

Aug. 15-19: High-Speed Photography, Stroboscopic Light Laboratory, MIT, Cambridge, Mass.

Aug. 18-19: Electronic Circuit Packaging Symp., Univ. of Colo., Boulder, Colo.

Aug. 22: Scientific Apparatus Makers Assoc., Market Managers, SAMA, Statler Hilton, Los Angeles.

Aug. 22-26: Thermonuclear Plasma Physics Symposium, Oak Ridge, U. S. Atomic Energy Comm., Gatlinburg, Tenn.

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

Aug. 23-26: Association for Computing Machinery, Nat. Conf., Marquette Univ., Milwaukee.

Aug. 23-Sept. 3: National Radio & Tv Exhibition, Earl's Court, London.

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

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

Sept. 7-9: Automatic Control, Joint Conf., ASME, IRE, AIEE, ISA, MIT, Cambridge, Mass.

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.

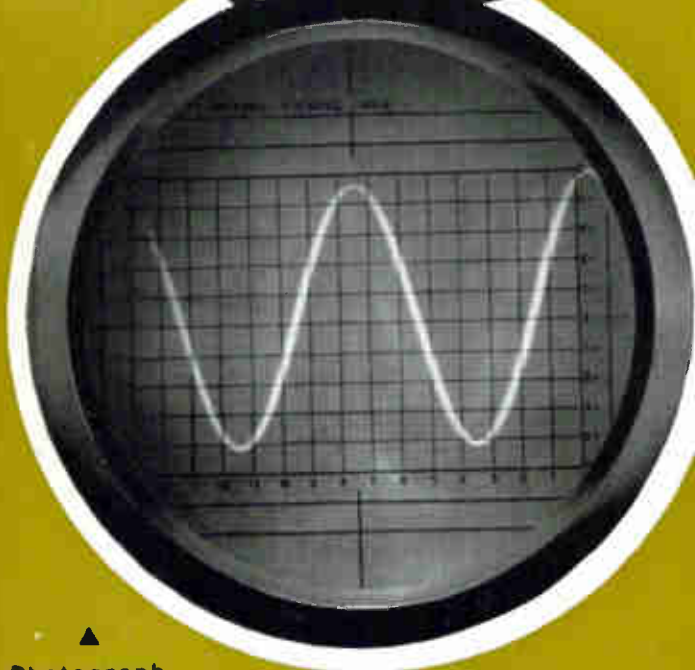
Sept. 13-14: Bionics Symposium, Applying Biological Principles to Engr. Design, ARDC, Wright Air Devel. Div., Dayton Biltmore Hotel, Dayton, O.

Sept. 14-15: Industrial Electronic Test Equipment Symposium, Armour Research Foundation, Chicago.

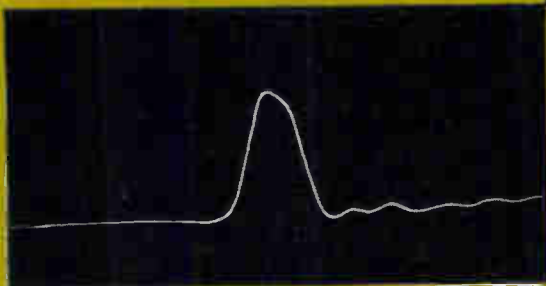
Oct. 10-12: National Electronics Conf., Hotel Sherman, Chicago.

DC TO **2000 Mc**
BANDWIDTH

0.2 μ sec
RISE TIME



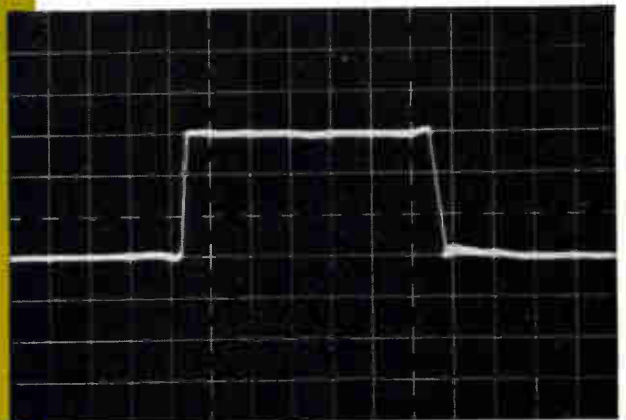
▲ Photograph, actual size, of high frequency sine wave display.



milli-mike TRAVELING WAVE
OSCILLOSCOPE SETS NEW
PERFORMANCE STANDARDS

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.



▲ Pulse display on illuminated reticle photographed with ordinary camera.

◀ Photograph of one milli-microsecond single transient display.

For full details, write for Data Sheet 7070.

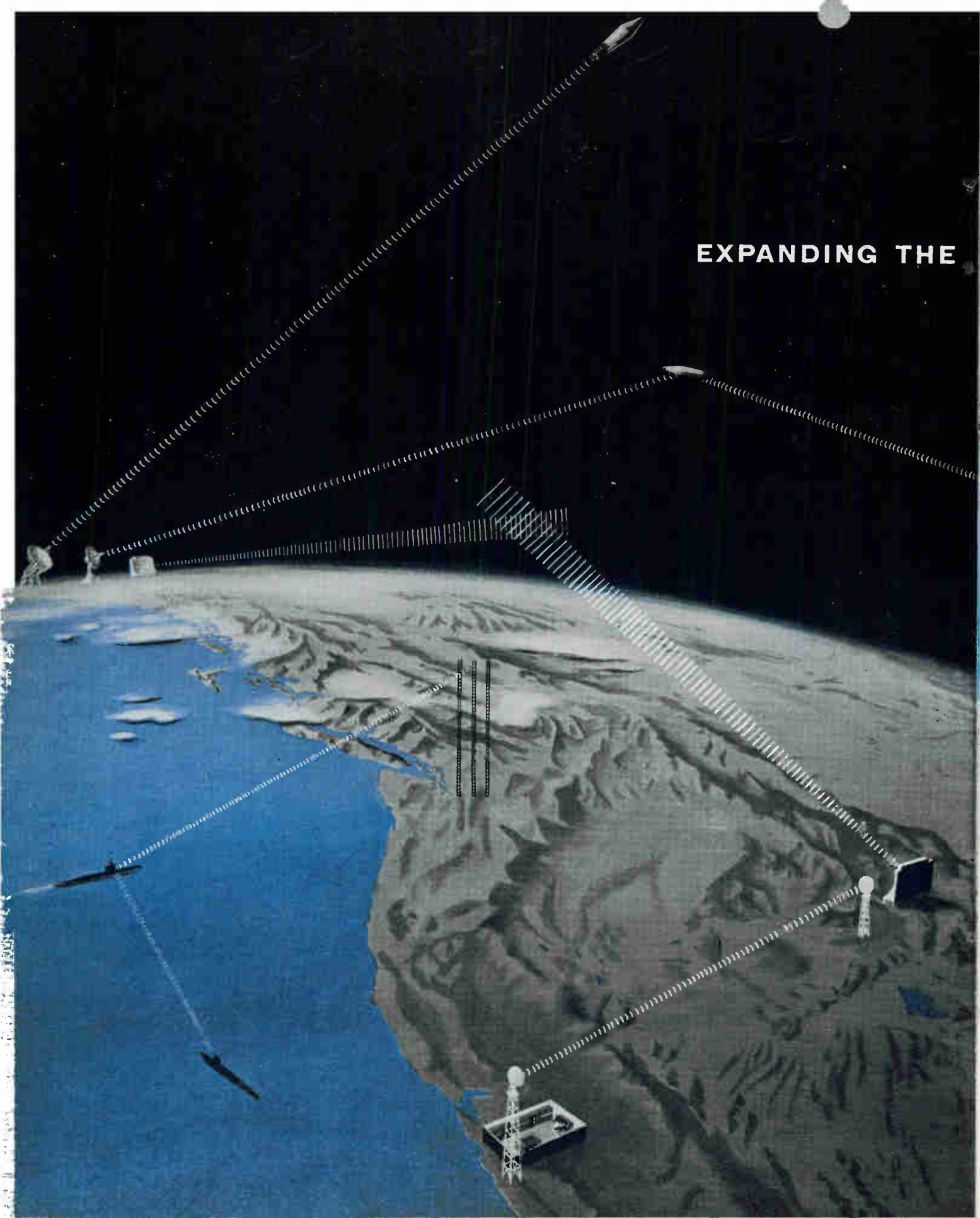
WESCON BOOTHS 519 & 520



Edgerton, Germeshausen & Grier, Inc.

162 BROOKLINE AVENUE, BOSTON 15, MASSACHUSETTS

EXPANDING THE





Herodotus, the historian, records (490 B.C.) the use of burnished shields for military signaling. This was the forerunner of the heliograph, invented by Sir Henry C. Mance, which came into wide use centuries later.

FRONTIERS OF SPACE TECHNOLOGY IN COMMUNICATIONS

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;
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MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER*

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NEW from

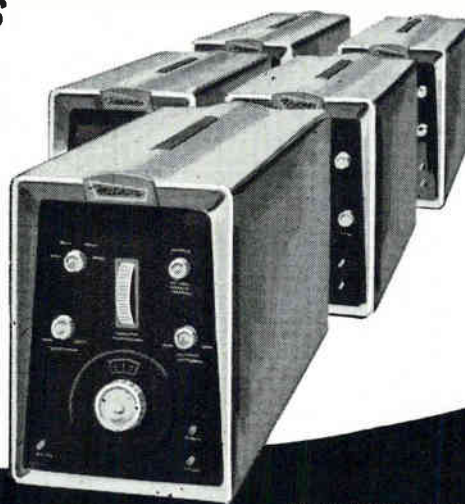
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*seasoned microwave
designers and builders*

WESCON
Booth 2224



Model SGO-2, common power supply



Model SGL-2, 1-2 KMC
Model SGS-2, 2-4 KMC

Model SGC-2, 4-8 KMC
Model SGX-2, 8-12 KMC
Model SGK-2, 12-18 KMC

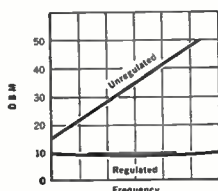
Swept Signal Generators offering Constant Power Output over Entire Band

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.

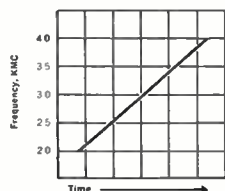
All five units are compatible with Melabs' radiometer and panoramic display unit.

Addition of a receiver box creates a swept receiver or panoramic analyzer.

TWT amplifiers with power outputs up to 1 watt can be supplied.



Power output



Linear time/frequency
characteristic

SPECIFICATIONS

Model SGS-2, S Band, with SGO-2 Power Supply

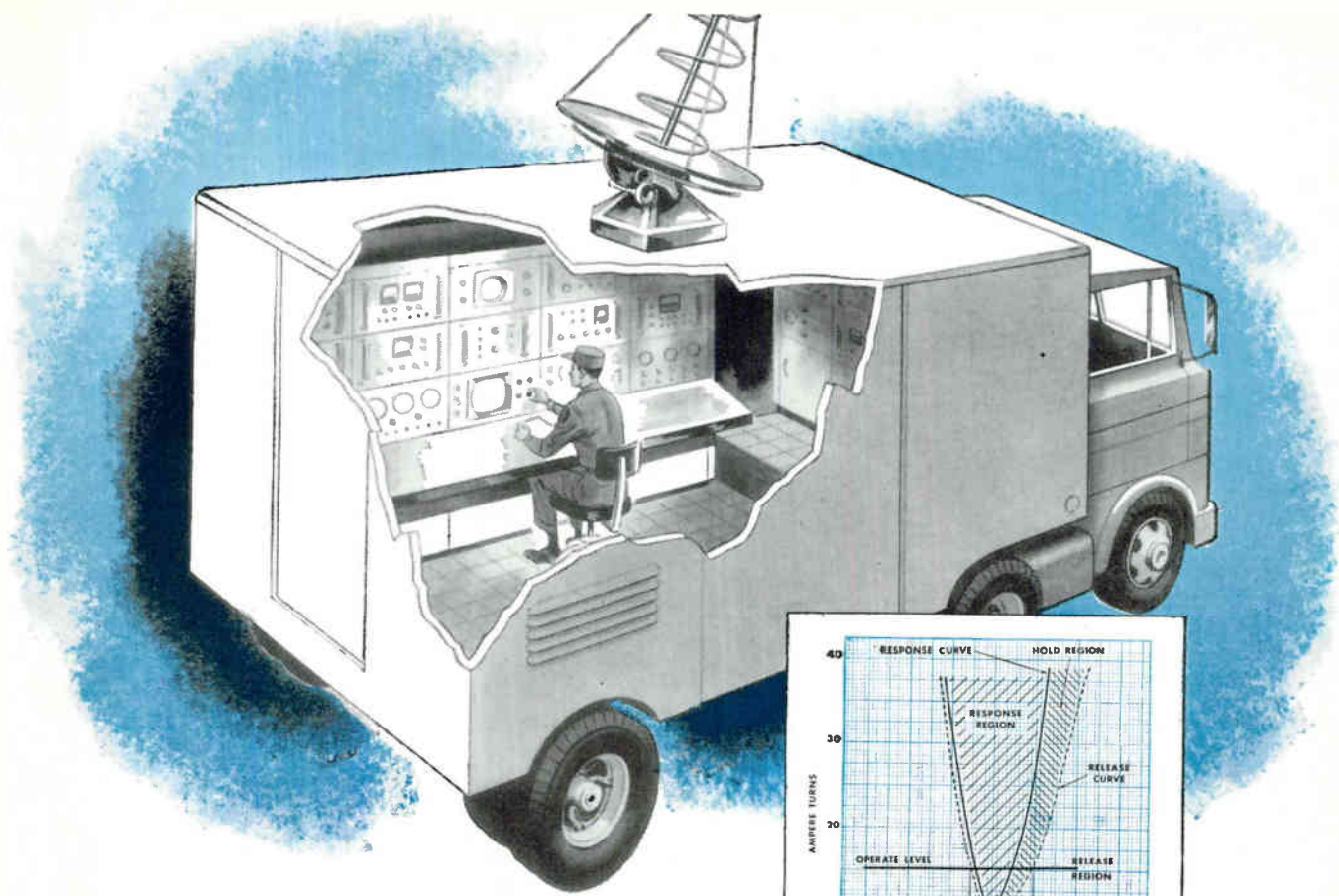
- Power output:** Regulated, 10 mw \pm 1 db; unregulated, 10 mw at 2 KMC, rising to 300 mw at 4 KMC; manual adjustment range, 30 db.
- Internal modulation:** For regulated power, pulse, 1-10 μ sec; square wave. Rep rate, 100-5000 cps.
- External modulation:** Any type, unregulated only.
- Sweep:** 0.3 to 30 cps; cw through 100% of band.
- Price:** (Model SGS-2, \$2,300.00; Model SGO-2, \$900.00;
Model SGL-2, \$2,600.00; Model SGC-2, \$2,400.00;
Model SGX-2, \$2,600.00; Model SGK-2, \$4,500.00.
- Specifications similar
- Data subject to change without notice. Prices f.o.b. factory.

Melabs

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

(pronounced MEL-LABS) · Dept. M7, 3300 Hillview Ave.
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WURLITZER

DR-5 RESONANT REED RELAY

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

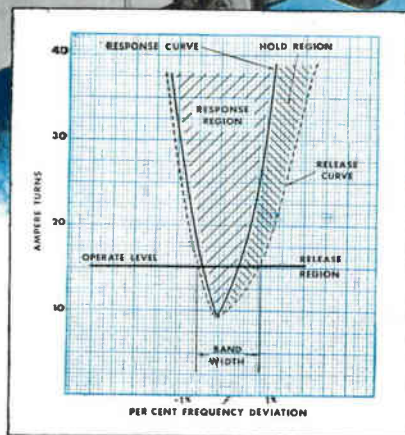
This new Wurlitzer Reed Relay incorporates shock and vibration resistance, zero mechanical coupling to support, and closely controlled response and hold regions.

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 1/2% 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 Telemetry

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



WURLITZER

Research
Engineering
Production

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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.

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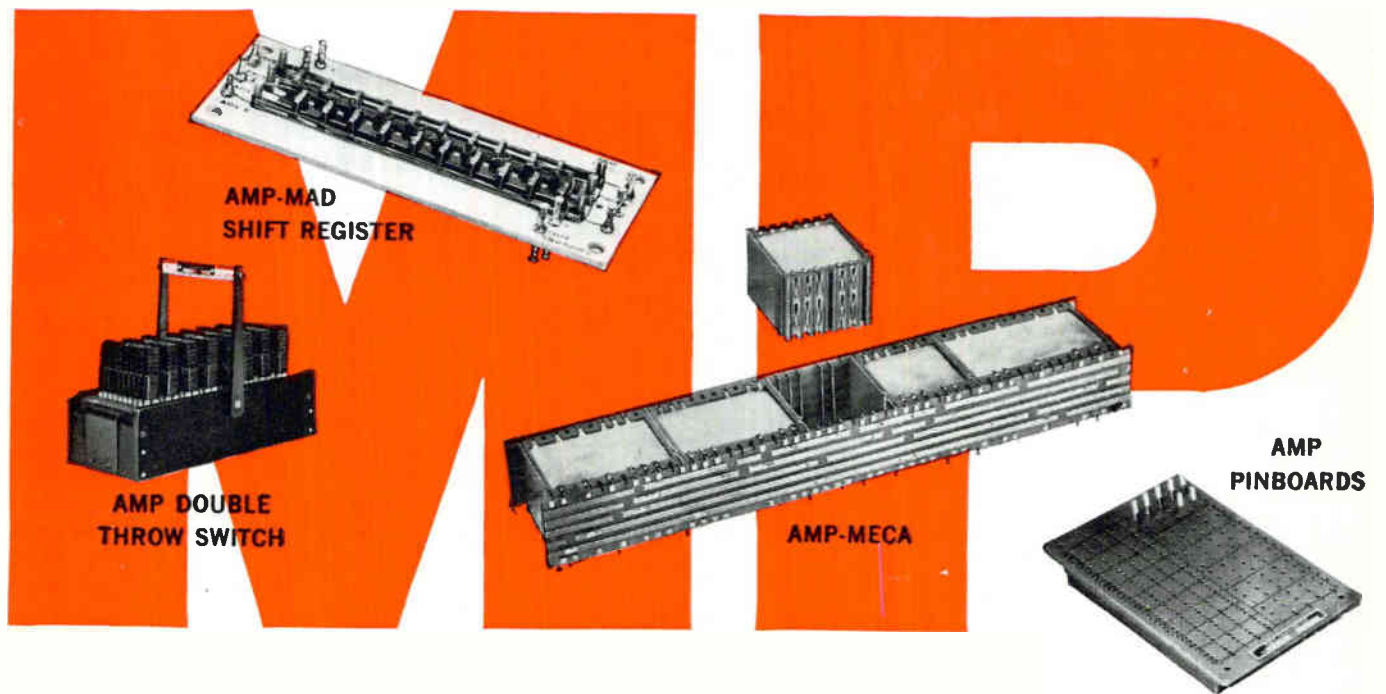
IN THE BIG IS



AMP

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1960 PRODUCT STORY BEING TOLD BY



INCORPORATED

Harrisburg, Pennsylvania

BOOTHS 2001-2003, AUGUST 23-26, 1960

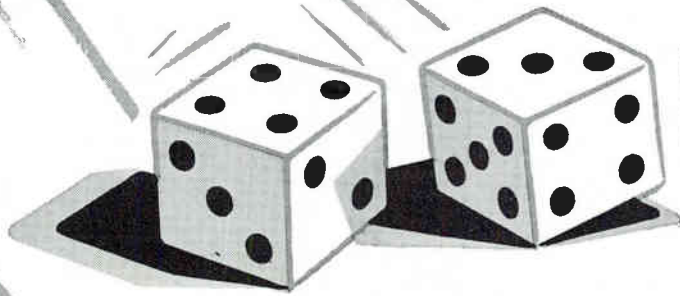
August 12, 1960

CIRCLE 71 ON READER SERVICE CARD 71

WHY GAMBLE?

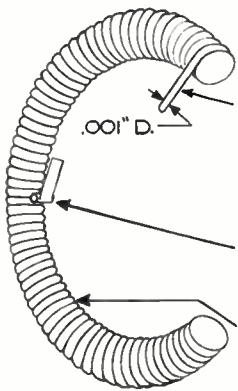
RELIABILITY

is a NATURAL...



WITH **CIC** PRECISION FILM POTS!

HERE'S WHY!

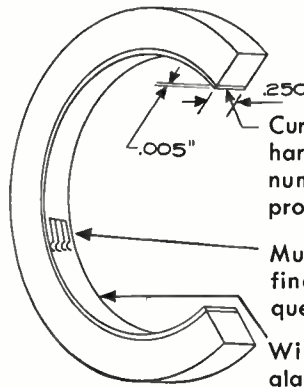


WIRE-WOUND... THE HARD WAY

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

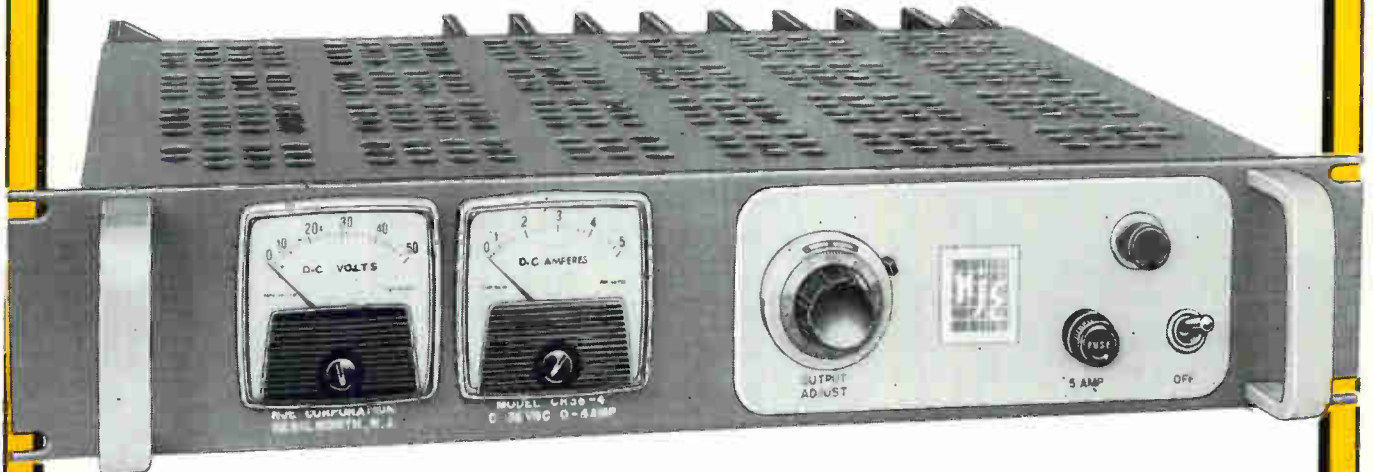


92 MADISON AVENUE, HEMPSTEAD, L. I., N. Y.

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NEW!

... NJE Again Advances the State of the Art!



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Power Supply in a 3 1/2" Panel

(Pat. Pending)

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.

Output Volts Amps	Model No.	Input Power Volts Freq.**	Max. Ripple mv RMS	Static Regulation Load* Line*	Dimensions H x W x D	Approx. Weight Pounds	Price
0-10	0-10 QR-10-10	105-125 55-65	1	±0.01% or ±1 mv ±0.03% or ±3 mv	3 1/2" x 19" x 16 5/8"	41	\$485
0-18	0-6 QR-18-6	105-125 55-65	1	±0.01% or ±1 mv ±0.03% or ±3 mv	3 1/2" x 19" x 16 5/8"	41	485
0-36	0-4 QR-36-4	105-125 55-65	1	±0.01% or ±1 mv ±0.03% or ±3 mv	3 1/2" x 19" x 16 5/8"	41	485
0-60	0-2.5 QR-60-2.5	105-125 55-65	1	±0.01% or ±1 mv ±0.03% or ±3 mv	3 1/2" x 19" x 16 5/8"	41	510

* Whichever is greater.

** Available for 400 cycle operation.

60 and 400 cycle from stock subject to prior sale.



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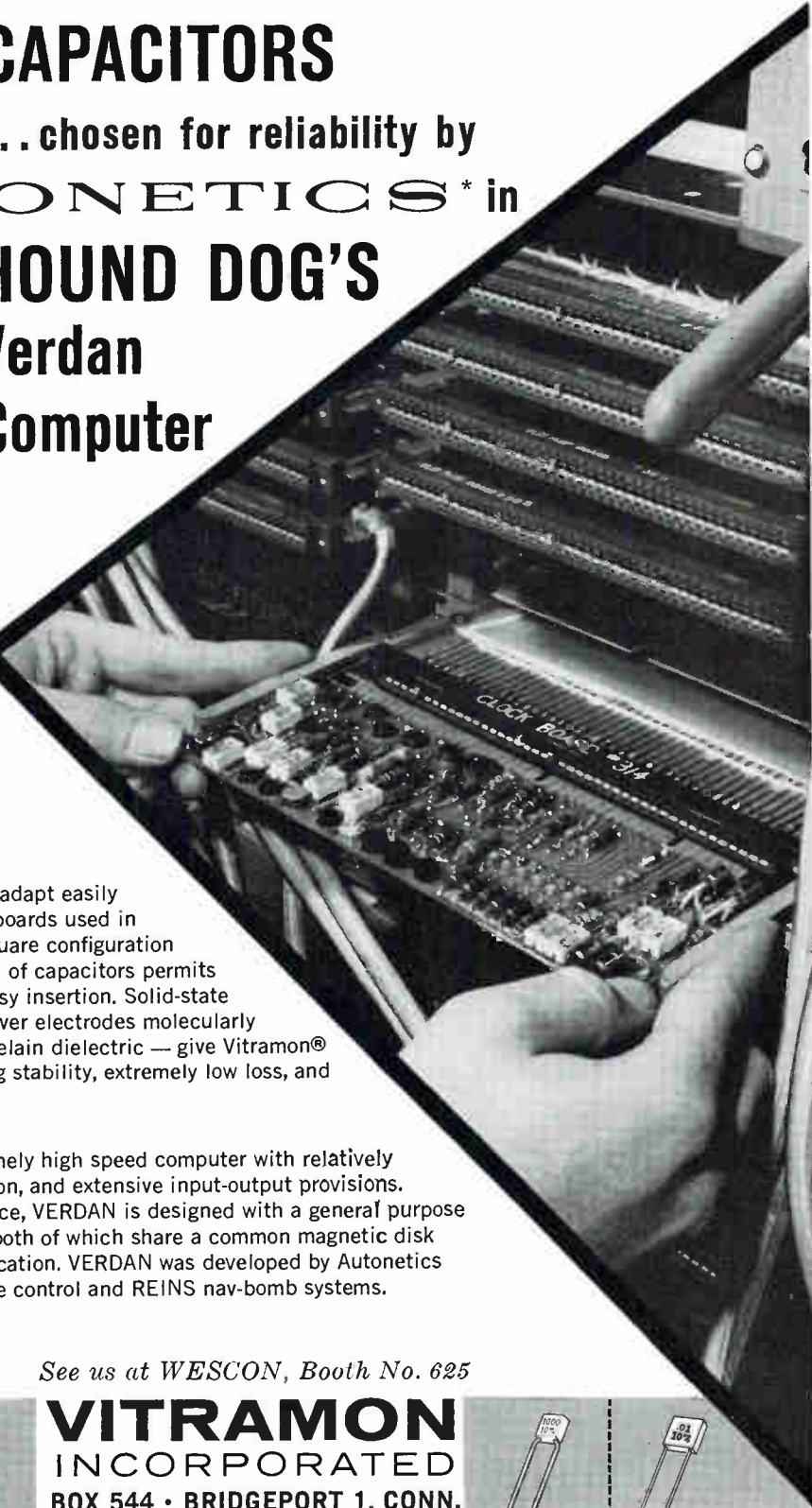
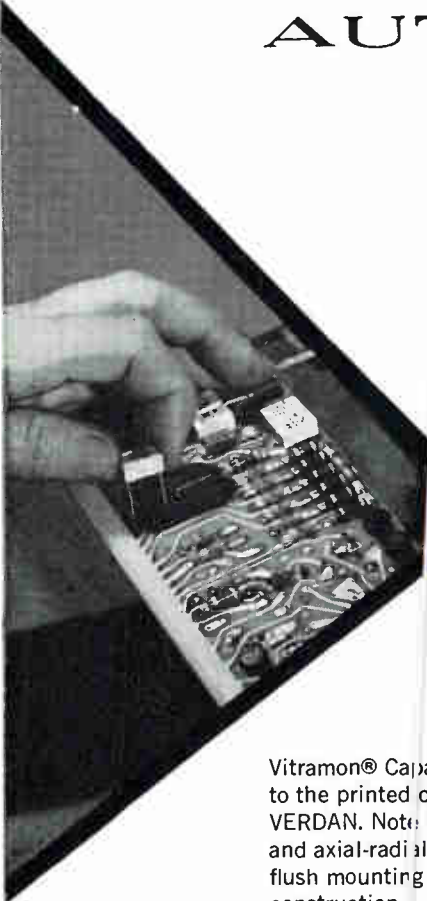
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VITRAMON®

SOLID-STATE PORCELAIN CAPACITORS

... chosen for reliability by
AUTONETICS* in
**HOUND DOG'S
Verdan
Computer**

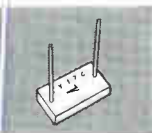
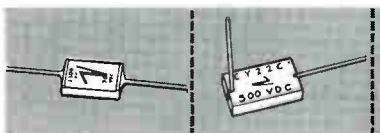


Vitramon® Capacitors adapt easily to the printed circuit boards used in VERDAN. Note how square configuration and axial-radial design of capacitors permits flush mounting and easy insertion. Solid-state construction — fine silver electrodes molecularly fused with dense porcelain dielectric — give Vitramon®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

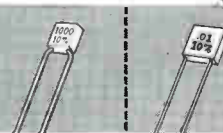
Autonetics' air-borne VERDAN is an extremely high speed computer with relatively high capacity, great flexibility of application, and extensive input-output provisions. Occupying less than 1½ cubic feet of space, VERDAN is designed with a general purpose section and a digital differential section, both 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.

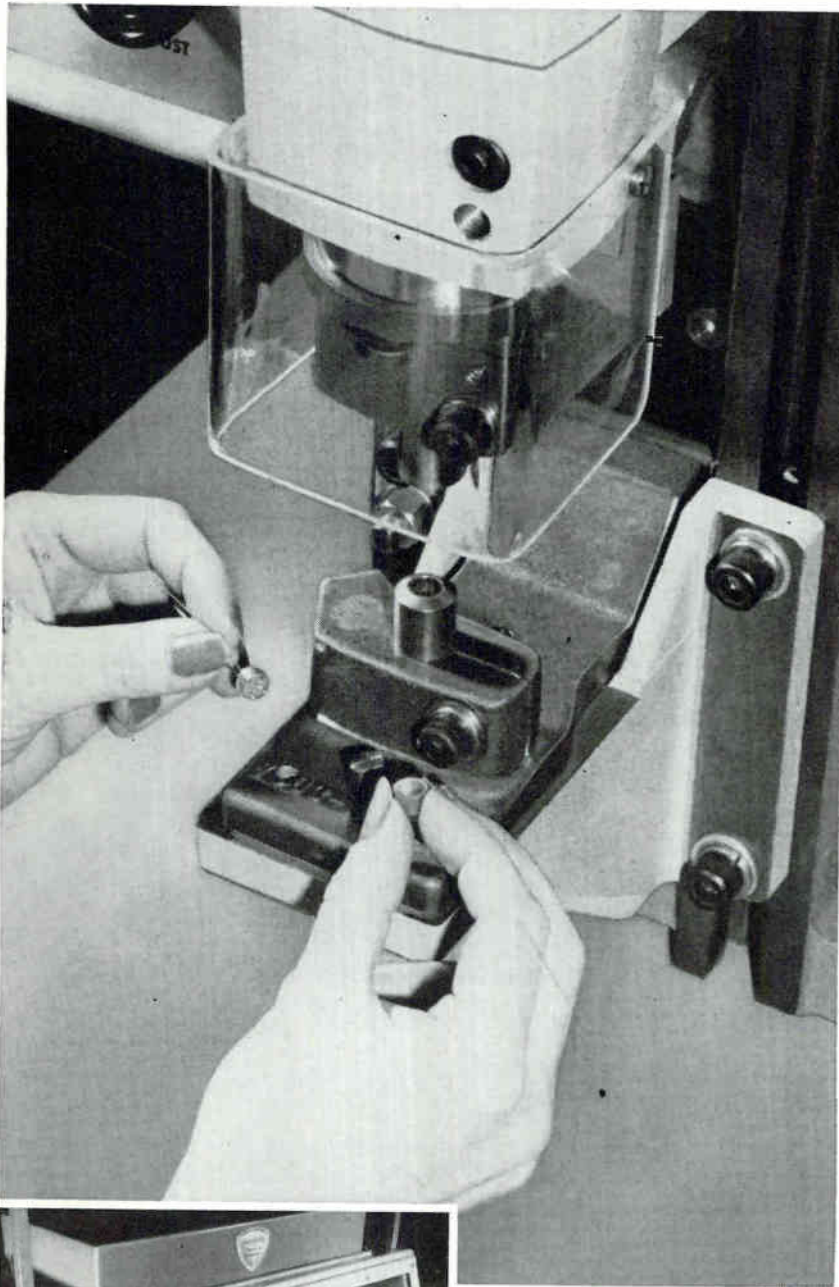
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The "M" head—Raytheon's completely new precision welding device—assures consistent welding performance even when joining miniature parts. The secret is the advanced design that achieves relatively low welding currents and electrode pressures.

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 adaptable to dial feed or in-line feed for automated production.

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

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Commercial Apparatus & Systems Division
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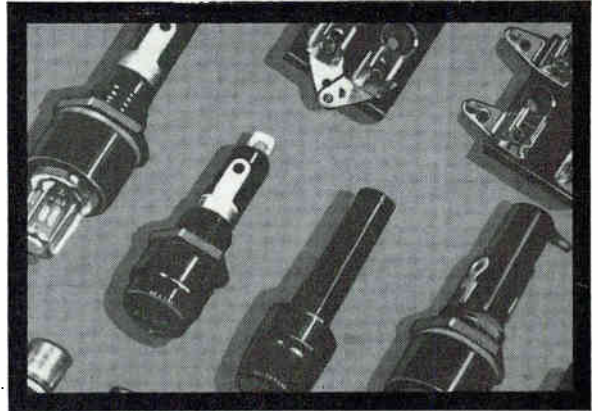
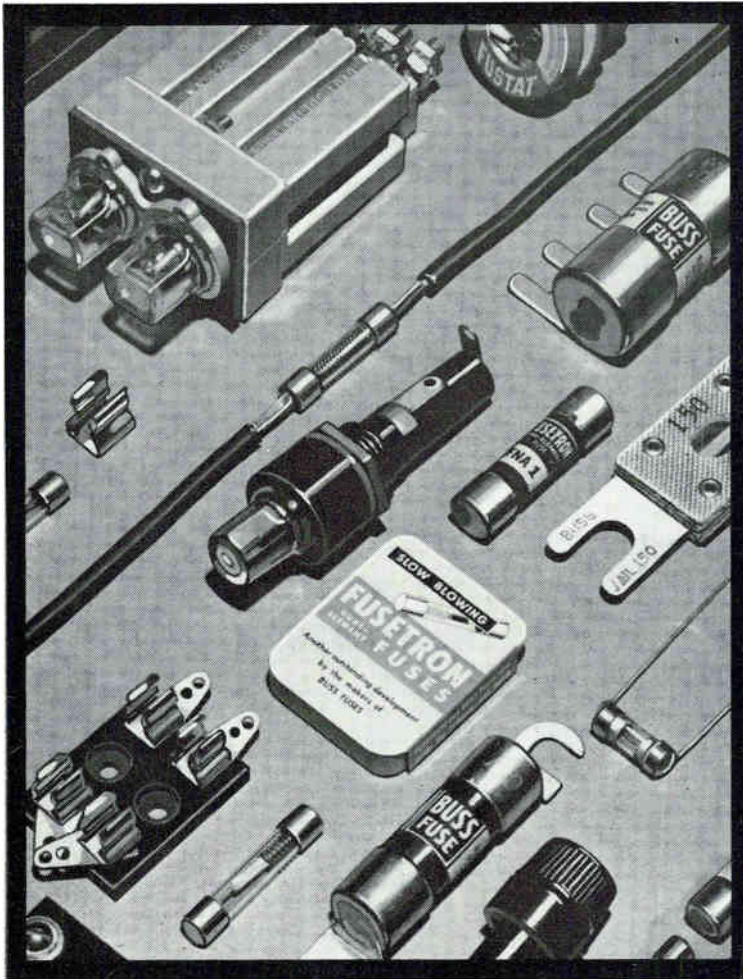
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in Electronics



FEATURES

- Can be used with any welder
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- 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



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.

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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.

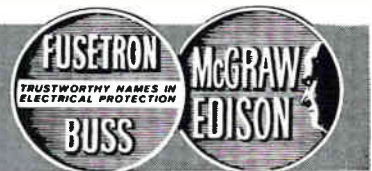
In many cases it is possible to find, in the complete BUSS line, a fuse and fuse mounting already available in local wholesalers' stocks, so that your device can be easily serviced.

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

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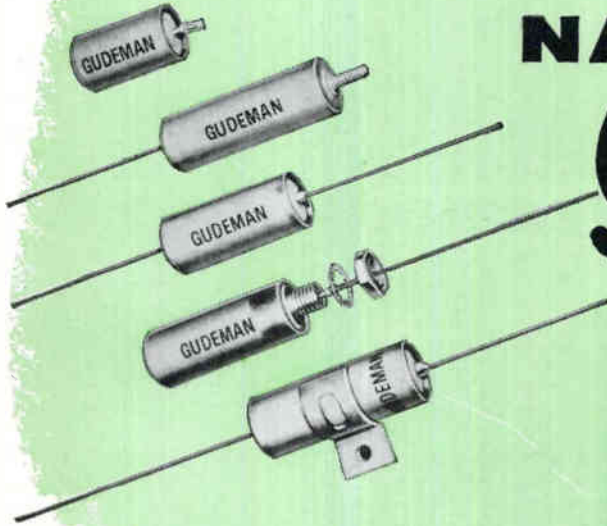
*BUSS fuses are made to protect - not to blow, needlessly.
BUSS makes a complete line of fuses for home, farm, commercial,
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**For close capacity tolerance
and capacitance stability**

Gudeman Polystyrene Capacitors
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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.



Gudeman plastic dielectric capacitors are processed in a special area where temperature and humidity are closely controlled. Dust and other contaminants are filtered out, and as an extra precaution, operators wear nylon caps, smocks, and gloves. Operators like Styroflex because it winds easily. Quality control inspectors like it because the capacitors test out "on the nose" with a minimum of rejects.



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- Teraglas**
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- Isolastane[®] sheet, tape, tubing and sleeving
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*TM (Reg. U.S. Pat. Off.) OCF Corp.

**Trademark applied for.

We will be very happy to supply information on any of our products on request.

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Natvar Styroflex is available in standard thicknesses from .00033" to .006" in rolls from 1/2" to approximately 10" in width, or in special put ups to meet manufacturing requirements.

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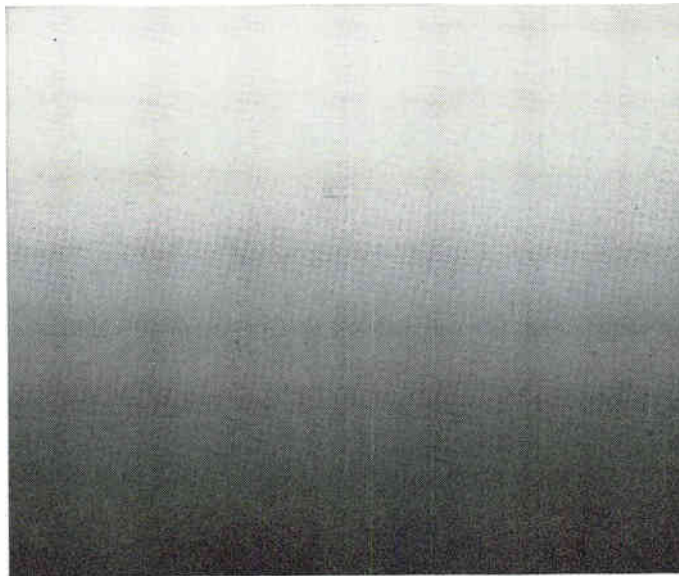
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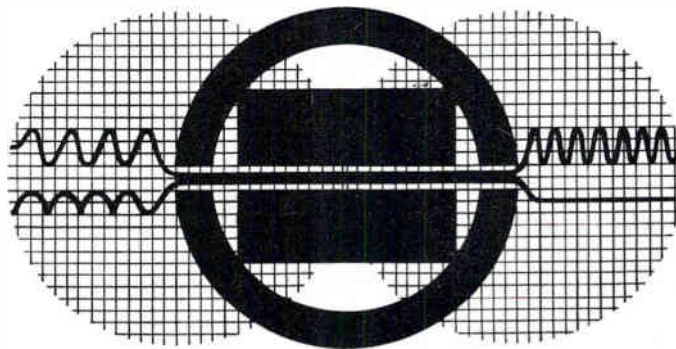
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Brushless Inductor Type Motor-Alternator Sets • 300 watts to 30 KVA, 100 cycles to 10,000 cycles, fixed or variable, single or 3 phase.



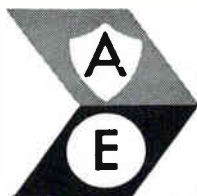
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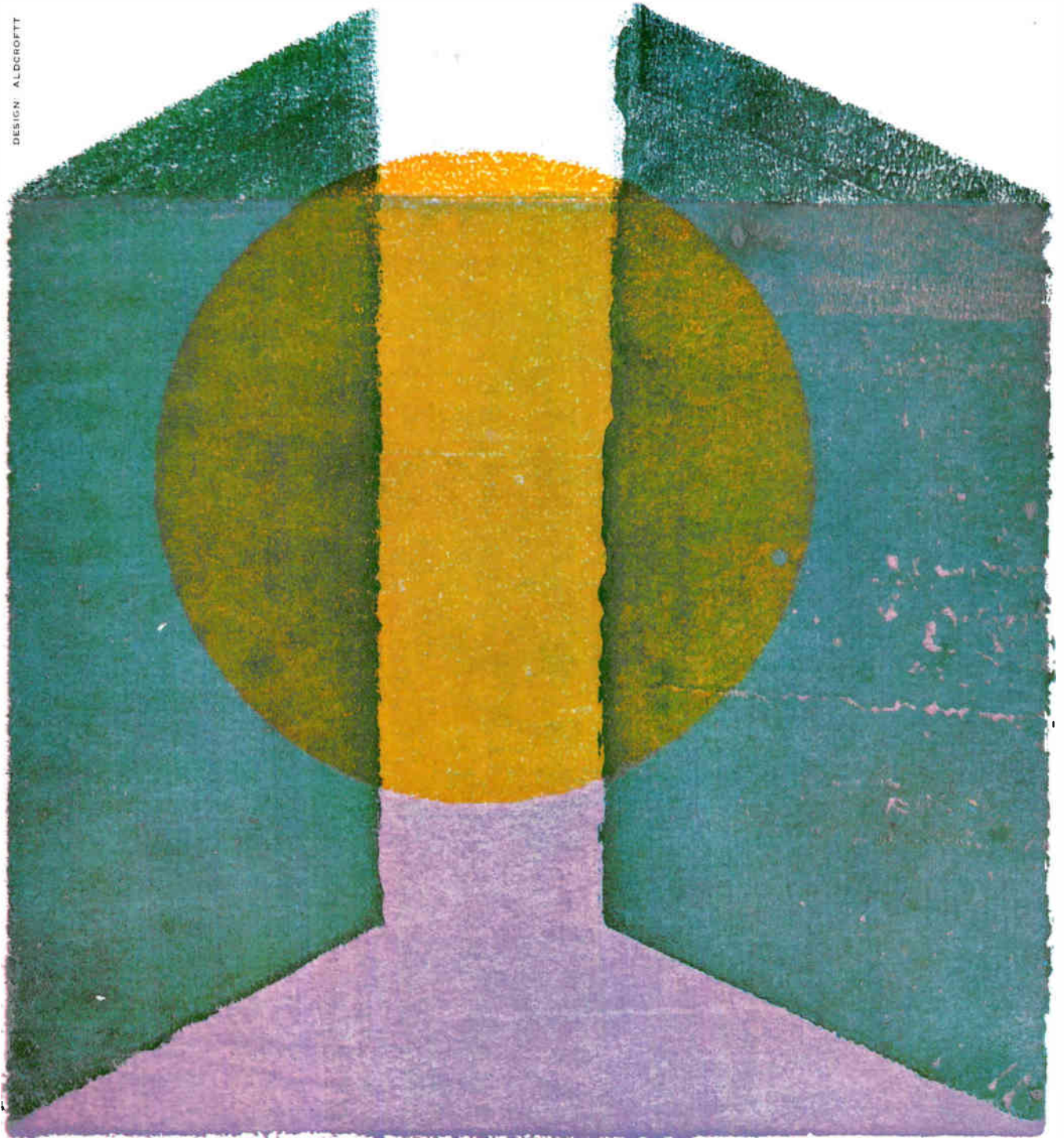


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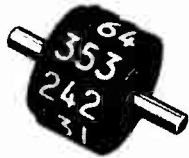
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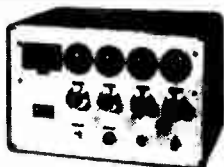
SERIES 1591



SERIES 1806



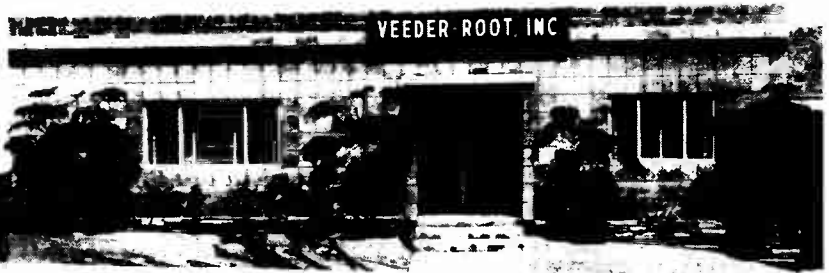
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in the West . . .*

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8 different ALSiMag compositions**



**Pressed ALSiMag ceramics . . .
9 different compositions**



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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 produc-
tion • Unequaled facilities for volume
production when you really need volume.

from one source . . .

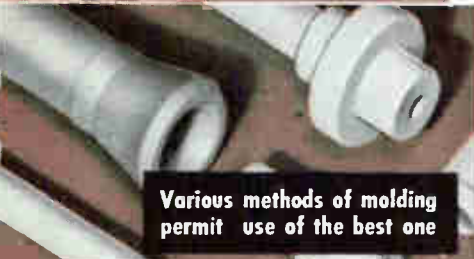
These are typical samples picked up in
our Inspection Department over a week
end. They illustrate the great variety
of technical ceramics constantly flowing
through our ultra-modern plants.

Parts are shown approximately 1/2 size.

Property Chart Sent on Request.



**Odd contours can be handled in
specialized molding processes**



**Various methods of molding
permit use of the best one**



**ALSiMag metal-ceramic
assemblies**



**Casting handles larger shapes,
odd contours**



**High temperature
hermetic seals**



Soft solder metalization



**Extruded, precision ground
to ± 0.0001"**



**Precision thin and
sub-miniature ceramics**

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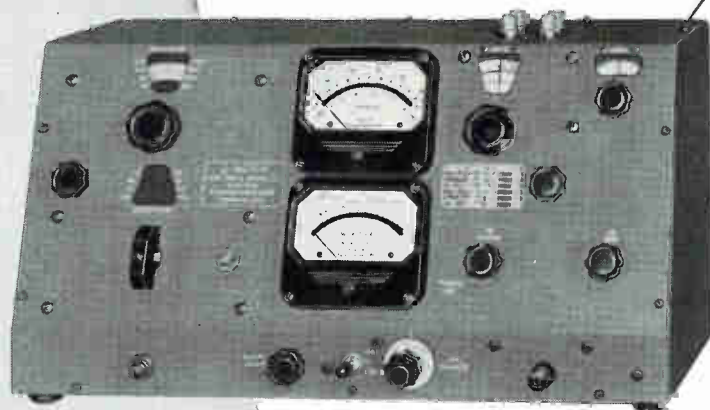
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Accurate Q Measurements

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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.

- 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)
- Δ 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

Specifications

	TYPE 190-A	TYPE 260-A
Freq. Range:	20 Mc. to 260 Mc.	50 Kc.* to 50 Mc.
Q Range:		
Total Range:	5 to 1200	10 to 625
Low Range:	10 to 100	10 to 60
Δ Q Range:	0 to 100	0 to 50
Q Accuracy:	$\pm 7\%$ * 20 Mc. to 100 Mc. $\pm 15\%$ * 100 Mc. to 260 Mc. *for circuit Q of 400 read directly on indicating meter.	$\pm 5\%$ * 50 Kc. to 30 Mc. $\pm 10\%$ * 30 Mc. to 50 Mc. *for circuit Q of 250 read directly on indicating meter.
Capacitor Range:	7.5 to 100 μf	30 to 460 μf
Capacitor Accuracy:	$\pm 0.2 \mu\text{f}$, 7.5-20 μf $\pm 0.3 \mu\text{f}$, 20-50 μf $\pm 0.5 \mu\text{f}$, 50-100 μf	$\pm 1\%$ or 1 μf , whichever is greater.
Price:	\$875.00 F.O.B. Boonton, N. J.	\$850.00 F.O.B. Boonton, N. J.

*1 Kc. to 50 Kc. with external oscillator.

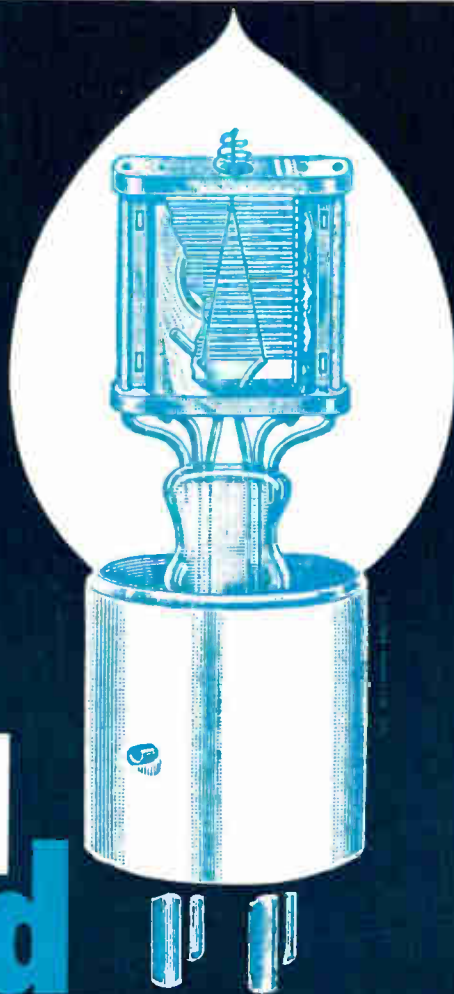
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WESCON SHOW—BOOTHS 751-752



Boonton Radio Corporation

BOONTON, NEW JERSEY

Precision Electronic Instruments since 1934




THEN
and

NOW

AT WESCON—BOOTH 728


“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.



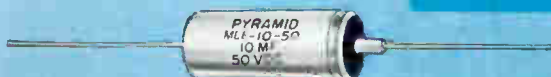
type TAD . . . solid tantalum high reliability capacitors. They are available in a wide range of sizes and values, are hermetically sealed, and have a long shelf and operating life.

temperature range: -80°C to $+85^{\circ}\text{C}$
 $+125^{\circ}\text{C}$ (with derating)
Write for bulletin ET-7



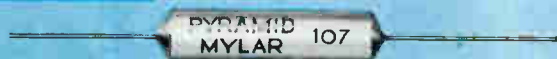
type TAK-H . . . wet electrolyte tantalum capacitors with built-in rugged construction, seep and vibration proof, and made to meet specifications MIL-C-3965.

Write for bulletin ET-8



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

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



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

temperature range: -55°C to $+125^{\circ}\text{C}$

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

*Mylar—reg. duPont TM

Write for bulletin MY-2

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 $+105^{\circ}\text{C}$. 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

- A. Temperature— -55°C to $+75^{\circ}\text{C}$
- B. Altitude— -1000 Feet to $+80,000$ feet
- C. Humidity— Section 4.4.3 of MIL-E-5272
- D. Vibration— 0.30 inch double excursion from 3 to 18 cycles per second and ± 2 g. acceleration from 18 to 500 cycles. (Without vibration isolators)
- E. Crash Safety— Repeated shocks of 30 g. with durations of 11 milliseconds
- F. Salt Atmosphere— Section 4.6.1 of MIL-E-5272
- G. Fungus Growth— Section 4.8.1 of MIL-E-5272
- H. Sand and Dust— Section 4.11.1 of MIL-E-5272

GENERAL PERFORMANCE SPECIFICATIONS

- A. Gain Variation— Less than 10% due to any given parameter extreme variation.
- B. Linearity— Better than 10% through the range of 3% to 80% of full output.
- C. Noise— Less than 5% of maximum output.
- D. Phase Shift— Less than 8 degrees.



TYPE 9805-20— SYNCHRONIZER

Same as 9805-19 except Control Transformer Speed is 10 degrees/second—Min.

TYPE 9805-19—SYNCHRONIZER



Synchronizer

Motor Control Phase— 40/20 volts, 1.7 watts, 400 cycles
 Motor Reference Phase— 57.5 volts, 2.2 watts, 400 cycles
 Generator Excitation— 57.5 volts, 3.0 watts, 400 cycles
 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 9616-08—DEMODULATOR AMPLIFIER



Demodulator Amplifier

Input Impedance— Greater than 25,000 ohms
 Output Impedance— 2830 ohms (Dual)
 Voltage Gain— Greater than 115
 Supply Voltage— 28.0 D.C.

TYPE 9616-07—SYNCHRONIZER AMPLIFIER



Synchronizer Amplifier

Input Impedance— Greater than 50,000 ohms
 Voltage Gain— Greater than 250
 Load— Control Phase of Motor Generator of 9805-19 or 9805-20

TYPE 9616-16—4-CHANNEL ISOLATION AMPLIFIER



4-Channel Isolation Amplifier

Input Impedance— 1200 ohms per channel
 Voltage Gain— $.98 \pm .01$ per channel
 Load Impedance— 1200 ohms per channel
 Supply Voltage— 48VDC

TYPE 9616-09—SERVO ACTUATOR AMPLIFIER



Servo Actuator Amplifier

Input Impedance— Greater than 50,000 ohms
 Output Impedance— 400 ohms
 Voltage Gain— Greater than 900
 Supply Voltages— 100.0 volts D.C., 28.0 volts D.C.

TYPE 9616-15—RELAY AMPLIFIER



Relay Amplifier

Input Impedance— Greater than 15,000 ohms
 Relay Closing Voltage— 150-175 Millivolts, 400 cycles
 Relay Opening Voltage— 125-150 Millivolts, 400 cycles
 Relay Contacts— 4 Pole, Double Throw— Dry Circuit
 Supply Voltage— 28.0 V. D.C.

TYPE 9616-06—SUMMING AMPLIFIER (DUAL)



Summing Amplifier

Summing Inputs— 10 (per channel)
 Gain— Nominal 1.0; variable from 0.1 to 10.0
 Input Impedance— Dependent on Summing Channel. (50,000 ohms—500,000 ohms)
 Load Impedance— Greater than 10,000 ohms
 Supply Voltage— 28 V. D.C.



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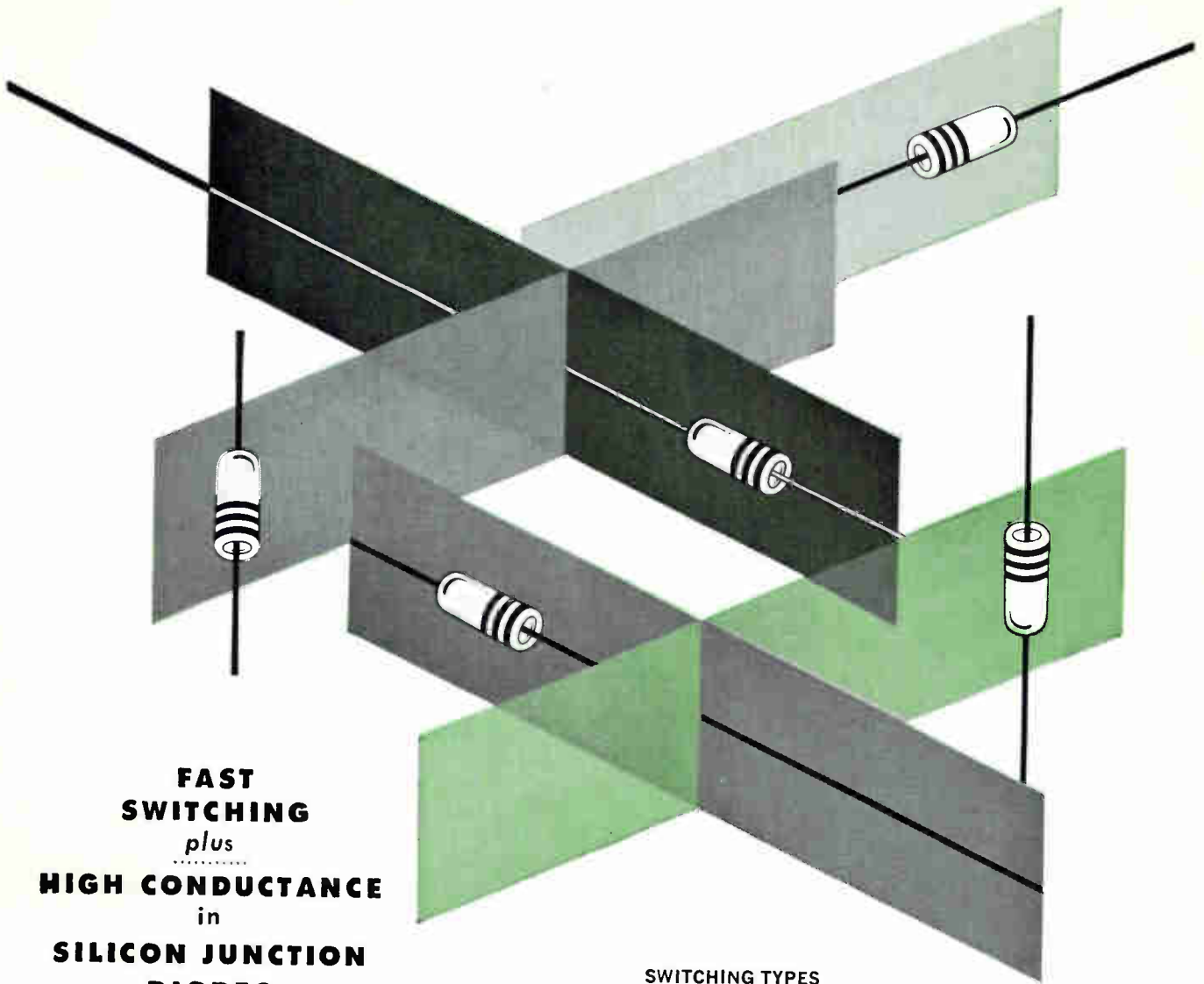
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**FAST
SWITCHING**
plus
HIGH CONDUCTANCE
in
**SILICON JUNCTION
DIODES**

SWITCHING TYPES

New circuit possibilities for low impedance, high current applications are opened up by Clevite's switching diodes. Type CSD-2542, for example, switches from 30 ma to $-35v$. 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

JAN		SIGNAL CORPS	
1N457 -	MIL-E-1/1026	1N662 -	MIL-E-1/1139
1N458 -	MIL-E-1/1027	1N663 -	MIL-E-1/1140
1N459 -	MIL-E-1/1028	1N658 -	MIL-E-1/1160
		1N643 -	MIL-E-1/1171

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

Reliability In Volume . . .

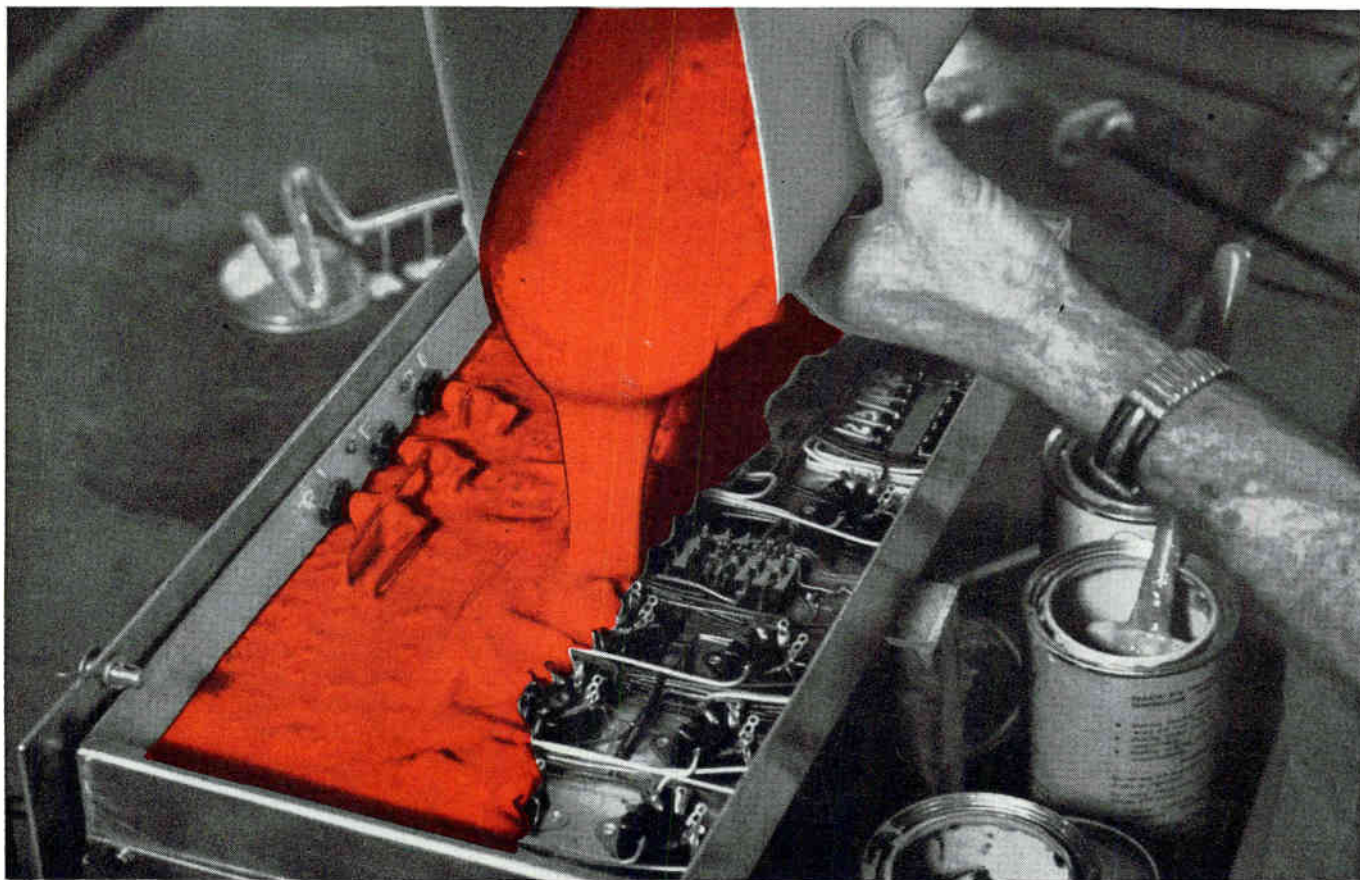


CLEVITE TRANSISTOR

254 Crescent Street Waltham 54, Mass. Tel: TWinbrook 4-9330



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.

CIRCLE 289 ON READER SERVICE CARD

For "Silicones for the
Electronic Engineer",
Write Dept. 3508

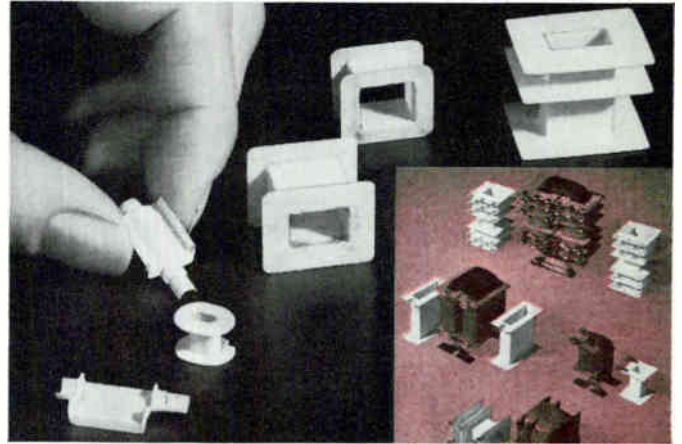


Dow Corning

... Specify Silicones

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.



CIRCLE 290 ON READER SERVICE CARD

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.

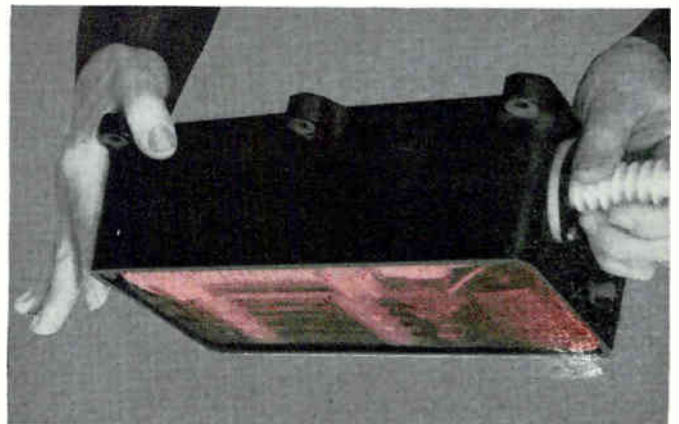
Dow Corning silicone compounds don't melt, lose their grease-like consistency or dielectric properties from -70 to 200 C. Dow Corning silicone compounds have been found ideal for potting transistors. They cushion junctions against shock and vibration . . . improve heat dissipation because of their good 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.



CIRCLE 291 ON READER SERVICE CARD

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 1/4" apart, yet output voltages run from 1,000 to 25,000 volts!

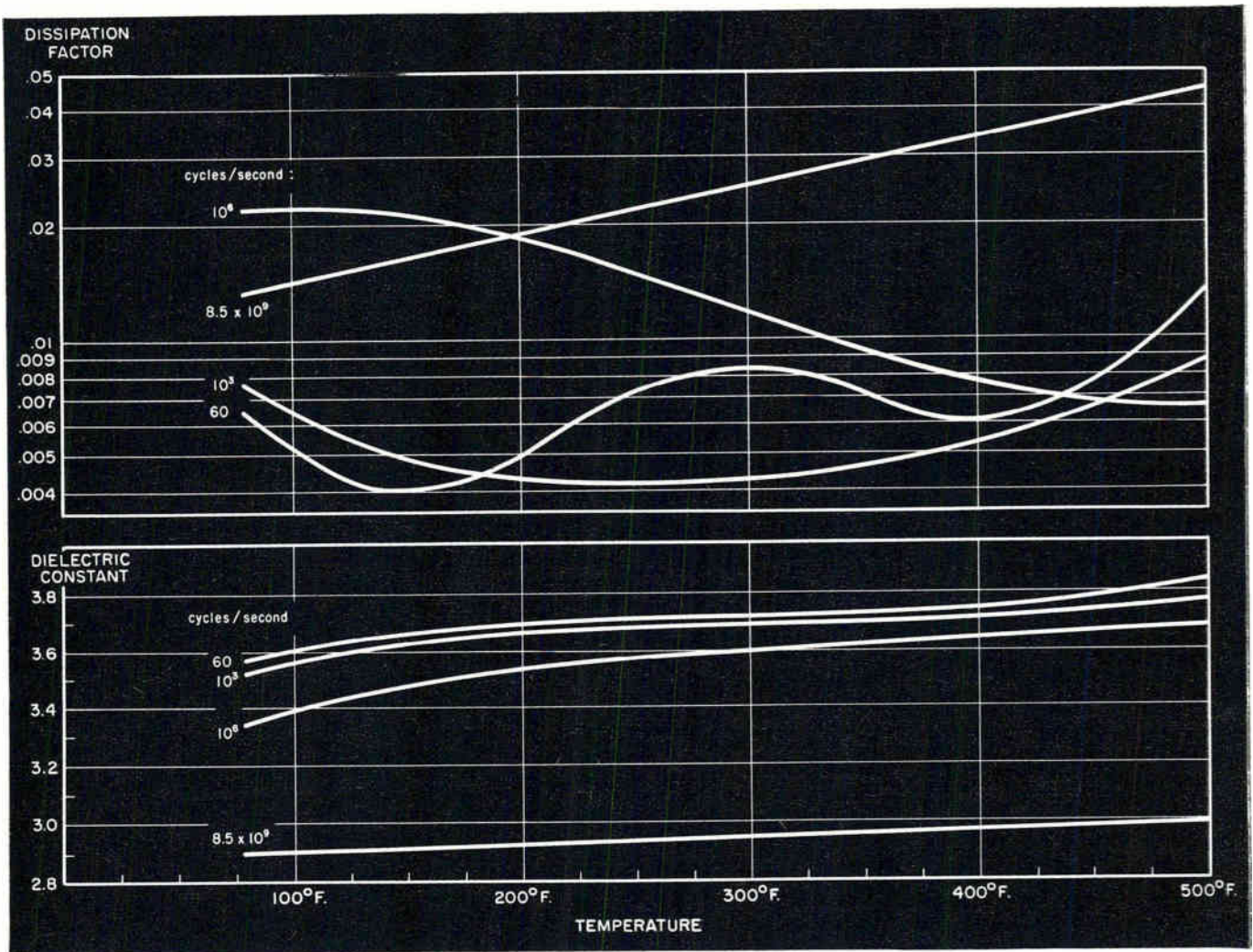


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Good electrical properties at H.D.T.'s* above 500°F. now possible in epoxy resin potting systems

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)



PMDA (PYROMELLITIC DIANHYDRIDE)

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY

The Offner Type **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.



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

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

VERSATILITY of application—one set of amplifiers covers all uses, micro-volt 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.



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)

(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, .66 gm.-cm²; Acceleration, 37,000 rad./sec.²; No load speed, 6500 rpm; Damping coefficient, 36 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./sec.²; No load speed, 6500 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./sec.²; No load speed, 6200 rpm; Damping coefficient, 38 dyne-cm-sec/rad.; 3.0 watts/phase @ stall; Gen. output, .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./sec.²; No load speed, 6200 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, 24,700 rad./sec.²; No load speed, 6000 rpm; Damping coefficient, 39 dyne-cm-sec/rad.; 3.0 watts/phase @ stall; Flywheel damping, 60 dyne-cm-sec/rad.; Corner freq., .98, 2.8 and 18.5 cps.

lo-J

Rotor inertia, .54 gm.-cm²; Acceleration, 32,700 rad./sec.²; No load speed, 6000 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



NEW DIFFUSED SILICON DIODES



featured in more efficient economical switching block

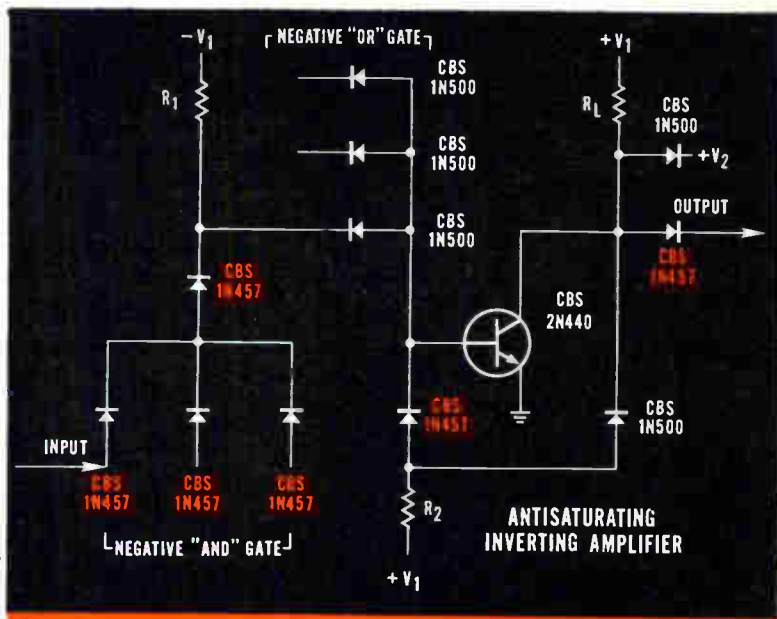
New CBS high back-resistance diffused silicon diodes for positive switching now join CBS high-conductance and fast-recovery types. Efficient and flexible switching is made possible (see circuit). CBS diffusion techniques offer three major advantages over the alloying method: Close process control of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

Type	Min. Rev. Voltage @ 100 μ A (volts)	Min. Forward Current	Maximum Reverse Current				Avg. Rect. Fwd. Current	
			@ 25°C		@ 150°C			
			I_F (mA)	E_F (volts)	I_R (μ A)	E_R (volts)		
1N456	-30	40	1.0	0.025	-25	5	-25	90
1N457	-70	20	1.0	0.025	-60	5	-60	75
1N458	-150	7	1.0	0.025	-125	5	-125	55
1N459	-200	3	1.0	0.025	-175	5	-175	40

Other CBS Diffused Silicon Types

Type	Min. Reverse V @ 100 μ A	Min. Avg. Forward @ 1V mA @ 25°C	Bulletin
High Conductance Types			
1N482	-40	100	E-373
1N483	-80	100	E-373
1N484	-150	100	E-373
1N485	-200	100	E-373
Fast Recovery Types			
1N625	-35	20	E-374
1N626	-50	20	E-374
1N627	-100	20	E-374
1N628	-150	20	E-374
1N629	-200	20	E-374

CBS ELECTRONICS

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semiconductors

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

Westinghouse Electronic Tube Division, Elmira, N. Y.

A New Galaxy in Electronics and Aerospace Activity

Ling-Altec Electronics, Inc.

and

Temco Aircraft Corporation

Join Forces as



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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UNITED ELECTRONICS COMPANY	TEMCO INDUSTRIAL DIVISION
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LING ELECTRONICS DIVISION	
PEERLESS ELECTRICAL PRODUCTS DIVISION	

New!

REMOVABLE CONTACT

BY CONTINENTAL CONNECTORS

ENLARGED VIEW TO SHOW DETAIL
OF PRECISION MADE SCREW MACHINE CONTACT



Closed Entry Cartridge completely protects socket contact against probe damage or handling inside and outside molding

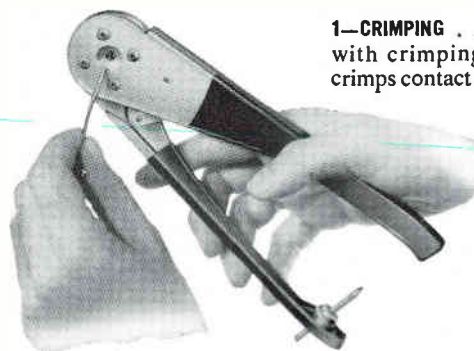
Eliminate all connector soldering operations with Continental Connector's new, improved removable contact with crimp terminations. Extra wide, three-tine spring clutch on pin and socket provides maximum holding area between contact and molded block. Contacts are supplied separately and are wired independently. 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.

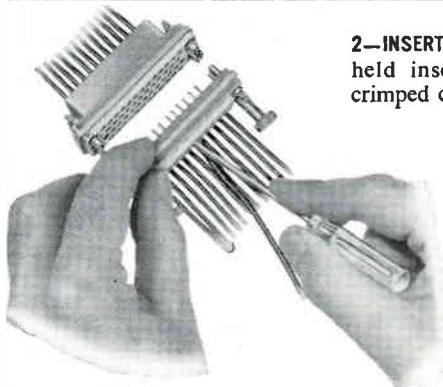
These removable contacts are designed for use with Continental Series 25 Miniature Rectangular connectors in sizes of 14, 26, 34, 50, 75 and 104 contacts. Both socket and pin contacts are made of phosphor bronze with gold plate over silver plate. Terminations accommodate any #16 to #22 AWG wire. Removable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



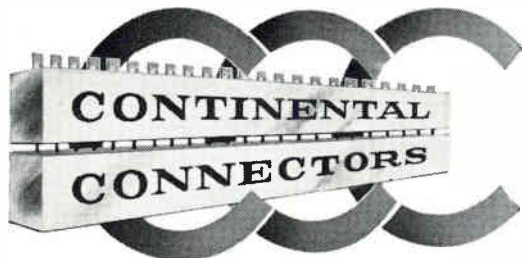
1—CRIMPING . . . One motion with crimping tool quickly crimps contact securely to wire



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



MANUFACTURED BY
CONTINENTAL CONNECTOR CORPORATION,
AMERICA'S FASTEST GROWING LINE OF
PRECISION CONNECTORS

See us at the Wescon Show—Booths 855-856

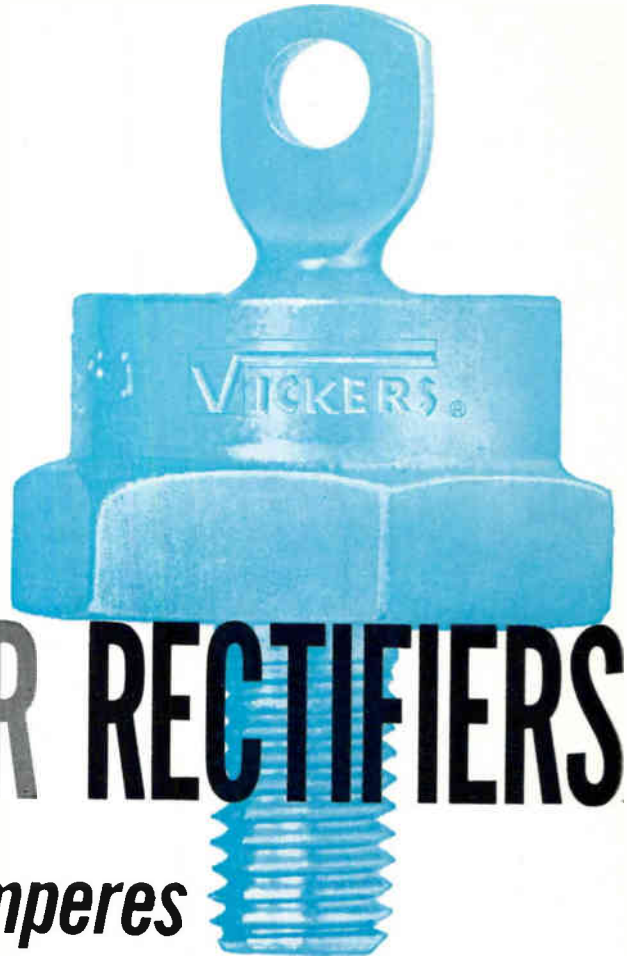
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SILICON POWER RECTIFIERS

18 and 35 amperes



SILICON POWER RECTIFIERS
CATALOG NUMBERS

Peak Inverse Voltage	LOW POWER			MEDIUM POWER	
	2 Amperes	8 Amperes	12 Amperes	18 Amperes	35 Amperes
50V	—	—	—	DA05	EA05
100V	—	—	—	DA10	EA10
150V	—	—	—	DA15	EA15
200V	AA20	BA20	CA20	DA20	EA20
250V	—	—	—	DA25	EA25
300V	AA30	BA30	CA30	DA30	EA30
350V	—	—	—	DA35	EA35
400V	AA40	BA40	CA40	DA40	EA40
500V	AA50	BA50	CA50	DA50	EA50
600V	AA60	BA60	CA60	DA60	EA60

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RELIABILITY
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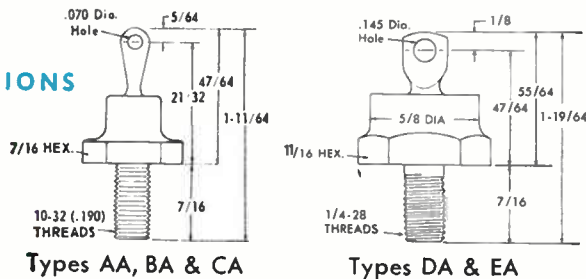
SILICON RECTIFIER STACKS

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.

EPA 3300-5

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ELECTRIC PRODUCTS DIVISION

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INTRODUCING THE ONLY SELF TUNING ULTRASONIC CLEANERS



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.

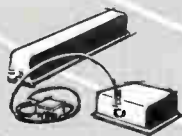
Powertron's complete line of Autosonic cleaners includes tank models from 2 gals. to 100 gals., cabinet models, immersible transducers, degreasers and accessories, competitively priced and available from stock. Whatever you want to clean can be cleaned better in an Autosonic.

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"



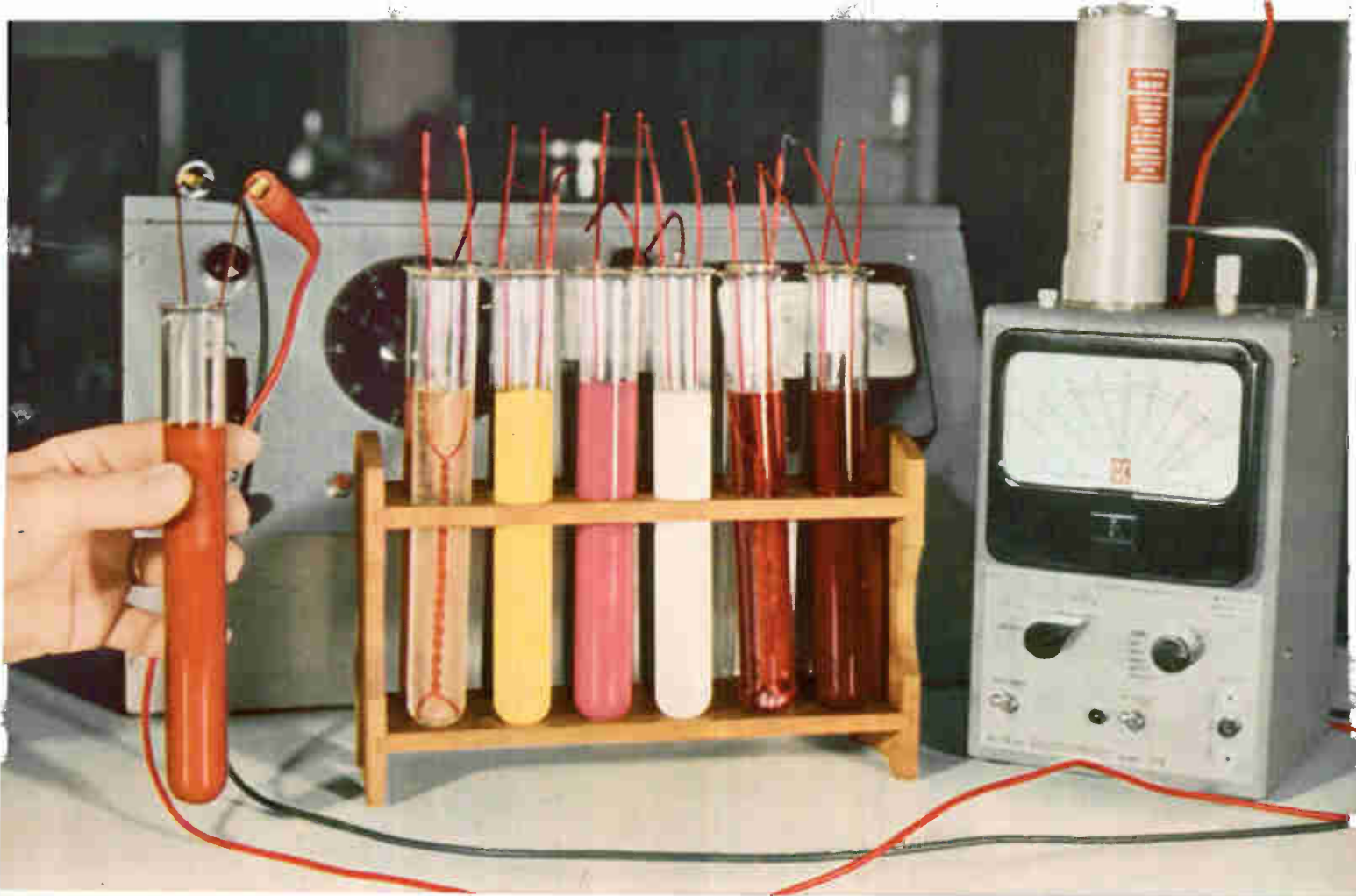
Powertron's new line of self tuning ultrasonic cleaners CUT CLEANING TIME 300% over outmoded ultrasonic systems. Case histories on file show up to 900% faster cleaning consistently, and savings of \$3,000 a month in labor costs — details on request.



POWERTRON'S COMPLETE LINE OF AUTOSONIC CLEANERS INCLUDES TANK MODELS, CABINET MODELS, IMMERSIBLE TRANSDUCERS, DEGREASERS AND COMPLETE PROCESS SYSTEMS.

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Compatibility testing of Epoxy Magnet Wire with encapsulating materials.

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° 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.

G19251

ASK THE MAN FROM

ANACONDA[®]
FOR EPOXY MAGNET WIRE

ANATHERM 155°C (AIEE Class F)
high temperature resistance



NYFORM 105°C (AIEE Class A)
superior windability



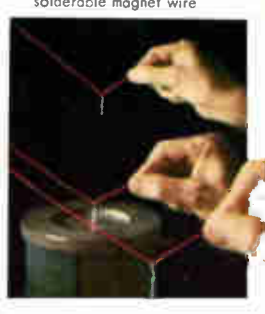
PLAIN ENAMEL 105°C (AIEE Class A)
low-cost enameled magnet wire

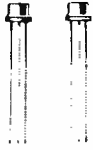


FORMVAR 105°C (AIEE Class A)
proven dependability



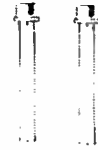
ANALAC 105°C (AIEE Class A)
solderable magnet wire





EXTRA QUALITY AT NO EXTRA COST WITH BENDIX TRANSISTORS

Bendix Bulletin



Up-to-the-minute news about transistors

NEW DRIVER TRANSISTORS SWEEPING THE FIELD

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

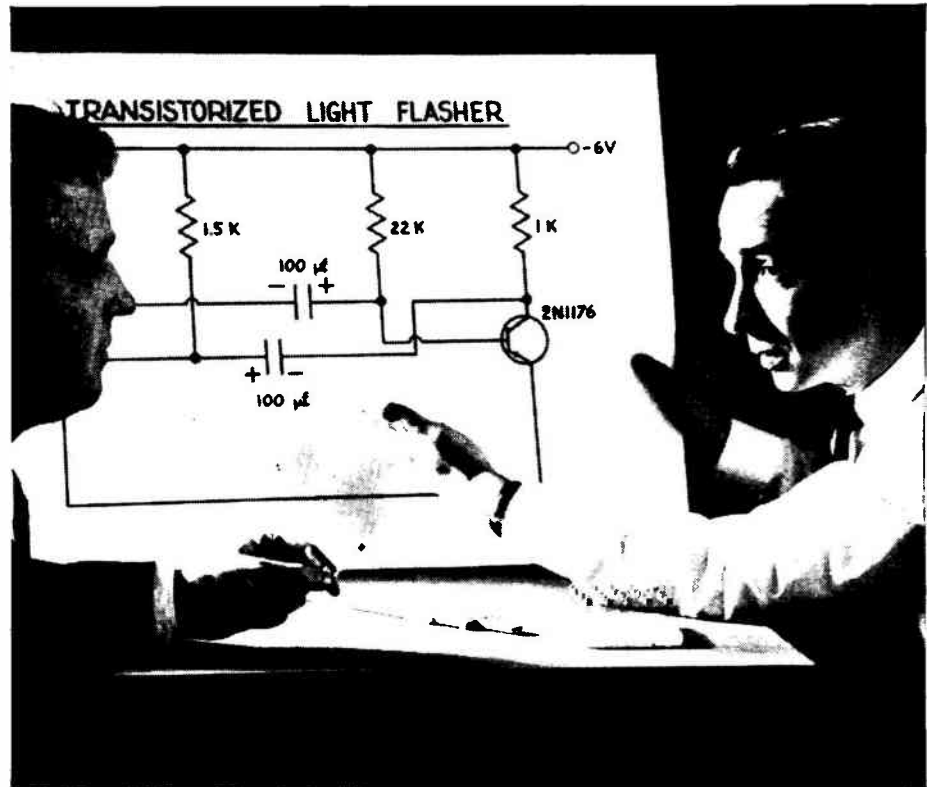
Called the "workhorse of the transistor industry," the new Bendix® Driver Transistor series is winning the nod from more and more engineers daily. These men find it the answer to audio frequency and switching applications requiring extra performance without extra cost.

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.

*TRADEMARK



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

TYPE NUMBERS	MAXIMUM RATINGS				TYPICAL OPERATION			
	V _{ce} Vdc	I _c mAdc	P _c mW	T _j °C	T storage °C	h _{fe} I _c = 10 mAdc	f _{cb} I _c = 100 mAdc I _b = 10 mAdc	V _{ce} (Sat)
2N1008	-20	300	400	85	-65 to +85	90	1.2 mc	0.15 Vdc
2N1008A	-40	300	400	85	-65 to +85	90	1.2 mc	0.15 Vdc
2N1008B	-60	300	400	85	-65 to +85	90	1.2 mc	0.15 Vdc
2N1176	-15	300	300	85	-65 to +85	65	1.2 mc	0.15 Vdc
2N1176A	-40	300	300	85	-65 to +85	65	1.2 mc	0.15 Vdc
2N1176B	-60	300	300	85	-65 to +85	65	1.2 mc	0.15 Vdc

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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HOW TO TURN A MESS.....

Progress in Systems packaging...for the Missile Age

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.

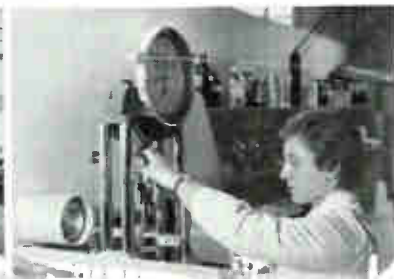
CRAIG SKILLS AND SERVICES

- Systems housings — light weight, 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,

MASS PRODUCTION FACILITIES



ENGINEERING AND RESEARCH SERVICES



QUALIFICATION TEST PROGRAMS



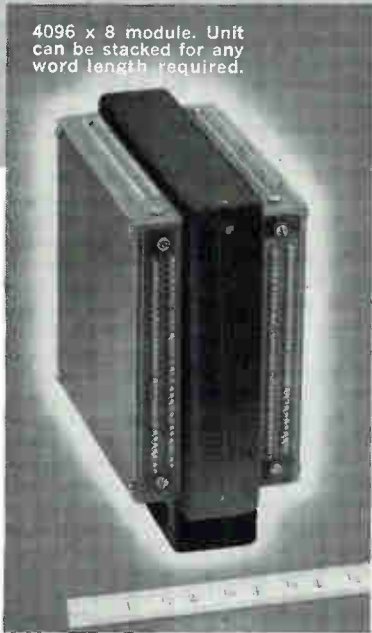
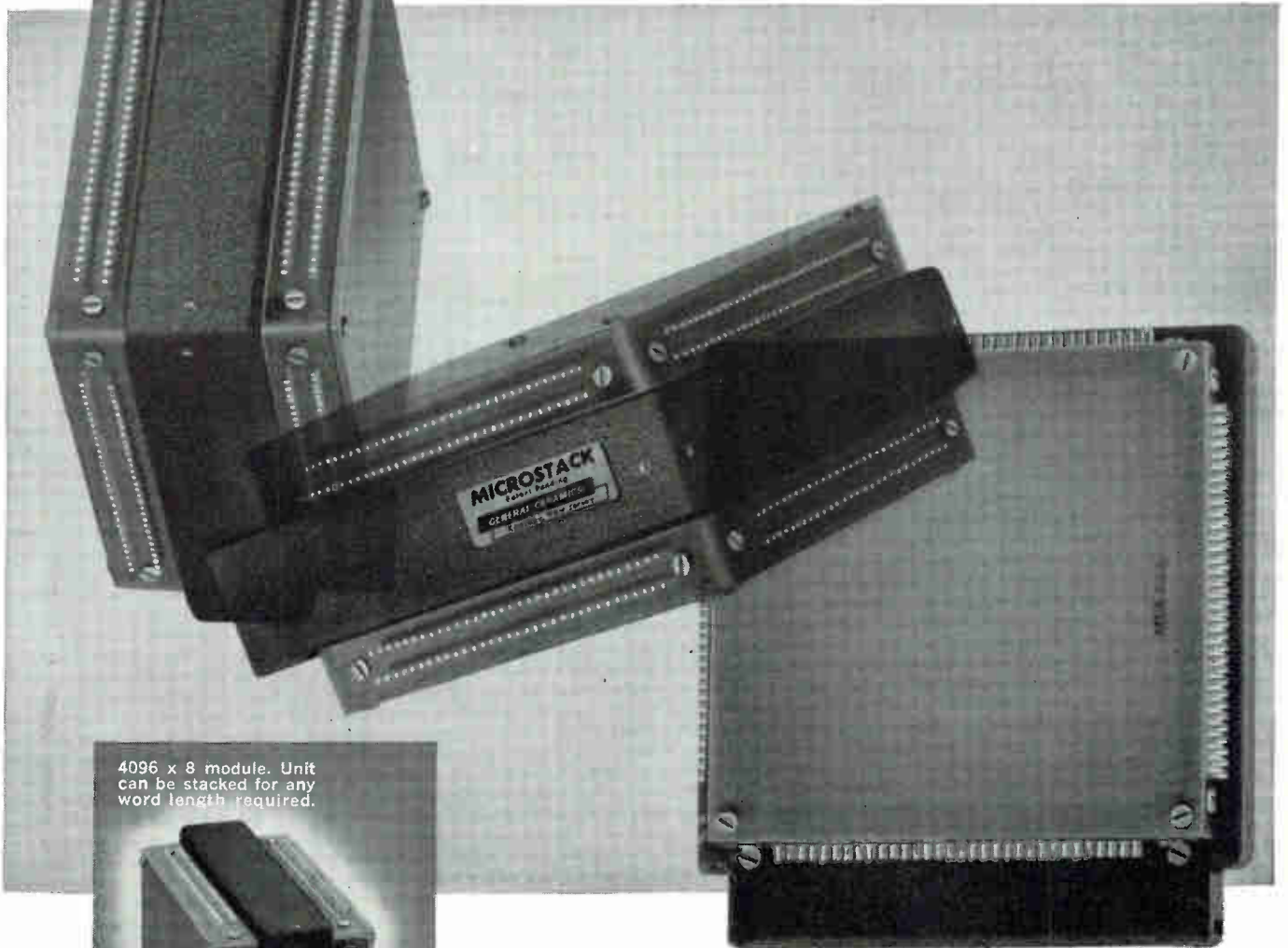
AIR TRANSPORTABLE SHELTERS



New temperature controlled MICROSTACK® meets

-55°C to +85°C

MILITARY REQUIREMENT



4096 x 8 module. Unit can be stacked for any word length required.

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 $+85^{\circ}\text{C}$. 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.



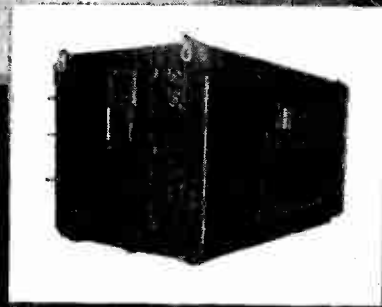
APPLIED LOGIC DEPARTMENT
GENERAL CERAMICS
KEASBEY, NEW JERSEY, U.S.A.

TECHNICAL CERAMICS, FERRITE AND MEMORY PRODUCTS

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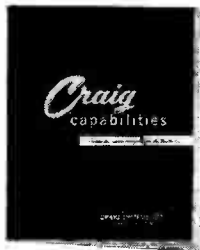
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Craig's capabilities brochure will be sent on request. Write to Dept. E-4.

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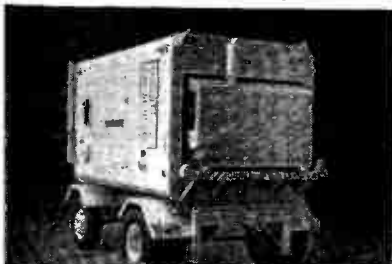
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1028 Connecticut Ave., N. W.
District 7-1575

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Business systems and equipment are another Craig specialty through LeFebure Corporation, Cedar Rapids, Iowa — a Craig subsidiary

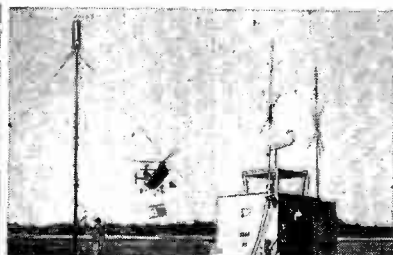
MOBILE GROUND SUPPORT EQUIPMENT



COMPLETE SYSTEMS PACKAGING

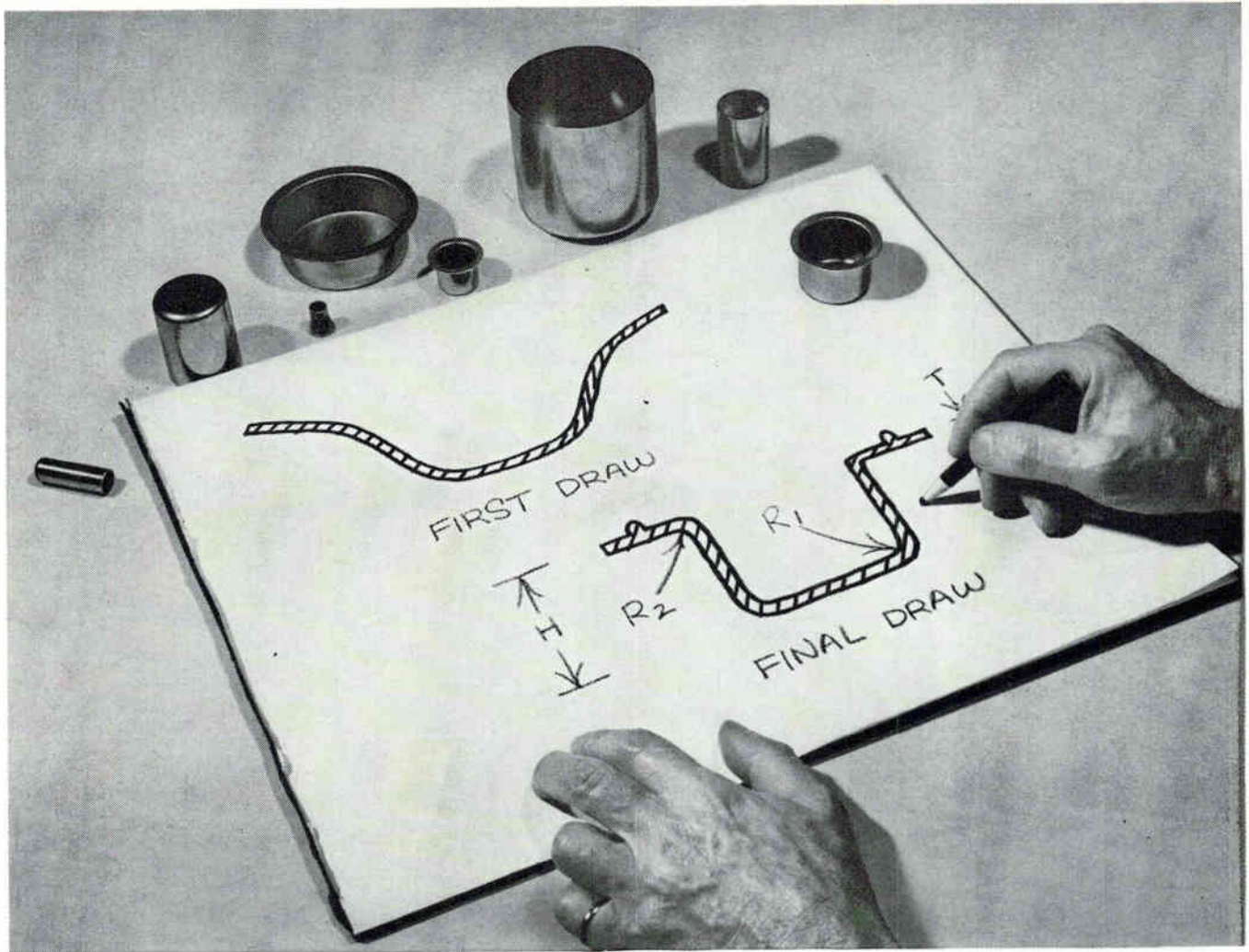


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Engineering hints from Carborundum

Correct techniques simplify production of KOVAR[®] Alloy drawn shapes

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:

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

CARBORUNDUM[®]

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 metallized-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.





Eighteen-foot diameter radome of WSR-57 Stormfinder radar. System operates at S band, has 250-mile range.

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.

EQUIPMENT CHARACTERISTICS

Iso-echo feature. Sensitivity Time Control of 20 db between 10-100 miles. Triple display indicator unit: (1) 7" RHI (range height indicator), (2) 12" PPI (plan-position indicator), (3) 7" A/R Scope for storm intensity measurement.

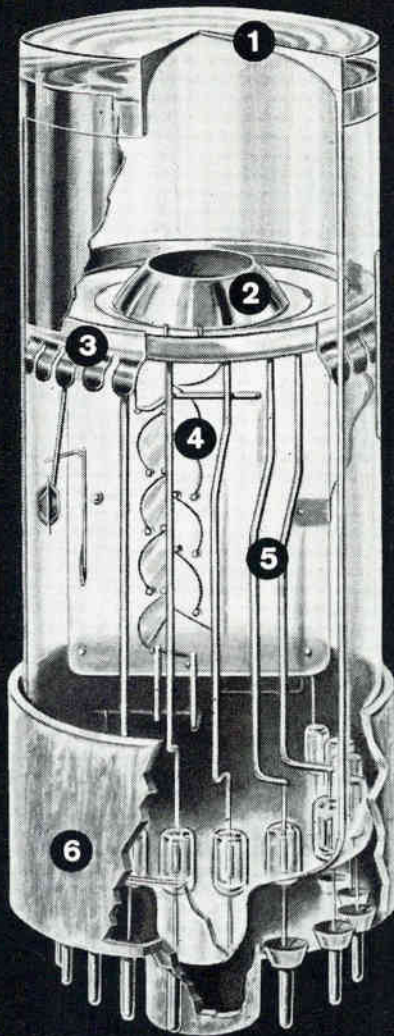
Power output	500 KW
Frequency	2.7 — 2.9 kmc.
Beamwidth	2.2°
Elevation	—10° to +45° @ 6 scans/min
Azimuth	360° @ 1.4 scans/min

*from testimony before a House Appropriations subcommittee, January 18, 1960.



For Raytheon Weather Radar Brochure, Write: Director of Marketing, Equipment Division, Dept. C3, Raytheon Company, West Newton, Mass.

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matches curvature of cathode for spherically symmetrical electrostatic field.

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assures increased resistance to shock and vibration.

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is specially designed for fast time response.

5. STURDY LEAD WIRES

result in rugged construction.

6. INTERCHANGEABLE DESIGN

can be substituted directly for many existing photomultiplier types.

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"

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



LABORATORIES

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A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

You are invited to visit CBS Laboratories Booth #2523
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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.

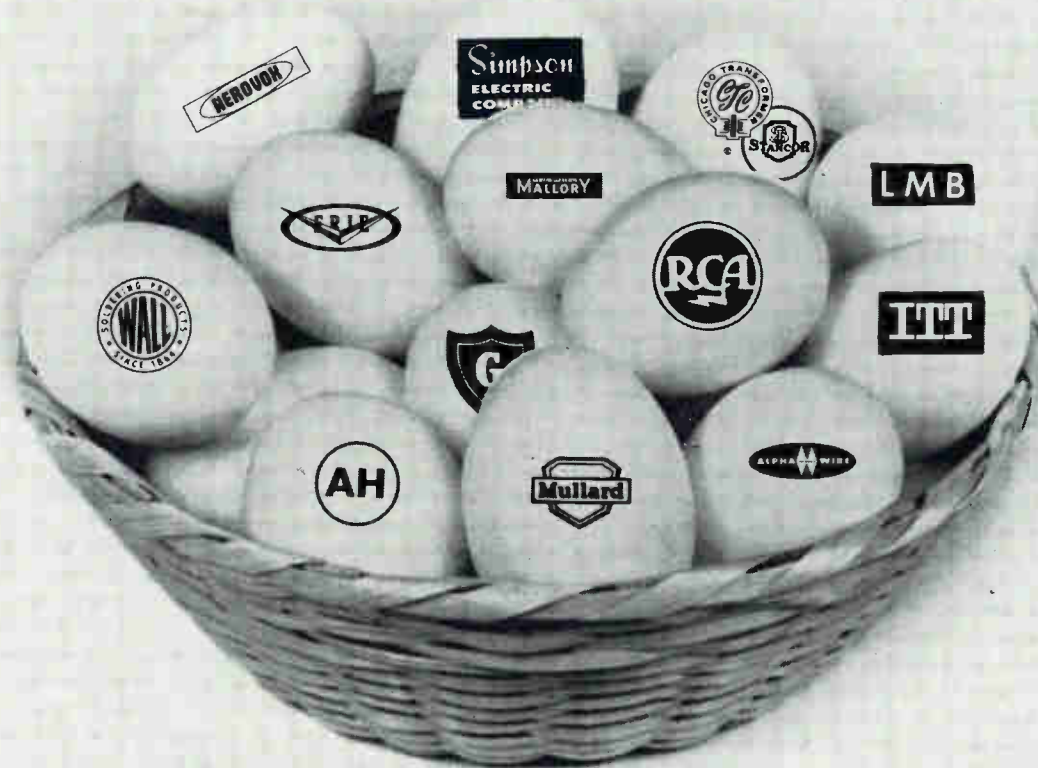


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PLANTS: RIVERSIDE, CALIF. AND AMES, IOWA

Exclusive manufacturers of Trimpot®, Trimit® and E-Z-Trim®. Pioneers in transducers for position, pressure and acceleration.

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your eggs
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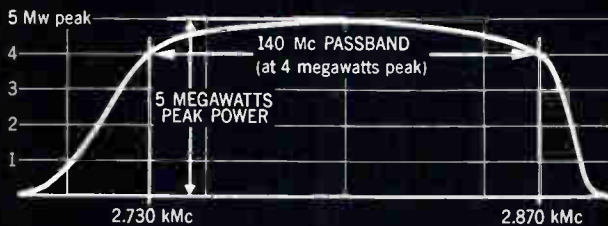


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VARIAN presents the VA-839

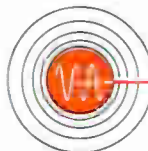
HIGH EFFICIENCY KLYSTRON with BANDWIDTH RIVALING TWT's

- 43% efficiency • 140 megacycles bandwidth
- 5 megawatts peak • 10 kilowatts average
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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.

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Representatives thruout the world

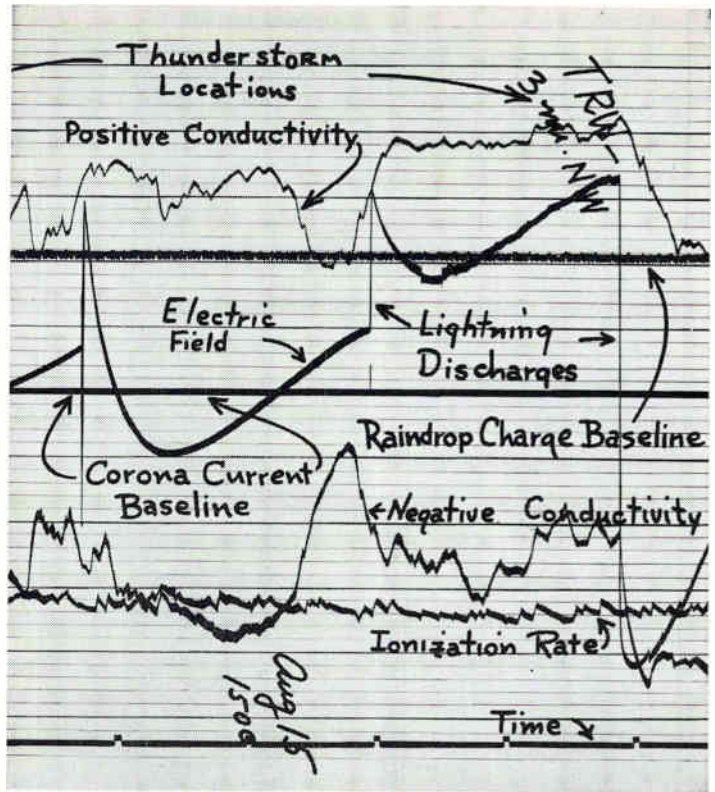


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In research ...

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.

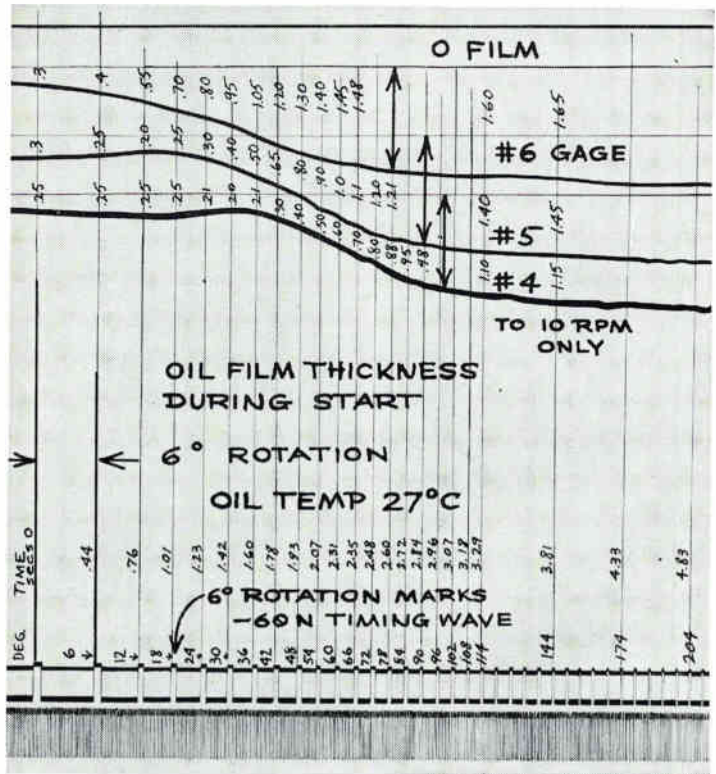


these are records of leadership

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.



Unretouched records 2/3 actual size.

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

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simple
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1

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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.

2

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.

3

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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.

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THE LAMINATED SHIM COMPANY, INC.

GLENBROOK, CONNECTICUT
Telephone DAVIS 5-2631

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THE LAMINATED SHIM COMPANY, INC.
4608 Union St., Glenbrook, Conn.

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.

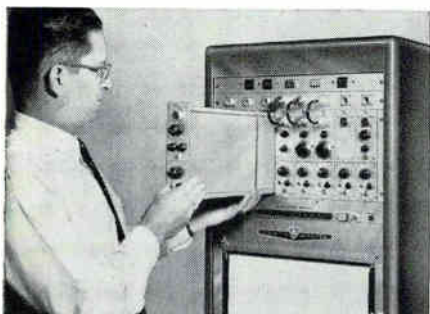
Finest Frequency-Amplitude Performance

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!

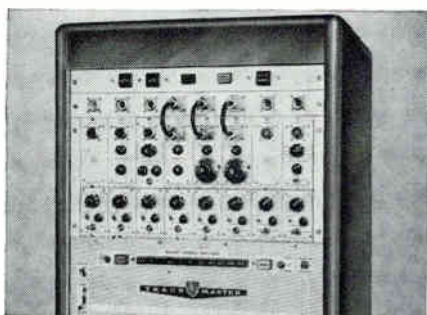
Band Amplitude Product (i.e. Bandwidth times Amplitude) is 5600...140 cps (3 db point) x 40mm! TRACE-MASTER can provide meaningful signal information in areas never before possible with direct-writing recorders!

Finest Chart-Drive Facilities

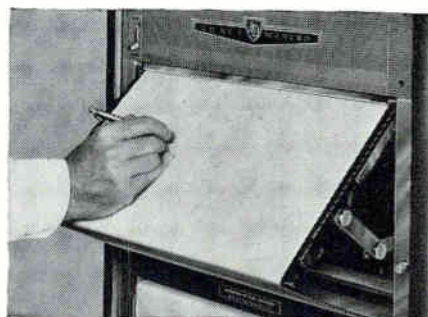
TRACE-MASTER provides widest chart-speed range...0.1 to 500 mm/sec...of any direct-writing recorder! Convenient push-button selection...new speed is accurately established before finger can leave the button. Unique take-up reel automatically stores full 1000 ft. record. Writing table tilts to convenient 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.



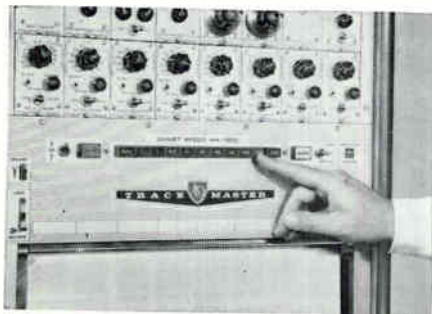
*is the
recorder!*

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 ($\pm 1\%$) and stability in rectilinear presentation permit full use of this unexcelled resolution.

Finest Systems Oriented Compatability

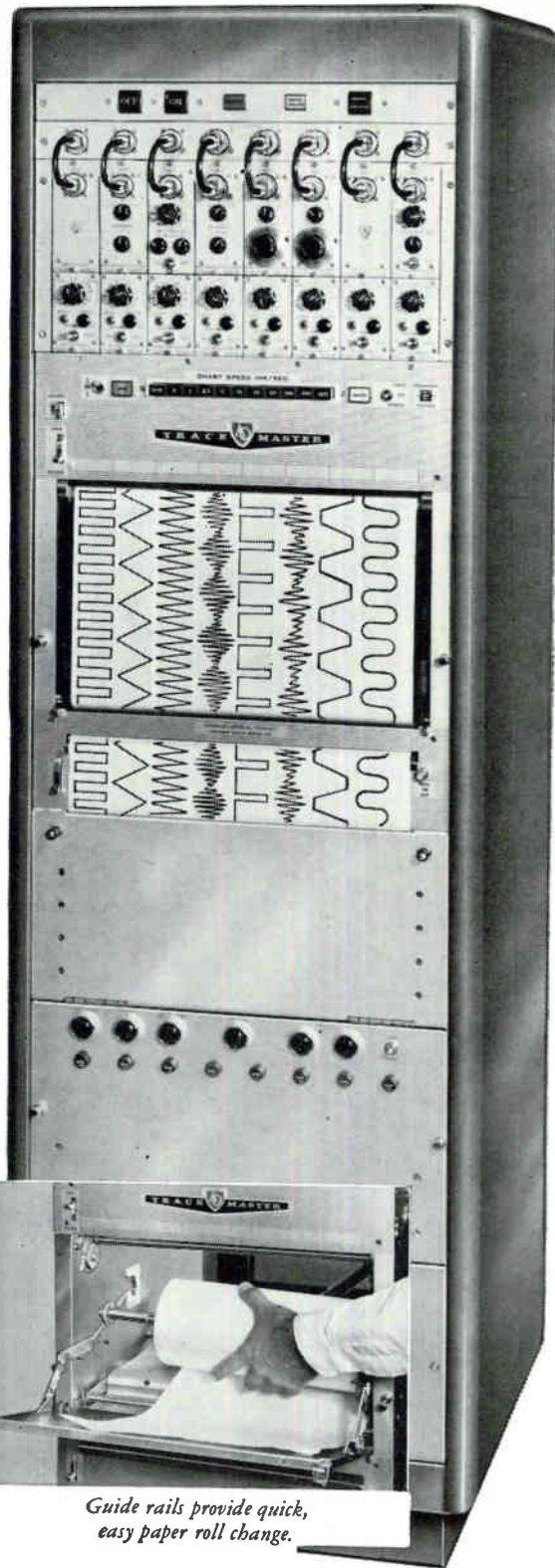
Fully transistorized circuitry... generous performance margins... conservative derating... application of combined dc level and signal multiple feedback... complete interchangeability of modular signal-conditioning elements... are only some of the outstanding features that combine to make the AO TRACE-MASTER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



Widest range chart speed... push-button selection through 0.1 mm/sec to 500 mm/sec.



Guide rails provide quick, easy paper roll change.



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

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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.

Dept. H 106, American Optical Co., Buffalo 15, New York.

Please send engineering bulletins on the New AO Trace-Master.

Name _____

Business Address _____

City _____ Zone _____ State _____

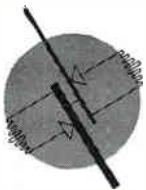
NEW

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 semi-conductor components. Cooling systems of advanced design insure long life and trouble-free operation.

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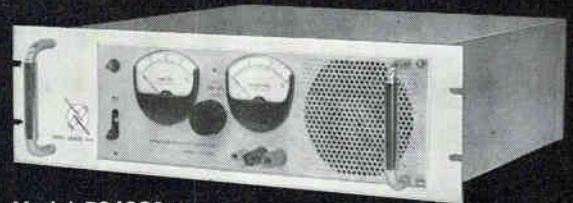
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POWER SOURCES, INC.

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Model PS4232
115-325 volts DC out
at 1.5 amp maximum



Model PS4330
0-36 volts DC out
at 30 amp maximum

POWER SUPPLIES

High Voltage Supply Specifications

	PS4222	PS4230	PS4232
DC Output Range	35-215 volts 0-1.5 amps	90-300 volts 0-1.5 amps	115-325 volts 0-1.5 amps
AC Input	105-125 volts, 50-60 cps*, all models		
Regulation (line)	Better than 0.1% or 0.2 volts over entire input range		
Regulation (load)	Better than 0.1% or 0.2 volts for no-load to full load		
Transient Response	Output remains within regulation limits for step-function change of ± 10 volts in 105-125 volt input range Output remains within regulation limits for changes from no-load to full-load or full-load to no-load		

Low Voltage Supply Specifications

	PS4305	PS4315	PS4330
DC Output Range	0-36 volts 0-5 amps	0-36 volts 0-15 amps	0-36 volts 0-30 amps
AC Input	105-125 volts, 50-400 cps, all models		
Regulation (line)	Better than 0.025% or 3 mv over input range		
Regulation (load)	Better than 0.05% or 5 mv, no-load to full-load variation		
Transient Response	Output remains within regulation limits for line voltage steps of ± 10 volts within input range Output recovers in 100 usec for no-load to full-load or full-load to 10% load step changes.		

*400 cps available on order



6. Series 56—Padding potentiometer— $\frac{1}{4}$ " wide x $\frac{3}{16}$ " high x $1\frac{1}{2}$ " long. Available in many variations including various terminations.



1. Series 42—Over 2,000,000 produced since 1942—The standard of reliability.



2. Series SC42-970—Sine-Cosine potentiometer version of famous Series 42.



5. Series 57— $\frac{1}{2}$ " precision trimming potentiometer— $\frac{1}{2}$ " dia.—available with glass seal back cover.



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3. Series 55—10 turn potentiometer—available in 3 sizes— $\frac{7}{8}$ " dia., $1\frac{1}{2}$ " dia., and 2" dia.—winding molded to housing—shock-proof construction.



4. Series 54—The ultimate in precision—available in 5 sizes: $\frac{7}{8}$ " dia., $1\frac{1}{16}$ " dia., $1\frac{3}{8}$ " dia., 2" dia., and 3" dia.

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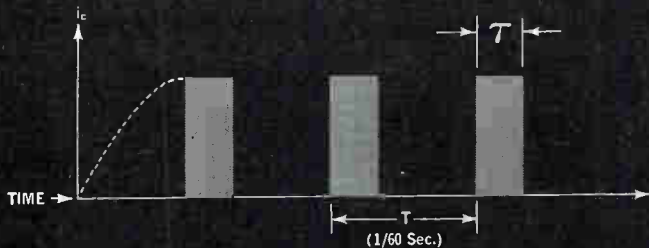
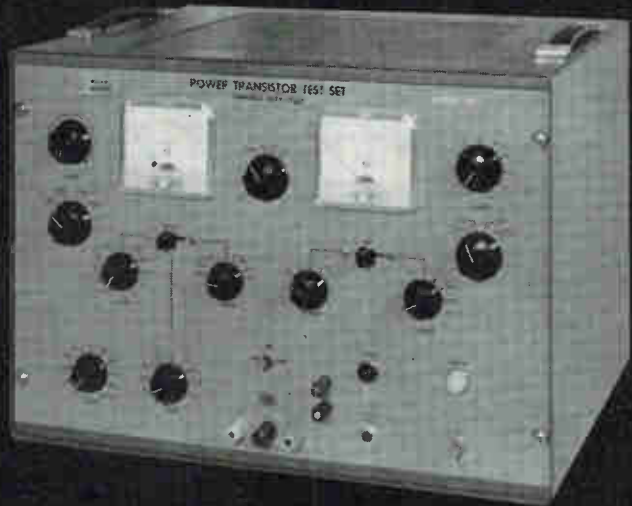
August 12, 1960

CIRCLE 113 ON READER SERVICE CARD

113

New B/A Model NC-1

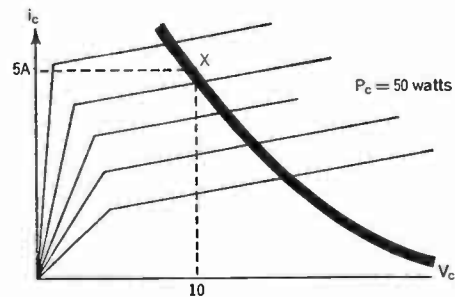
TESTS POWER TRANSISTORS BY VARYING DUTY CYCLE



- Minimizes heat sink requirements
- Puts less stress on the transistor
- Permits tests at very high power levels — 750 watts maximum power with maximum current of 50A or maximum voltage of 250V.

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 μsec. wide at 1/60 Sec. repetition, the average power is:

$$P = V_c I_c \tau / T$$

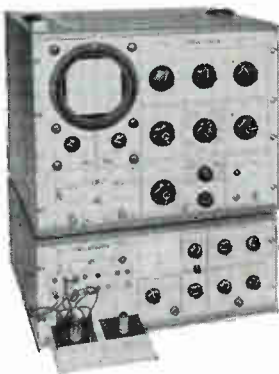
$$(10) (5) \frac{(100 \times 10^{-6})}{1/60} = 0.3 \text{ Watt}$$

The Baird-Atomic NC-1 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-1, tests are conducted under pulse conditions in the common emitter configuration — the meters present DC readings of V_{BE} , I_B , V_{CE} and I_C . The instrument also measures leakage current and floating potential by standard techniques.

CURVE TRACER MODEL MW-1

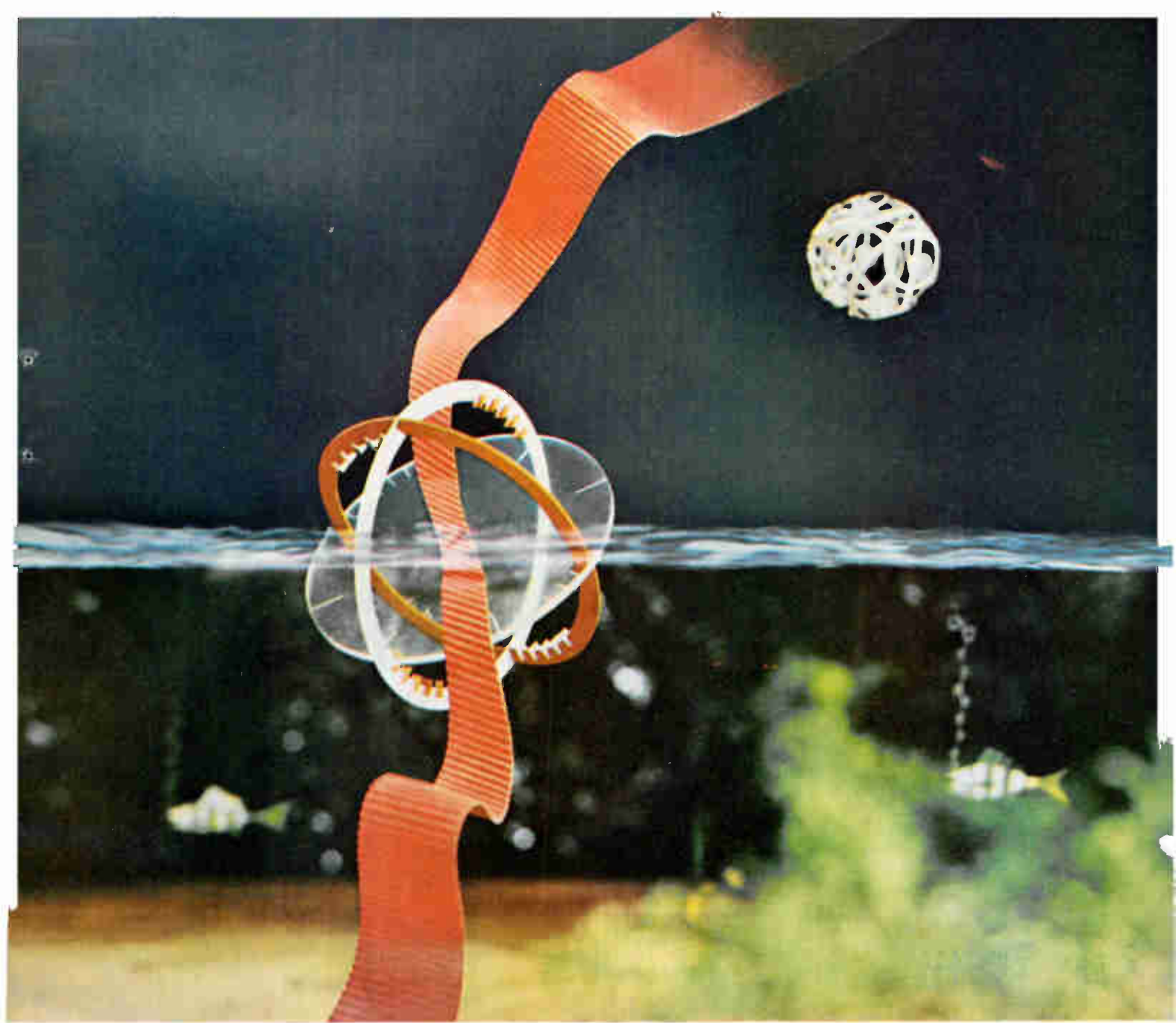
- Designed to display families of characteristic curves for PNP and NPN transistors — either common base or common emitter configurations.
- Both input and/or output current or voltage may be selected as components of the curves displayed.
- Operational range includes the highest maximum current (30 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.)



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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 versa-

tile 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.

Hipernas — and many other systems such as the Air Force GSN-5 and the Navy's SPN-10 All-Weather Automatic Landing Systems — typify Bell's capabilities in the broad field of electronics. This diversity of activities offers an interesting personal future to qualified engineers and scientists.



Avionics Division

BELL AEROSYSTEMS COMPANY

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HUGHES flat-face storage tubes, now available in quantity, enable you to increase display capability by a factor of 4. Display readouts are easier and more accurate because of the new picture clarity, sharper focus and finer detail provided by the optically-flat face and high light output of these new TONOTRON® Tubes from HUGHES.

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FEATURES:

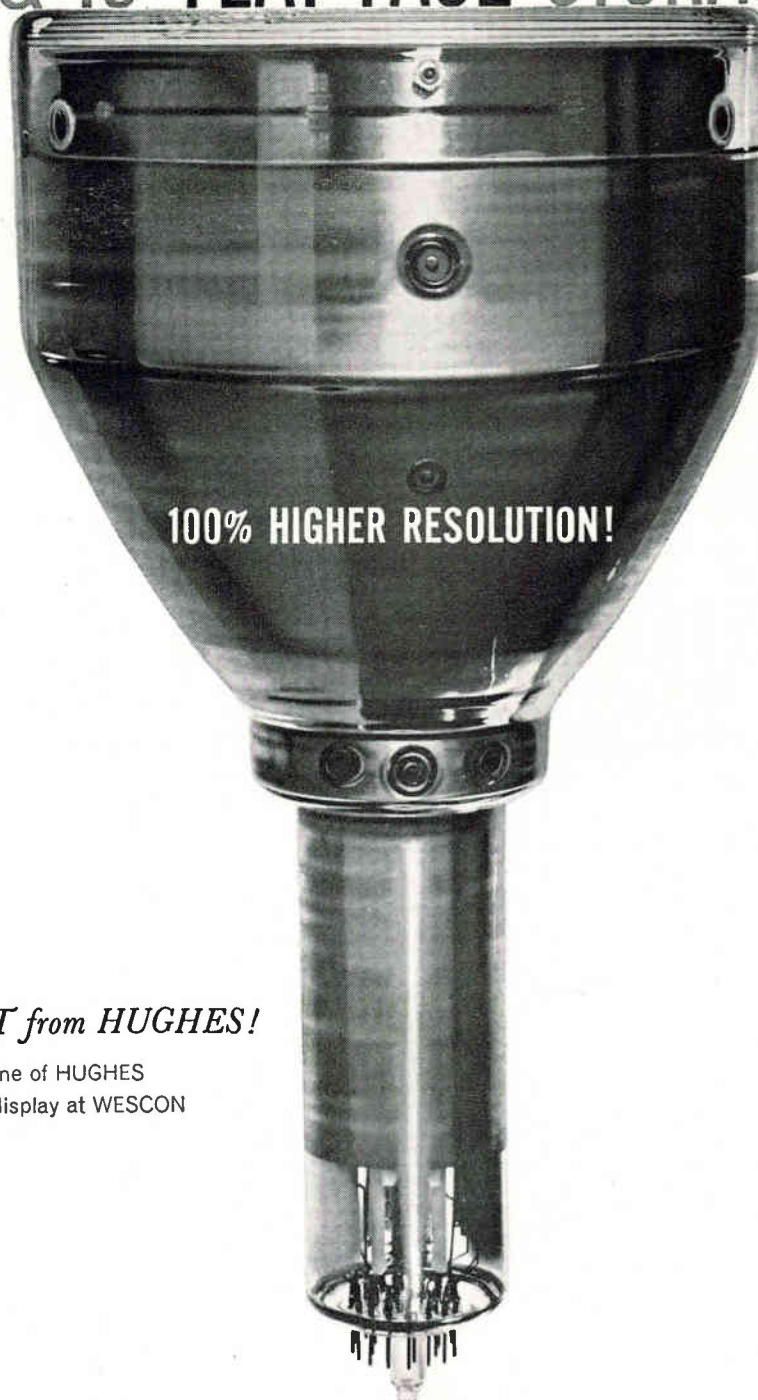
- Axial writing gun
- Electrostatic focusing
- Electromagnetic deflection
- P20 aluminized phosphor

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VACUUM TUBE PRODUCTS DIVISION

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Glass-to-Metal Seals for the Space Age...



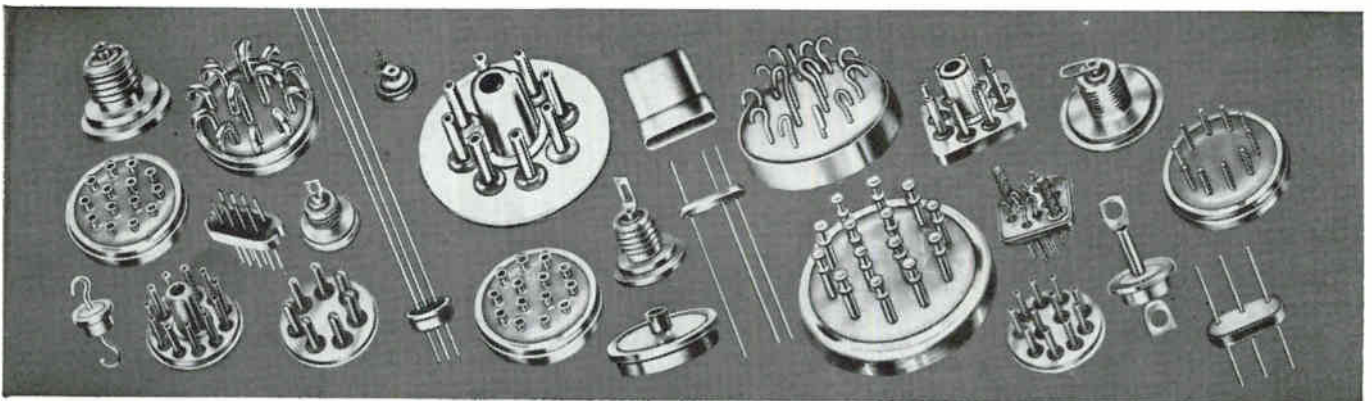
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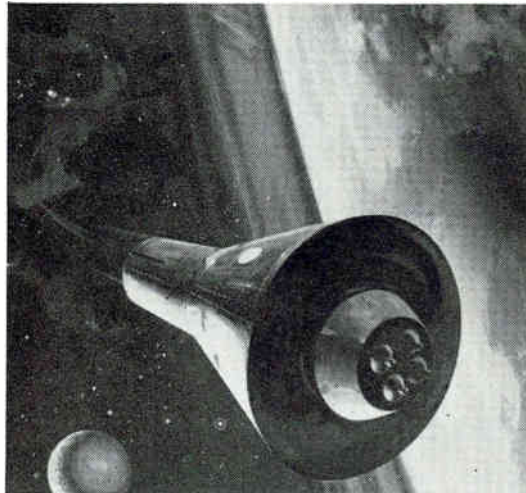


ELECTRICAL INDUSTRIES

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

A Division of Philips Electronics & Pharmaceutical Industries Corp.

Engineers Scientists... **HELP EXPAND
ELECTRONIC
FRONTIERS** at
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You are invited to join them . . . share in their pioneering knowledge in electronic research and development . . . use their extensive facilities . . . and help to do what has never been done before in electronics.

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.



COLLINS RADIO COMPANY
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PLAN NOW TO TALK TO A COLLINS REPRESENTATIVE AT THE WESCON SHOW

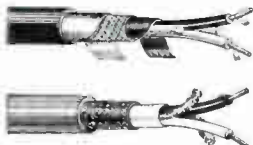
L. R. Nuss, Al Peachey and F. I. Aiken will be located at the Career's Inc. area in the Shrine Exposition Hall during the show. For a personal, confidential interview phone Richmond 6-1211 between 9 am and 9 pm.

NEW from Belden

for the WESCON SHOW

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Miniature Microphone Cables— Rubber, Plastic



No. 8413
Rubber

No. 8420
Plastic

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

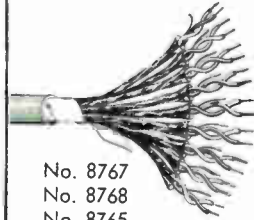
Miniature Broadcast and Audio Cables



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No. 8451

Occupy one-third to one-half space of standard cables. BELDFOIL® shielding gives high reliability with easy termination by utilizing the Drain Wire. 100% shielded against electrostatic fields.

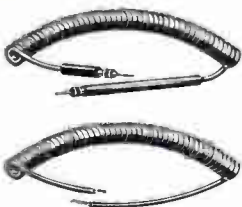
Multiple Pair Individually Shielded Cables



No. 8767
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No. 8765

Now available in 3, 6, 9, 11, and 15 pairs. Each BELDFOIL® pair provides 100% shielding and isolation of each pair. Lighter weight—smaller diameter.

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No. 8879

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Coiled 4 Conductor
Microphone Cable

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Ray Reading

Frank Timmons

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8-6-0

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(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.

**INTEGRAL-INTERLACE
(2000) SERIES**

INLINE (4000) SERIES

**GAP-MOUNTED®
(5000) SERIES**

**REDUNDANT
(6000) SERIES**

SIMPLIFY RELIABLE RECORDING SYSTEM DESIGN WITH...

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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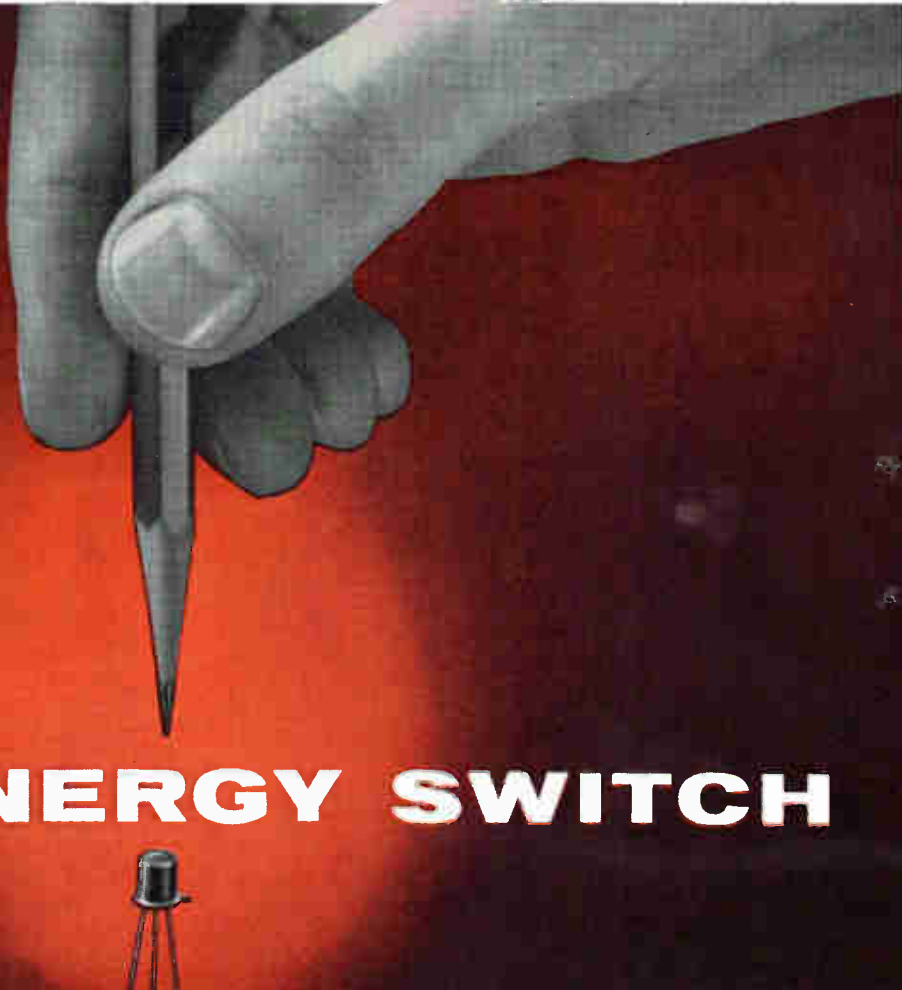
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ELECTRICAL CHARACTERISTICS						
	Designation	Description	Inductance (maximum)	Gap Length	Bias Current*	Record Current**
ANALOG	ARL	Low impedance record head. Used with transistor driver.	1.30 MH	.0005"	6 to 20 MA, up to 1 mc	0.7 MA 8db below saturation
	ARH	High impedance record head. Used with vacuum tube driver.	10 MH	.0005"	2 to 4 MA, up to 500 kc	0.2 MA 8db below saturation
	APH-ACH	High impedance playback head or combination record/playback head.	80 MH	.00025"	1 MA up to 60 kc	.09 MA
	ACL	Low impedance combination record/playback head for use up to 100 kc at 60 ips with 400 kc bias, or to 200 kc at 120 ips with 1 mc bias on half winding.	15 MH	.00025"	2.5 MA	0.1 MA
DIGITAL	DRL	Low impedance record head. Used with transistor driver. 12 volts single ended, or 6 volts double ended.	4.5 MH	.0005"	—	9 MA peak
	DRH	High impedance record head. Used with vacuum tube driver. Used as playback with DRL head.	55 MH	.0005"	—	3.5 MA peak
	DRP	Redundant record playback head.	18 MH	.0005" each	—	4 MA peak

*Depending on bias frequency and channel spacing.
 **Analog—8db below saturation for minimum distortion.
 Digital—for 130% saturation at 200 flux changes per inch, 60 ips.

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This new micro-energy switch is of great importance in the design of ultra-reliable, high density, high speed equipment. In micro-energy circuits, the total device dissipation is reduced to an absolute minimum . . . 250 microwatts . . . a prime consideration in achieving maximum reliability. The T-1930 is an important step toward microminiaturization . . . permitting high packing densities without excessive internal heat generation. For complete information write Dept. E-81260.

T-1930 . . . MICRO-ENERGY SWITCH . . . TO-18 CASE

MAXIMUM RATINGS

Storage Temperature 100° C
Total Device Dissipation at 25° C . . . 35 mw

CHARACTERISTICS

	MIN.	TYP.	MAX.
DC Current Amplification Factor, h_{FE} ($V_{CE} = -0.20$ v, $I_C = -2$ ma)	25	40	
Collector Voltage, V_{CE} ($I_C = -2$ ma, $I_B = -0.2$ ma)		.095	.13 V
Gain-bandwidth Product, f_T ($V_{CE} = 1$ v, $I_C = 1$ ma)	125	175	mc/s

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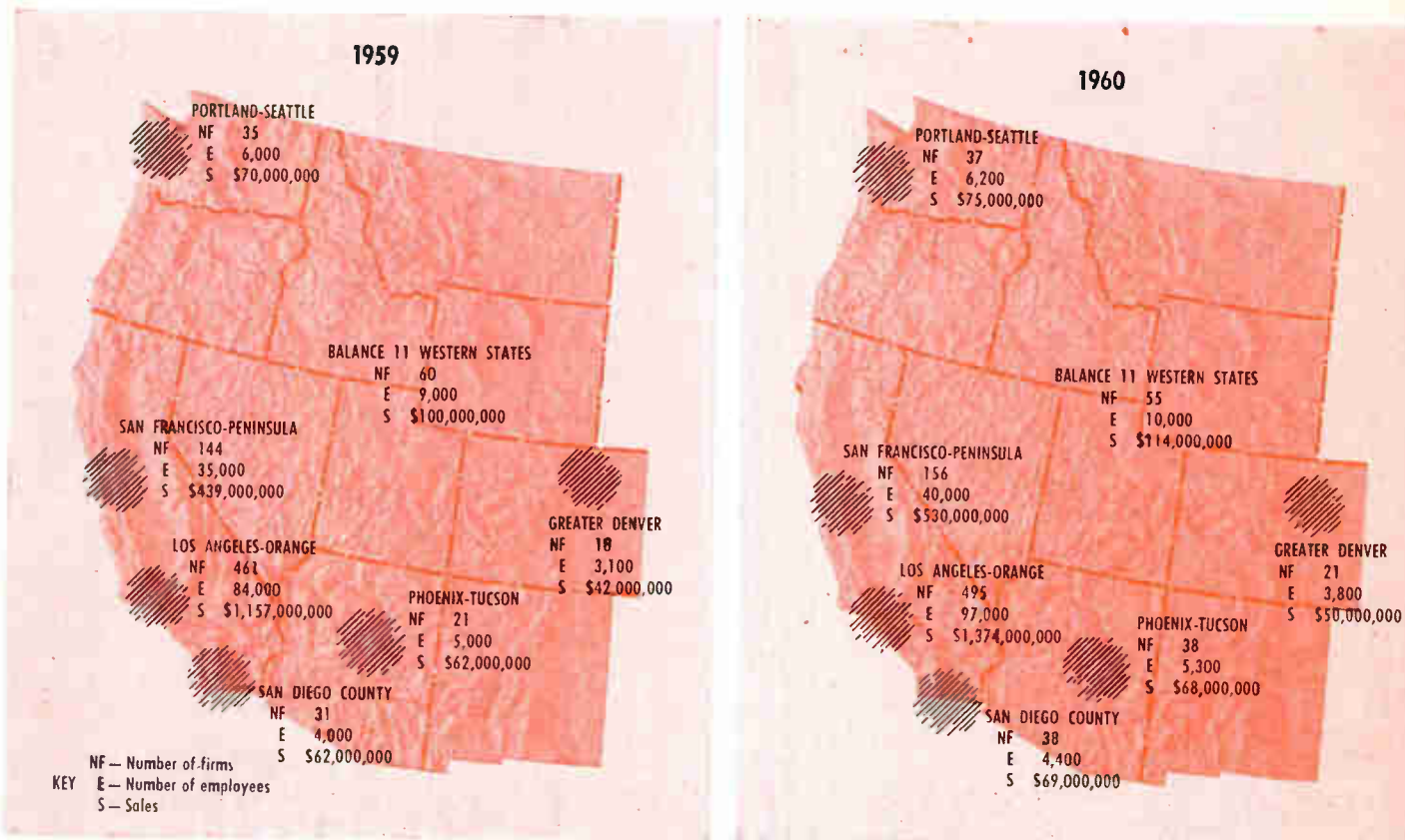
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Sales for this year are up over 1959 in west's six key electronics centers

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.

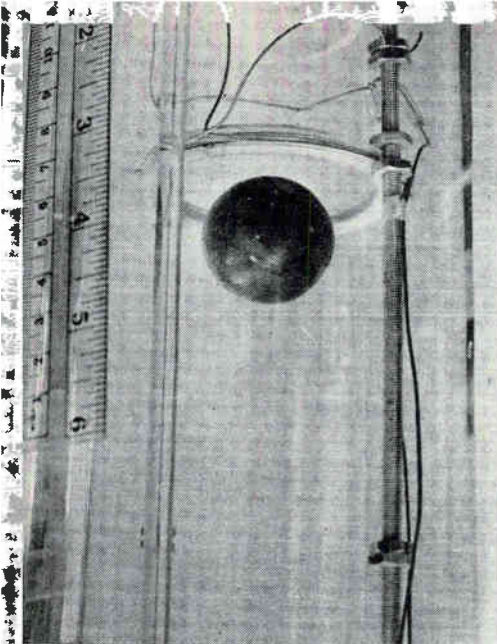
Latest figures from 759 companies in the eleven western states puts combined dollar volume at just over \$2 billion (excluding broadcast and service revenue), or 22 percent of the nation's total electronics industry. Employment by latest count is 155,000 with 93,000 people working in the metropolitan 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



Experimental cryogenic gyroscope at CIT's Jet Propulsion Lab



Half-inch-square synthetic ruby maser at tip of copper transition section held above 12-oz magnet by T. H. Maiman of Hughes Aircraft

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 -452 F 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

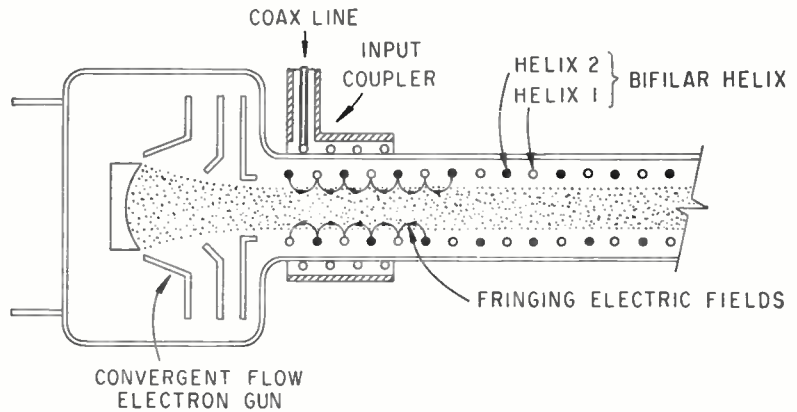
Pioneer V. Developers of the isolator claim it is adaptable to wide-band, low-power applications where minimum size and weight without sacrifice of performance are essential.

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 e-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



Gun and input region of Watkins-Johnson electrostatically focused traveling-wave tube

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



Prof. Von R. Eshleman and Lt. Col. R. C. Barthle inspect 40-Kw Collins transmitter that sent radar signal to sun and back in Stanford University experiment



Doughnut-shaped artificial neuron by Ford's Aeronutronic division duplicates human nerve

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 supplementary 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. Storage 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. Nonreciprocal 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 0.6 db or less and the isolation between uncoupled ports is 25 db or greater. The circulator can be switched in less than 0.5 μ sec.

Also reported are results when permanently magnetized ferrite toroids have been used in waveguide T and coaxial geometrics. (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 broader 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 metallic 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 scavenge oil line of the engine. Minimum size of bearing flakes 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.

flux 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 Co⁶⁰ 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 of 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 a *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 technique 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, *pnpn* 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 16½ 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 echos from back-

ground 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 nondes-

tructively 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 Bix 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



Miniaturized instruments accomplish simultaneous recording of body functions for Boeing bioscientists

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 Cal-Tech 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 crosstalk 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. ELSKEN,

Western Regional Research Laboratory,
Albany 10, Calif.



Physical layout of complete temperature-sensitive transmitter (left); a transmitter is readied for operation with its temperature-sensing probe inserted in an adjacent carton of strawberries (right)

IN THE PAST FEW YEARS, considerable work has been done here on the relation between food handling practices and frozen food quality^{1, 2}. 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 others³ 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.⁴ 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

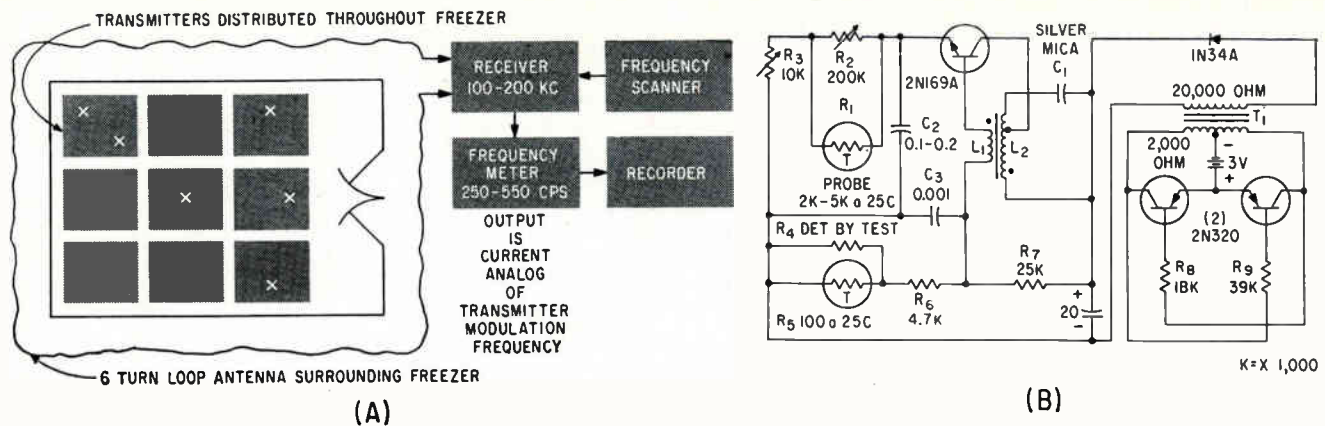


FIG. 1—Receiver pickup embraces whole storage area containing fruit (A); battery voltage is stepped up by converter to a more convenient level, and transmitter quench rate is governed by sensing thermistor (B)

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-traffic density 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 R_1 , R_2 , R_3 and C_3 , self-modulation or quenching action is obtained. Variation in quench rate is accomplished with R_1 . This is the temperature sensing element and consists of a glass-enclosed bead insertion-type thermistor. Thermistor R_1 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 T_1 , 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 constant⁶. 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_1 and L_2 on a flat ferrite strip. The ferrite core also brought the physical size of L_2 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-stacked, the can ends may approach within $\frac{1}{4}$ inch of the ferrite core of the transmitter coil. The effect could be minimized only by a trial-and-error method of adjusting L_1 to L_2 cou-

pling, number of turns, and the collector tap point.

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Since the operating point of the 2N169A transistor had a tendency to shift with temperature⁷, stabilization through use of thermistor R_3 and shaping network R_4 and R_5 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 co-

efficients, 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 from 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 three 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 operation⁷. 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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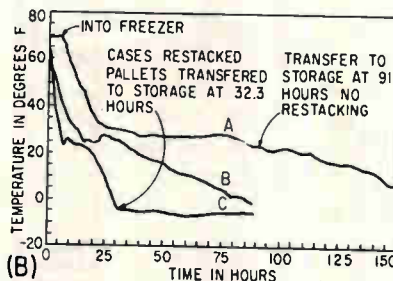
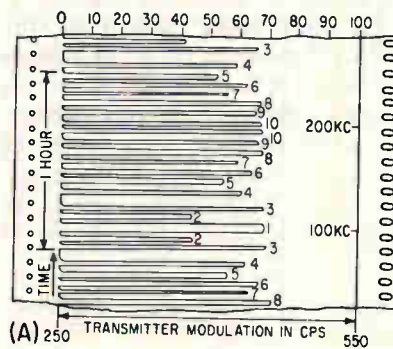


FIG. 2—Sample of strip chart shows responses from ten transmitters (A); temperature-time graph shows overall operation (B)

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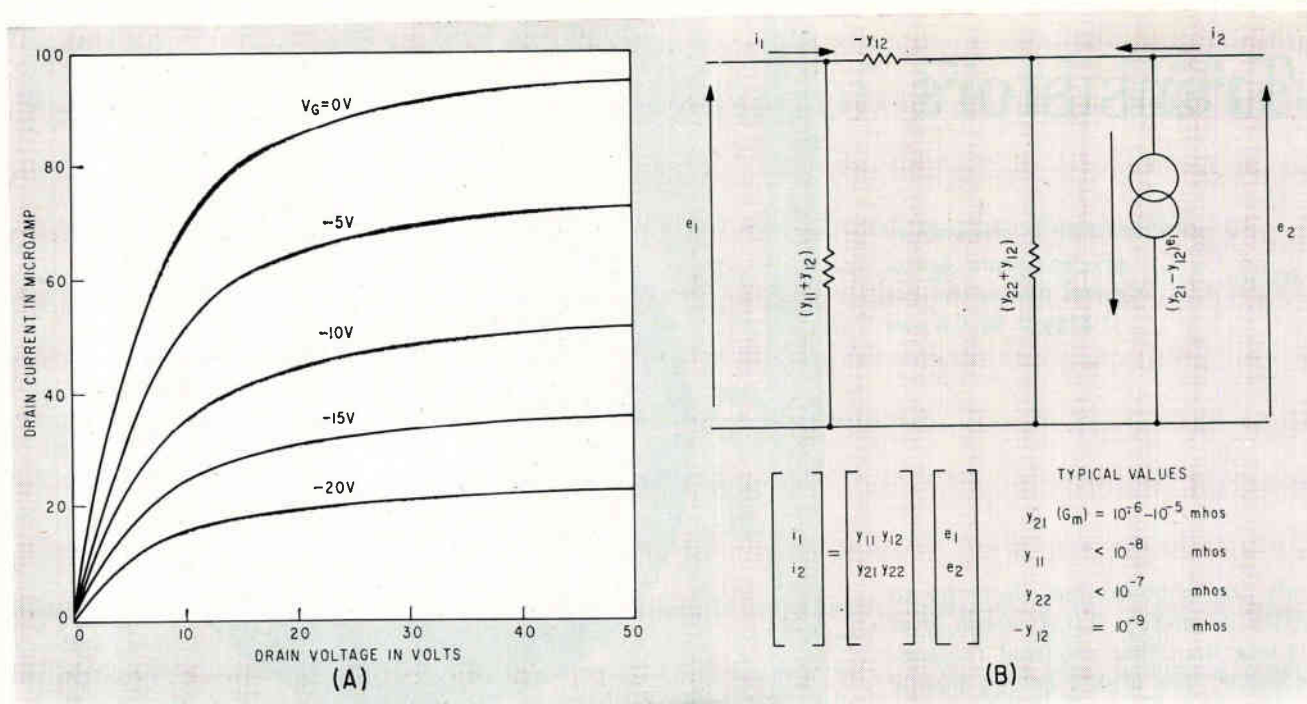


FIG. 2—Characteristics (A) are for common source connection and incandescent illumination of 100 ft-candles. Equivalent circuit (B) is similar to that for pentode

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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.

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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.

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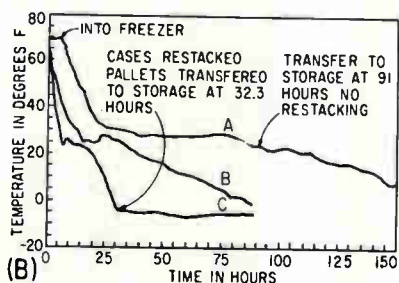
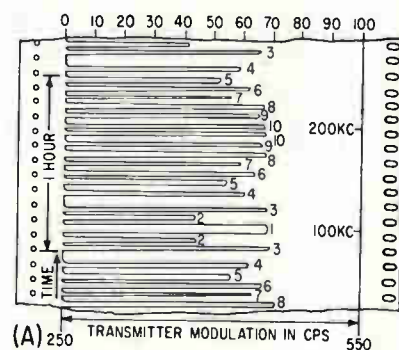


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Circuit Applications of Field Effect

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

By R. R. BOCKEMUEHL, General Motors Research Laboratories, Warren, Mich.

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 new², 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) surface 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 is 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 removed.

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

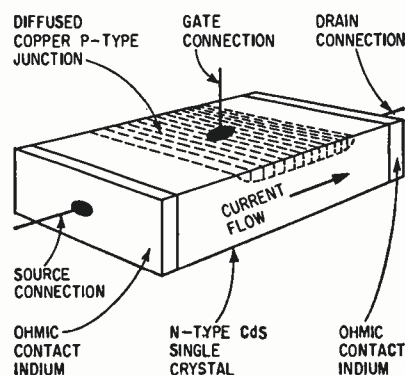
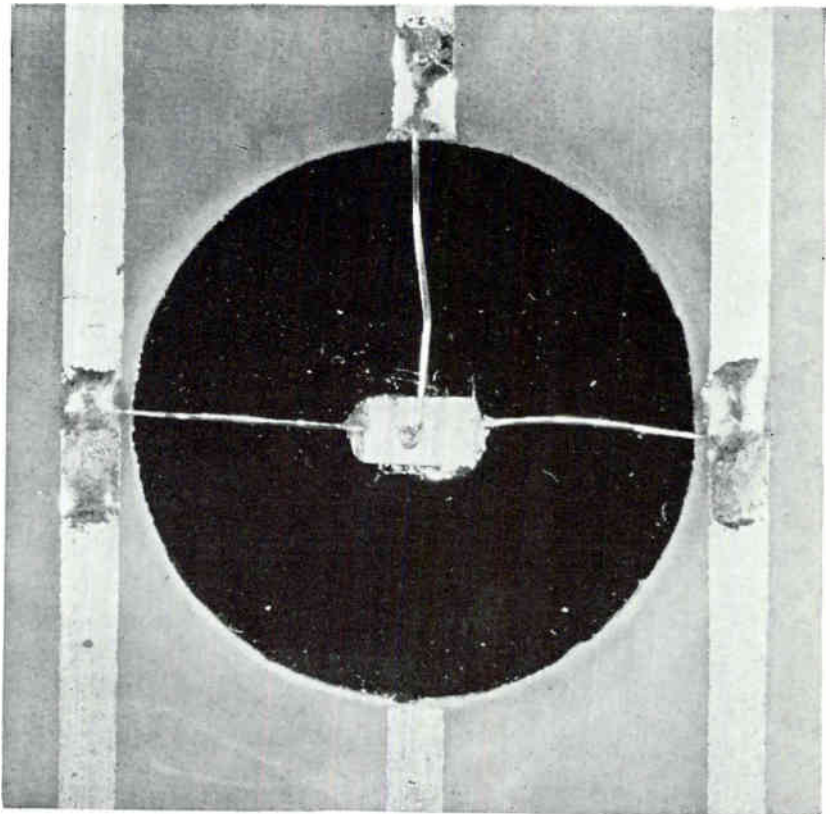


FIG. 1—Transistor is made by forming contacts on a crystal of CdS

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 conduction². 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^{1, 3} 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_{12} . As in junction transistors, a finite y_{12} 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

Device Comparison

	CdS-FET	Junction Transistor	Vacuum Triode	Vacuum Pentode
Mutual Transconductance (megohms)	10^{-5}	10^{-2}	10^{-3}	10^{-3}
Voltage Gain (open circuit)	10^2	10^3	10	10^3
Current Gain (short circuit)	10^2	10^2	10^3	10^3
Power Gain (matched load)	10^3	10^4	10^4	10^5
Input Resistance (ohms)	10^8	10^3	10^6	10^6
Output Resistance (ohms)	10^6 to 10^7	10^4 to 10^5	10^4 to 10^6	10^6
Quiescent Voltage	10^2	10	10^2	10^2
Quiescent Current	10^{-4}	10^{-3}	10^{-2}	10^{-2}

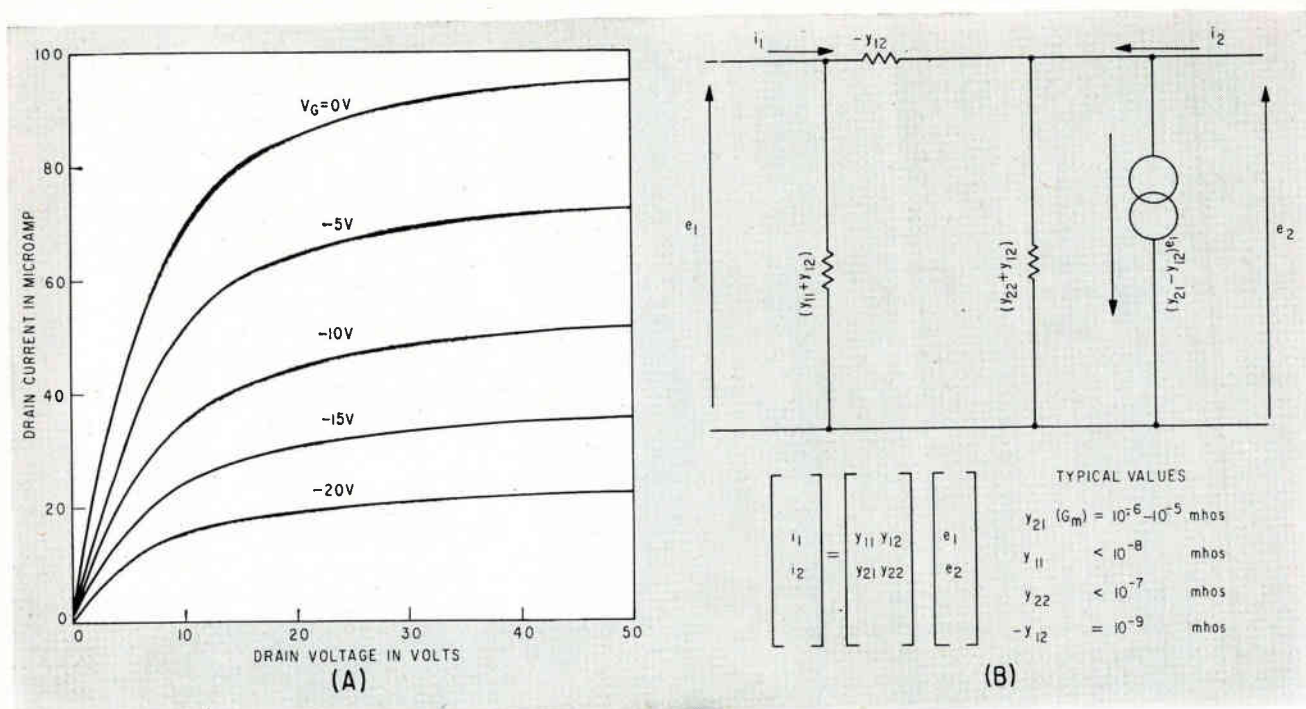


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The upper frequency limit of the transistor is imposed by the dielectric relaxation time, characterized by its dielectric constant and conductivity. Illumination determines the conductivity and therefore influences the upper frequency limit. Typical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

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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.

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Figure 3A illustrates a relaxation oscillator. The sawtooth output voltage is linear because of the

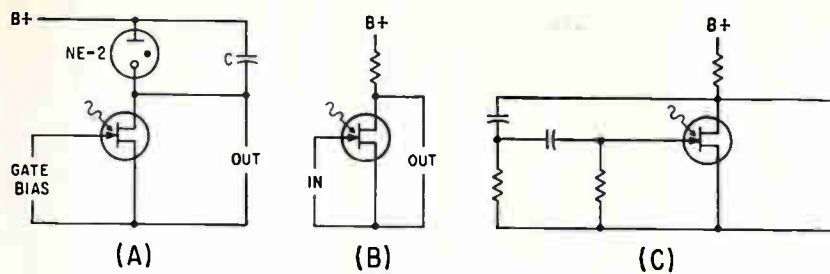


FIG. 3—Typical applications include linear sawtooth generator (A), basic amplifier (B) and phase-shift oscillator (C)

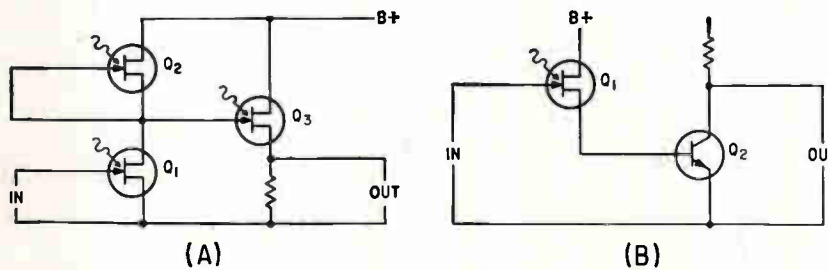


FIG. 4—Output impedance of (A) is reduced by using third transistor. Combination (B) is similar to vacuum triode

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 $0.001\text{-}\mu\text{f}$ 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_2 serves as the load for amplifier Q_1 . The output impedance of the $Q_1 - Q_2$ 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^{-3} mhos. The four-terminal characteristics of this combination are similar to those of a vacuum triode.

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ANALOG MULTIPLICATION

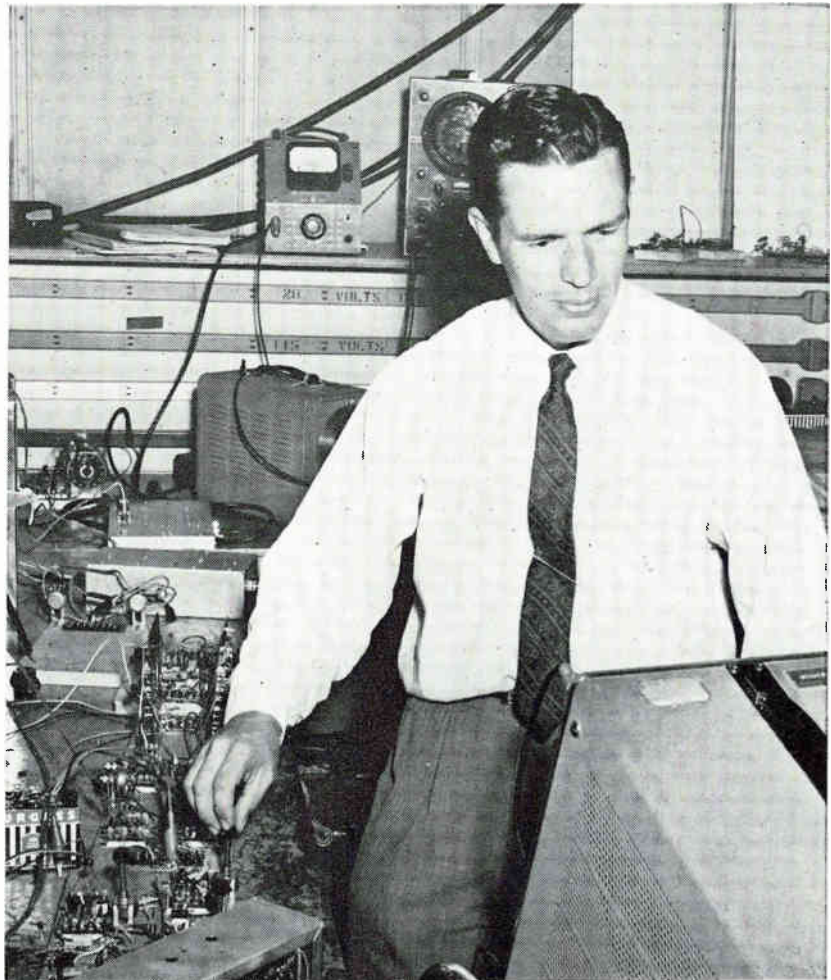
ELECTRONIC analog multiplication means have long been difficult. Methods capable of high accuracy have required extensive and complex circuits^{1, 2, 3}.

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_1 . The voltage is shown in the polarity that would be used to bias Q_1 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_1 conducts and the output is grounded. Solution rate $1/T_n$ must be high compared to rates of change of X and Y to enable the product to follow changes in the variables.

When Q_1 conducts, output voltage V_o differs from ground by the small drop (V_{ce}) across the saturated transistor. When Q_1 is cut off, V_o differs from X by the drop caused by transistor leakage current (I_L) flowing through R_c . The output waveform is shown in Fig.



Circuits perform satisfactorily at room temperatures

1B, related in time to the base gating waveform. The average value of V_o would be exactly proportional to XY if both V_{ce} and I_L were zero.

The voltage V_{ce} during the saturated interval depends on the normal and inverted current amplification factors a_n and a_i , base drive current I_b and collector current I_c . These quantities are related by

$$V_{ce} = \frac{KT}{q} \ln \left\{ \frac{\alpha_i [1 - (I_c/I_b)(1 - \alpha_n/\alpha_n)]}{1 + (I_c/I_b)(1 - \alpha_i)} \right\}$$

where a_n is grounded-base d-c current gain, a_i is inverted grounded base d-c current gain, I_c is collector current, I_b is base current and KT/q equals 0.026 volt at room temperature (300 K).

Regard V_{ce} as being made up of two components—a d-c part present

even when $I_c = 0$, and a dynamic resistance drop $I_c R_d$, where $R_d = dV_{ce}/dI_c$.

With this concept in mind, several general trends may be observed. Some of these trends are: V_{ce} decreases as the a 's increase, both the d-c part and the dynamic drop decrease; V_{ce} decreases if base drive is increased, the dynamic drop is reduced in this case; and V_{ce} varies linearly as I_c varies with a slope that is R_d .

If the transistor is used in inverted connection the same relationship for V_{ce} applies. But a_n and a_i are interchanged and I_c becomes I_e . Here the d-c component of V_{ce} will be smaller (because a_i is less than a_n), 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

By T. R. HOFFMAN, Engineering Consultant, General Electric Co., Schenectady, N. Y.

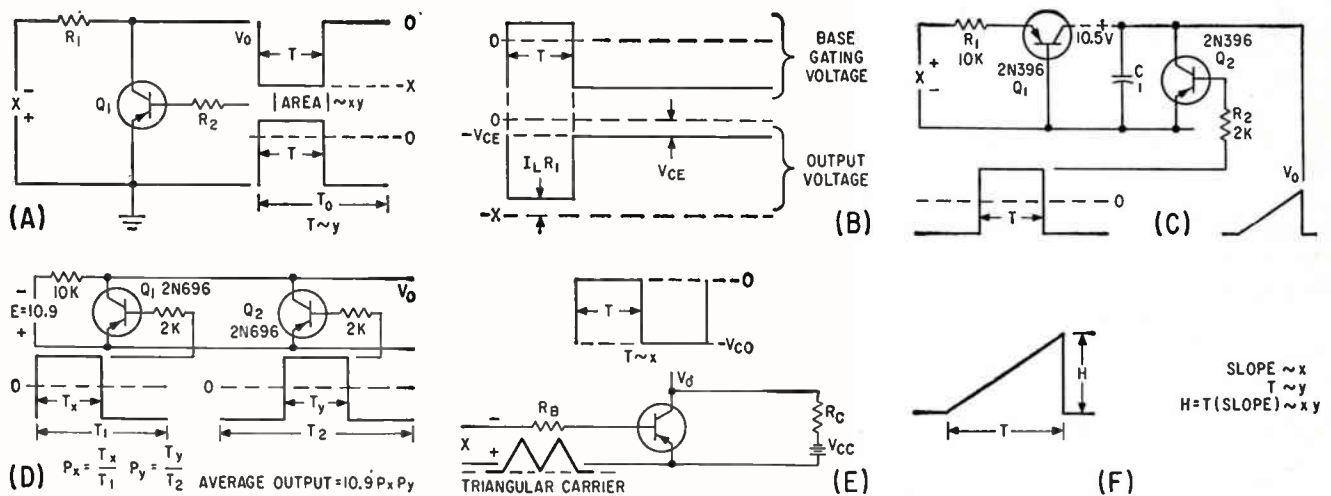


FIG. 1—Rectangular multiplier (A) and error signals found (B). Triangle multiplier (C) with its theoretical relationship (F). Probability multiplier (D) is a form of and gate while the pulse-width modulator (E) converts an analog signal voltage to a proportionate time interval

curves of V_{ce} plotted against X for a 2N396 germanium transistor in the circuit of Fig. 1A are shown in Fig. 2. These curves were obtained by replacing Q_1 base-gating waveform by a battery poled such that the Q_1 base-emitter junction was forward-biased. This simulates the worst possible condition of error due to V_{ce} . It is the case $Y = 0$.

The general trends are illustrated by Fig. 2. Some conclusions are: to minimize error due to V_{ce} high α 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-gating waveform without breaking down.

When Q_1 is cut off, leakage current I_L depends upon α_n , α_i and I_{co} (or I_{cs} in the inverted connection). Leakage current can be made small than I_{co} by reverse-biasing the base-emitter junction during the cut-off interval. The expression is

$$I_L = I_c = I_{co}(1 - \alpha_i)/(1 - \alpha_n \alpha_i)$$

Since both α_n and α_i are less than one, this represents a current less than I_{co} . If the transistor is in-

verted, so that α_n and α_i are interchanged and I_{co} becomes I_{cs} , 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_L 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_{co} 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_{cc} and I_L 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_1 during the time interval in which Q_2 is cut off. To the extent that Q_1 collector current is proportional to signal voltage X , the maximum triangle height H will be proportional to XY . When Q_2 is on, C is shorted and output voltage is zero. As in the rectangle method

$$H = 1/C \int_0^T i_c dt = I_c T/C \sim XY$$

the solution rate $1/T_0$ 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_1 and T_y/T_2 ; T_1 and T_2 are uncorrelated (frequencies $1/T_1$ and $1/T_2$ 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_1 , then the peak of the output voltage V_o will be proportional to X , with a proportionality constant depending on R_1 , C and the constant emitter voltage; V_o then becomes the input (instead of the constant voltage) for a second stage R_1 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 $AX + BX^2 + CX^3 + \dots$ 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.

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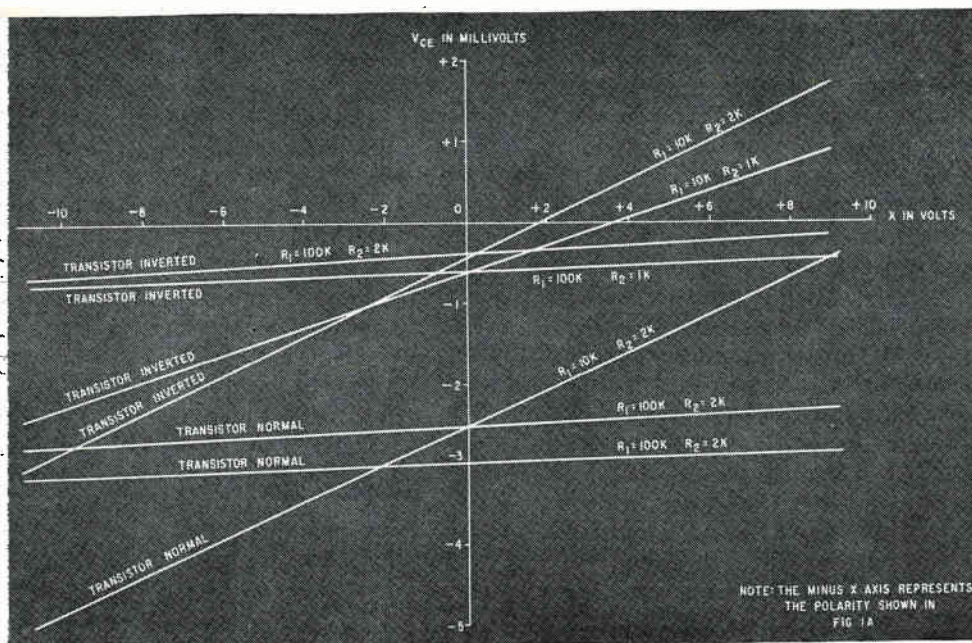


FIG. 2—Changes in V_{ce} plotted against X for a 2N396 transistor operating in the circuit configuration of Fig. 1A

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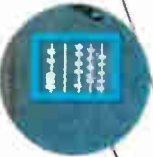
WEIGHT



VOLTAGE



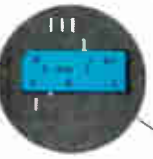
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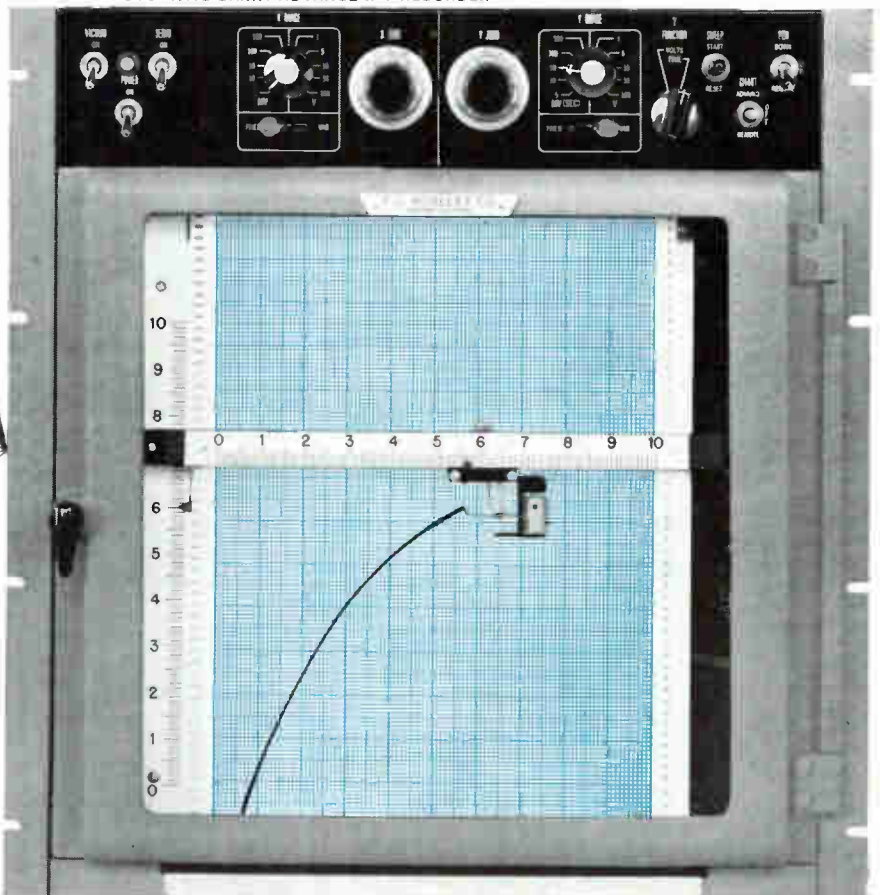
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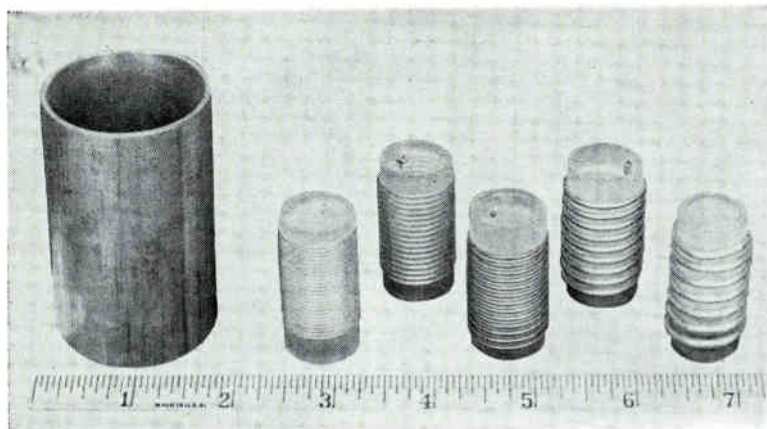
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Helical Resonator Design Chart



Helical resonators. Coils, from left to right: $f_o = 55$ Mc, $Q_u = 600$; $f_o = 78$ Mc, $Q_u = 720$; $f_o = 101$ Mc, $Q_u = 840$; $f_o = 145$ Mc, $Q_u = 880$; $f_o = 215$ Mc, $Q_u = 1,000$. Shield inside diameter = 1.63 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,

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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 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 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 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

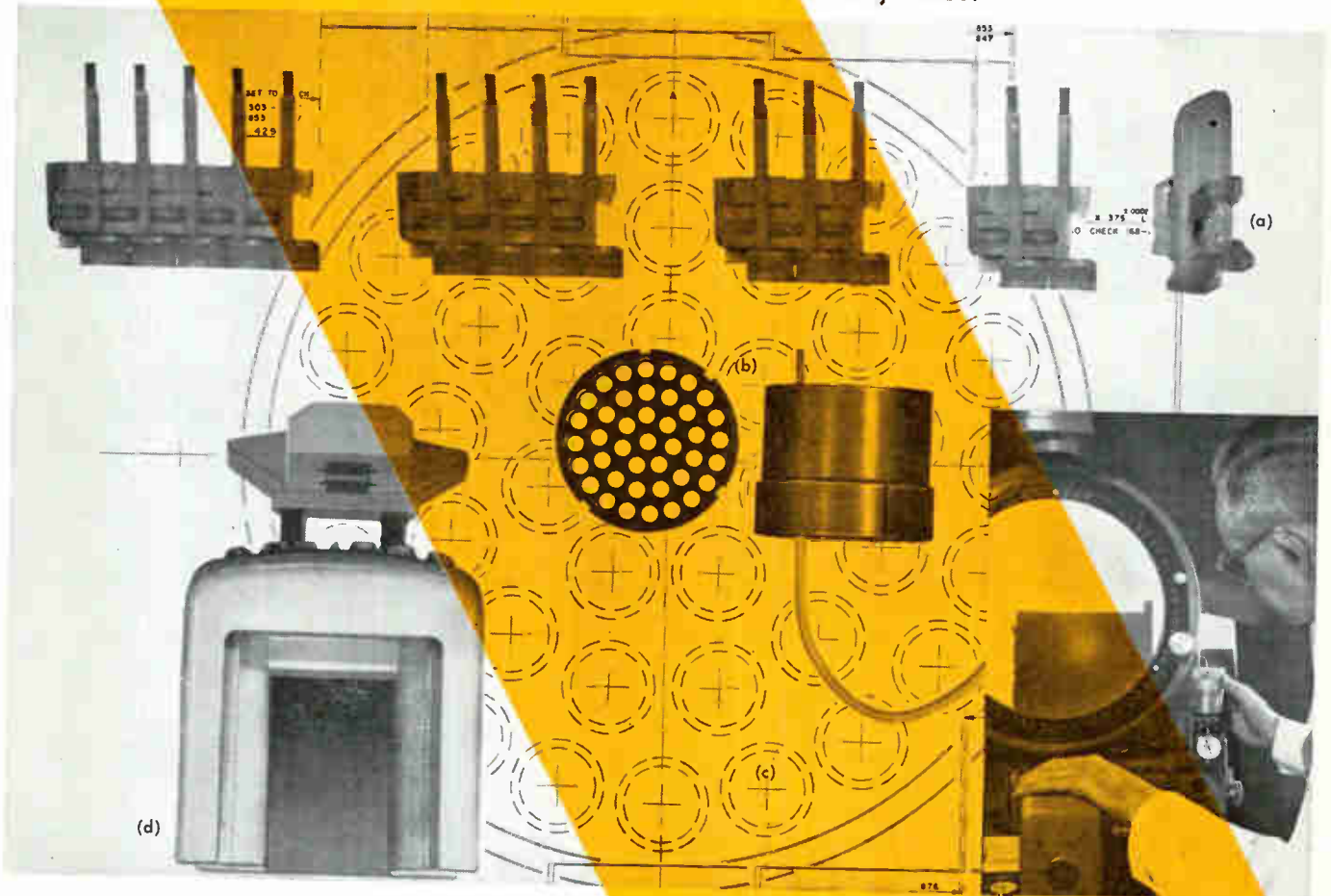
$$Q_u = 50Df_o^{1/2} \quad (1)$$

where f_o = 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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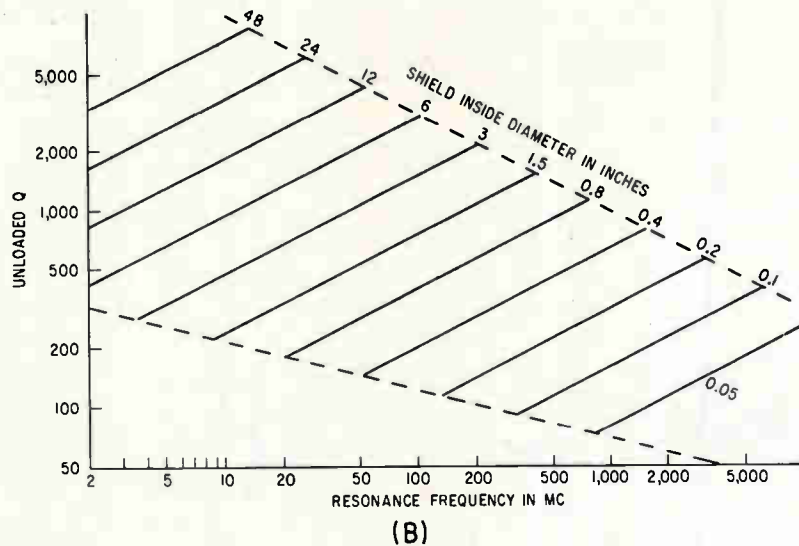
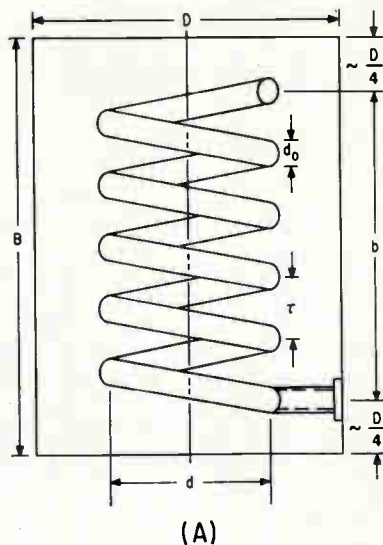


FIG. 1—Outline of helical resonator (A), and size of resonator (B) for given frequency and unloaded Q

under which Eq. 1 holds are $0.45 < d/D < 0.6$; $b/d > 1$; $0.4 < d_0/\tau < 0.6$ at $b/d = 1.5$; $0.5 < d_0/\tau < 0.7$ at $b/d = 4$; $d_0 > 5$ times skin depth; and $B \geq b + D/2$; where $B =$ inside length of shield, $b =$ axial length of coil, $d =$ mean diameter of turns, $d_0 =$ diameter of conductor, and $\tau =$ center-to-center spacing of turns.

The total number of turns, winding pitch (reciprocal of turns per inch) and characteristic impedance, for air dielectric between coil and shield, are

$$N = 1,900/f_0 D \text{ turns} \quad (2)$$

$$\tau = 1/n = D^2 f_0 / 2,300 \text{ inches} \quad (3)$$

$$Z_0 = 98,000/f_0 D \text{ ohms} \quad (4)$$

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 winding are approximately: electrical length = 94 percent of axial quarter wavelength = 84.6 electrical degrees; fringing capacitance = $0.15 D \mu\mu f$; and conductor 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 correspond to the two dashed lines bordering the plotted region on Fig. 1B. The upper limit lies within the region where a straight coaxial type should be compared to the helical type. As the frequency and Q increase beyond this limit, the straight coaxial type requires less volume than the helical type. Shape will influence the choice, the straight type being longer and more slender than the helical. An excellent 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 resonator. 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 required. 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 values 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 between 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-section 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 $1\frac{3}{4}$ by $1\frac{3}{4}$ (outside) brass tubing with 0.051 inch wall. (The inside surface of the shield and the coil conductor are plated.) The required 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 conductor and the coil is two inches long. Measurement on this resonator indicates unloaded Q of nearly 1,000, which is higher than predicted. The measurement is made by determining the bandwidth with extremely weak coupling to the measuring gear.

Example III: A resonator is

shown
actual
size



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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 section, 1 inch on each side (equivalent 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 $\frac{3}{8}$ inch diameter form, with one inch winding length. The chart gives $Z_0 = 350$ ohms. The capacitor values are computed by transmission-line equations. Under design equations, electrical length of the resonator is about $\theta = 84.6$ deg. Reactance looking into a short-circuited line is: $X = Z_0 \tan \theta = 350 \tan 84.6 \text{ deg} = 3,750$ ohms.

This is equal to the negative of the reactance of the fringing capacitance, which is: $C = 10^9 / 2 \pi f X = 10^9 / 2 \pi (240) (3,750) = 0.18 \mu\text{mf}$. Now, at 174 Mc, θ

$= 84.6 (174/240) = 61.5$ deg. By computation like that above, this requires $C = 1.4 \mu\text{mf}$. Similarly, at 148 Mc, $\theta = 52$ deg and $C = 2.4 \mu\text{mf}$. When the fringing capacitance is deducted, the required trimmer range is a little wider than 1.2 to 2.2 μmf . The unloaded Q computed by Eq. 1 is 790 at 174 Mc and 730 at 148 Mc.

Example IV: Design a resonator 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 unloaded Q of about 2,000 has been achieved. For comparison, a coaxial transmission-line resonator can be designed as shown

in Ref. 2. Use optimum ratio of conductor radii, $b/a = 3.6$. Derate the Q by 10 percent to allow for surface imperfections (as has been done in the Q formula for the helical type). Then, with f_0 in megacycles and inner diameter of outer conductor, D_c in inches: $Q_u = (0.9) (84) (0.5) (2.54) D_c f_0^3 = 96 D_c f_0^3$. Then, for $Q_u = 2,000$ and $f_0 = 400$ Mc, the outer conductor diameter is $D_c = 1$ inch. The length is almost quarter wavelength, plus a little for clearance at the open-circuited end, or about 8 inches. The volume of either type of resonator is proportional to diameter squared times length. Thus the approximate volume ratio is: (transmission line)/(helical) $= \frac{3}{8}$. However, the shape factor is one by eight inches for the transmission-line type against two by three inches for the helical type, which may favor one or the other

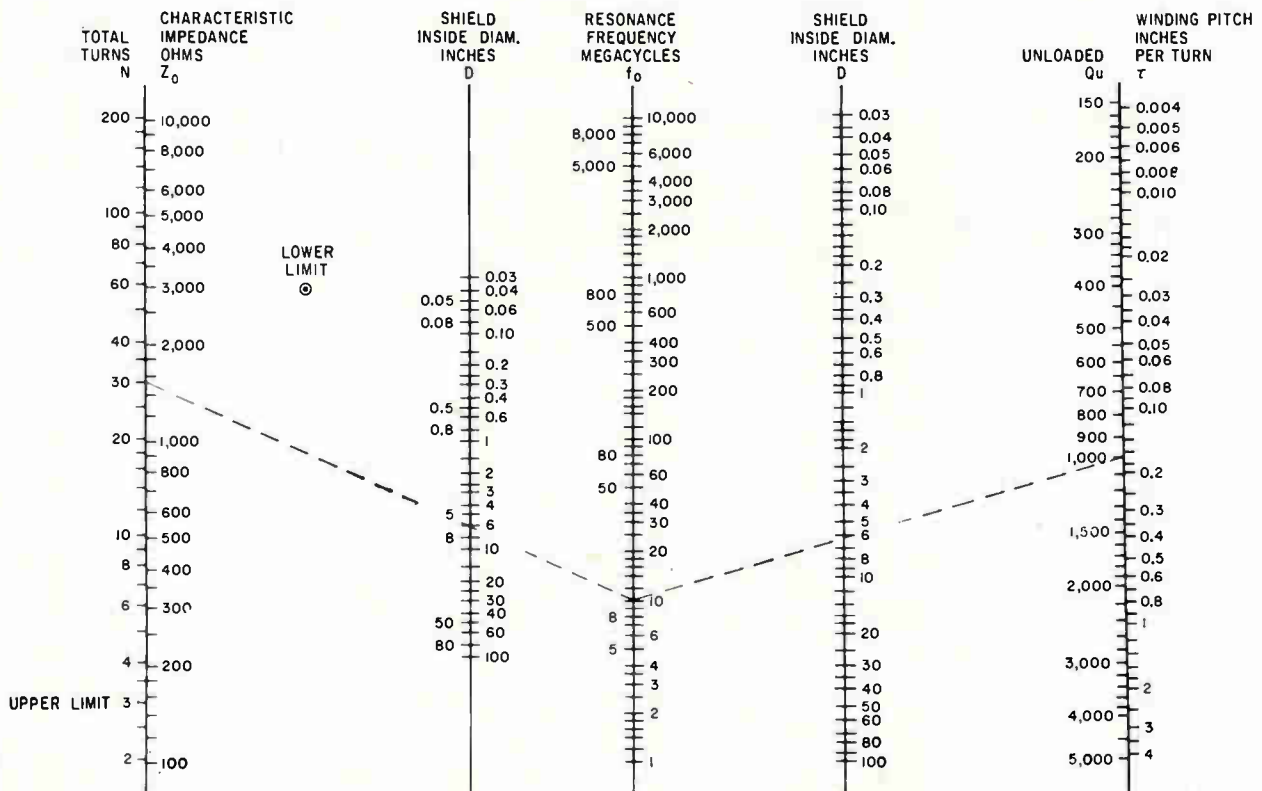


FIG. 2—Design chart for quarter-wave helical resonators. Dashed lines indicate example of chart's use

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3-Wheel

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

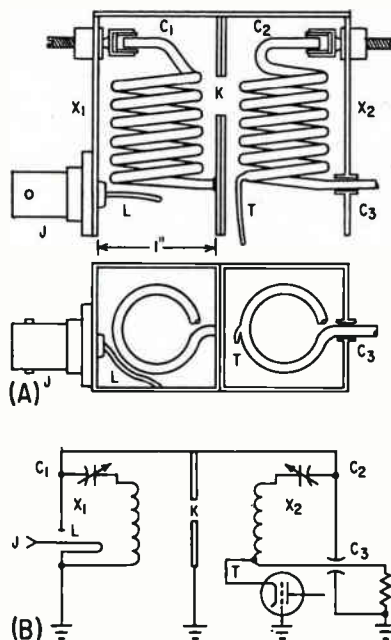


FIG. 3—Pair of helical resonators, side and bottom views (A), and application of resonators to input end of vhf amplifier (B)

of the loop should be perpendicular to the coil axis and only a small distance above the bottom of the coil. For resonators of few turns, the loop plane can be tilted parallel to the slope of the adjacent coil conductor. Some details of coupling and other application problems are illustrated in Fig. 3A and 3B.

Figure 3A shows a pair of helical resonators, each like that described in Example III. A schematic diagram, Fig. 3B, illustrates the application of the resonators to the input end of a vhf amplifier. The left-hand resonator coil X_1 is terminated at the bottom end in a low-re-

sistance soldered joint to the shield. The low-loss capacitor C_1 at the top end trims the resonance frequency to the assigned channel.

A commercial ceramic capacitor of about $3 \mu\text{mf}$ 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_2 and its trimming capacitor C_2 are similar to the above. Instead of soldering the lower end of the coil to the shield, it passes through by a $1,000 \mu\text{mf}$ ceramic feed-through capacitor C_3 . 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 .

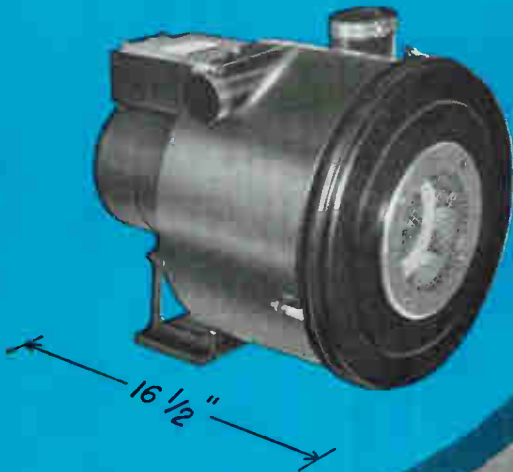
Formulas and other information on the performance of resonators are found in various texts.³ Equations 1-4 on which the electrical design chart is based can be derived by analogy of the resonator to a section of coaxial transmission line.¹ This can be done even though it does not function in a TEM mode, 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.

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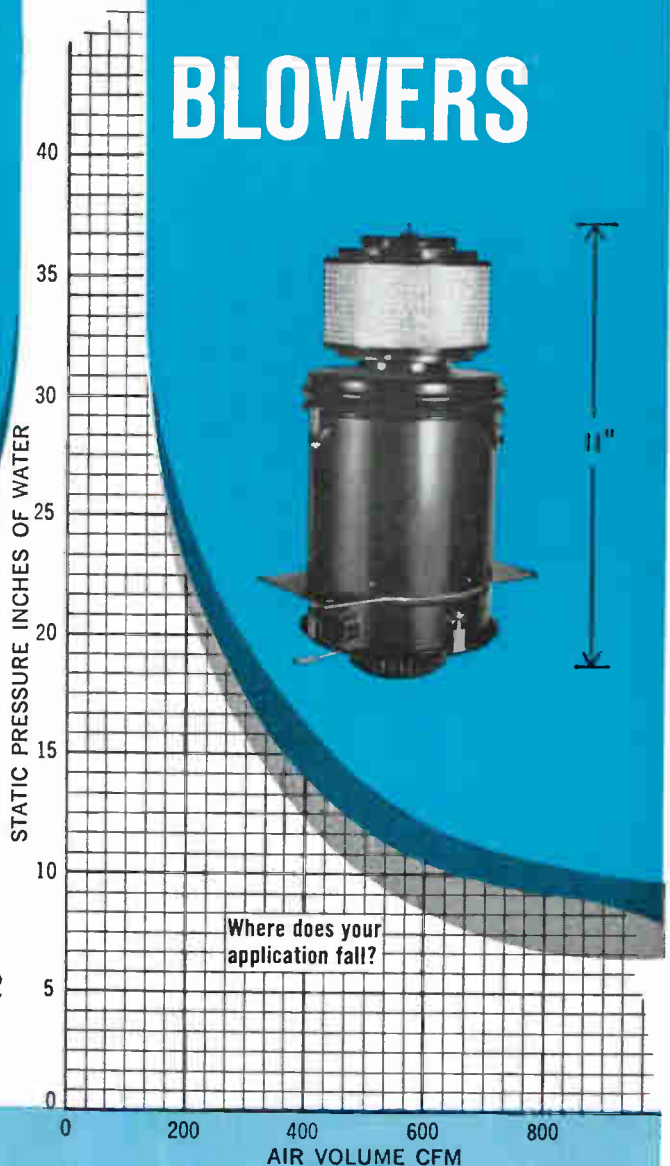
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Wind-Energy Convertors Provide High Power

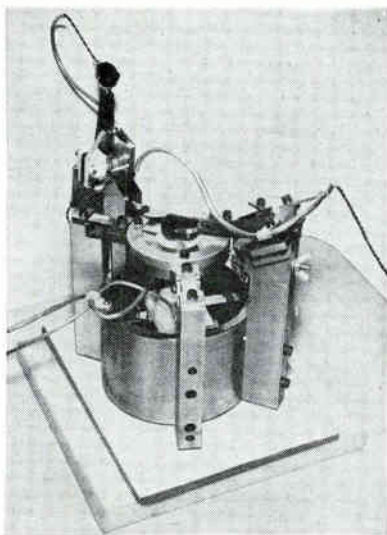
By M. C. GOURDINE, Jet Propulsion Laboratory, Pasadena, Calif.

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



Research instrument simulates mastoid bone covered with skin and fat, containing blood vessels and air spaces. Analog outputs are aiding Beltone Hearing Aid Co. to improve audiometers and hearing aids

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.¹

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^{210} . Because of their higher mobility, electrons are easily extracted from the flow by separation voltage V_s . The gas loses energy in opposing the electric field that appears in the external load at the rate I^2R , 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.² Distance between electrodes l is 10^{-2} m, voltage V is 4×10^4 volts, current density J is 0.85 amp/m² and ion concentration n is 2.21×10^{10} ions/m³.

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 1.5×10^{12} 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 generator³. It might also be used to charge large capacitor banks, possible faster and more efficiently than with conventional means. Because separation voltage

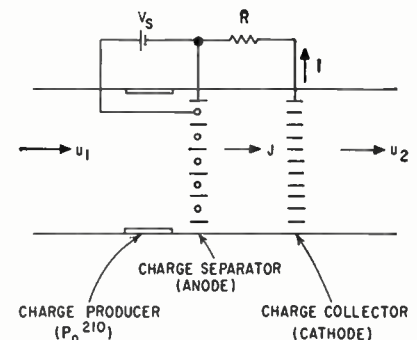


FIG. 1—Electrons are extracted from gas lightly ionized by alpha particles

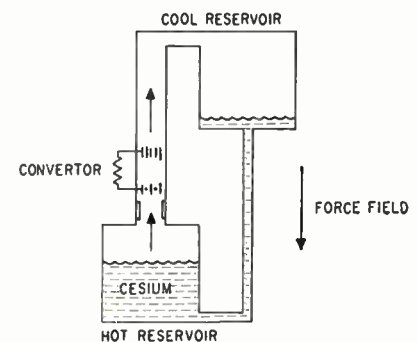


FIG. 2—Two-phase wind tunnel could power ion propulsion motors of space vehicle

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.



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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.

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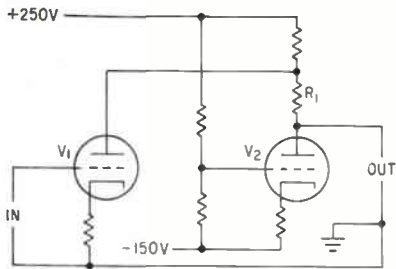
Circuit Removes D-C From Amplifier Signal Output

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_2 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.

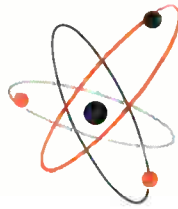
The circuit developed to remove the d-c component with insignificant loss in signal gain is shown in the figure. Amplifier tube V_1 is followed by constant-current tube V_2 in the coupling circuit. Tube V_2 and its plate and cathode resistances form a voltage divider. Voltage at the grid of V_2 is adjusted 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_2 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 .

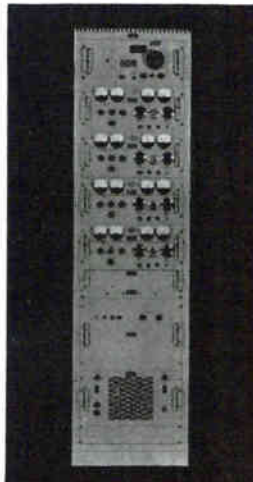
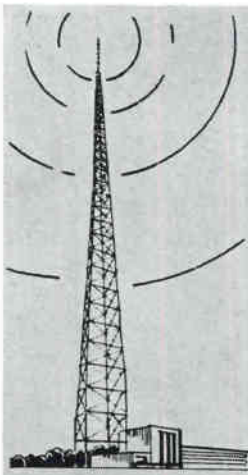
Resistance of the divider can be quite high, resulting in little signal attenuation. Divider resistance is $r_p + (\mu + 1) R_k$. If R_k is 200,000 ohms and μ is 70, tube resistance exceeds 14 megohms. If R_1 is 500,000 ohms, more than 96 percent of the change in plate voltage at V_1 will appear at the output—a loss of only 0.3 db.

In addition, the circuit tends to compensate changes in supply voltage, which affect V_2 as well as V_1 . 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.



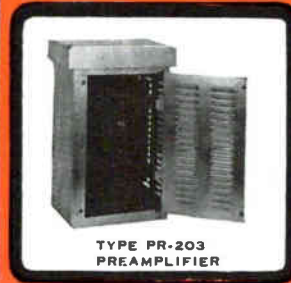
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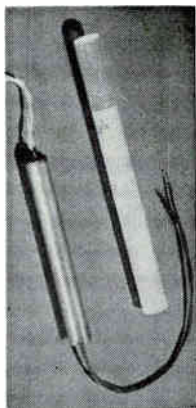
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Electro-Optical Switching Device

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 10^6 , allowing a-c or d-c information to pass.



Neatly packed

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.

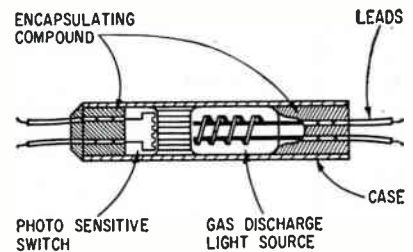
Typical values for the Raysistor are: $I_c = 3$ ma; $E_c = 100$ v; $R_s = 10$ Kohms *on*, 10 Mohms *off*. Life is not indefinite but should be better than 10,000 hours. Shunt capacity to r-f is about 4 pf. If one assumes 60 db attenuation in the off condition, the maximum frequency into a 10-Kohm load is 5 Kc.

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 Kohms; *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, thyatron 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 differ-



Cross-section of typical Raysistor developed by Raytheon. This family of electro-optical transformers opens up uses as a switch, scanner, potentiometer and transformer. Input-output isolation plus d-c control of a-c leads to simplified circuits

ential 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,

RAYSISTOR COMPARED WITH CONVENTIONAL SWITCHES

Quantity	Transistor	Thyatron	Relay	Raysistor A
Isolation	poor	poor	good	good
Polar	yes	yes	no	no
On-off ratio	10^4	10^{10}	10^{10}	10^6
Time (90%)				
Turn-on	10^{-9}	10^{-6} - 10^{-7}	10^{-3} - 10^{-4}	3×10^{-3}
Turn-off	10^{-9}	10^{-4} - 10^{-5}	10^{-3} - 10^{-4}	15×10^{-3}
Shunt capac	1-20 pf	1-2 pf	1-10 pf	4 pf
On resistance	1,000 ohms	a	a	10 Kohms
On volt drop	0-25 v	15 v	a	0-25 v
Max off volt	25 v	200 v	200 v	200 v
Max case temp	150 C	150 C	100 C	75 C
Microphony	good	fair	poor	good
Circuit noise	fair	poor	fair	good

a—negligible on resistance



8-channel Amplifier



2000 cps Optical Recorder

= a new
0 to 5000 cps
direct writing
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SANBORN "650" SERIES

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, 5, 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 from 1 to 24 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 1/4, 1/2, 3/4 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 17 1/2" by 16 1/2" 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.



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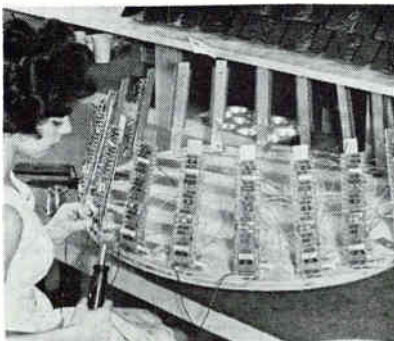
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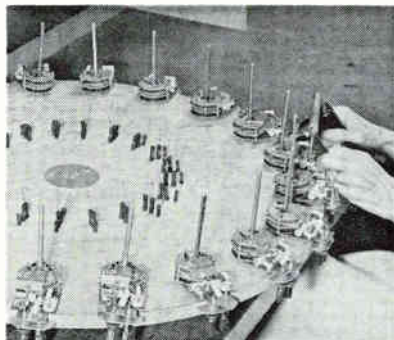
Swivel Chair Substitutes for Lazy Susan



Operators work around semicircle of assemblies



Plain turntable used for routine work



Radial holes keep matched components sorted



Revolving fixture for plug-in unit assembly

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 vtvm 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

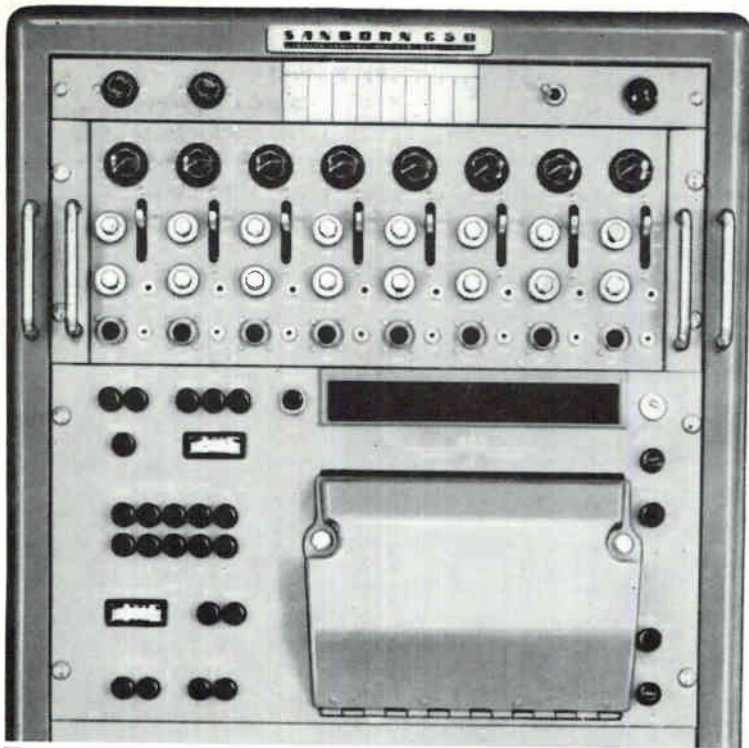
EFFICIENCY OF PHOTOETCHED wiring board printers has been stepped up significantly at Western Electric Company's North Carolina works by the use of black light lamps instead of carbon arc lamps.

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.

Changing to black light lamps eliminated the need to change burned-out electrode tips each shift and also eliminated the dust created



8-channel Amplifier



2000 cps Optical Recorder

= a new
0 to 5000 cps
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system

SANBORN "650" SERIES

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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, 5, 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 from 1 to 24 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 1/4, 1/2, 3/4 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 17 1/2" by 16 1/2" 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.



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COMPANY**

INDUSTRIAL DIVISION

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At the WESCON SHOW — Booths 608-609



*this
dime-
sized*
**SENSING
ELEMENT**
*is
going
places!*

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.

Transducer Division

CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

A SUBSIDIARY OF **Bell & Howell** • FINER PRODUCTS THROUGH IMAGINATION

the mechanical motion of the resonant elements was heard by a high-frequency microphone which was scanned over them by a motor. Later, an electrical pickoff was built onto each element and these scanned by a rotating switch. Presently a capacity commutator, using a rotating scanning plate and a fixed plate for each element, allows rapid scanning without rubbing parts.

As described by J. C. Davis, none of the previous scanning techniques were ideal. The first two were short lived and noisy. The last, still had high insertion loss and required mechanical motion. The answer to the problems of the spectrum analyzer was the Raysistor, a device capable of high speeds that used low power.

An obvious advantage of the Raysistor is that the device is simple to drive from either vacuum-tube or high-voltage transistor switching circuits. Commuted information is not restricted, since the controlled element is bilateral. Within the limitation places by shunt capacity around the off condition, the unit will handle either a-c or d-c amplitudes from a few millivolts to several volts, switched with equal db loss.

Slicing Thin Sections Of Semiconductors

A CUT-OFF machine capable of slicing semi-conductor samples as thin as 0.005 inch is now available from Will Corporation, Rochester, N. Y. Originally developed for dental research, the new Gillings-Bronwill Thin Sectioning Machine has successfully sliced samples of non-decalcified bone, crystals, stone, ceramics and petrographic materials. Success with these substances has led directly to the sectioning of semi-conductors.

An important feature of the new Thin Sectioning Machine is its ability to cut nearly plano-parallel sections which are immediately ready for examination; rarely require final polishing. Samples are embedded in plastic and secured to a movable motor-driven stage assembly. Once positioned, the sample is automatically advanced,

←CIRCLE 154 ON READER SERVICE CARD

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.

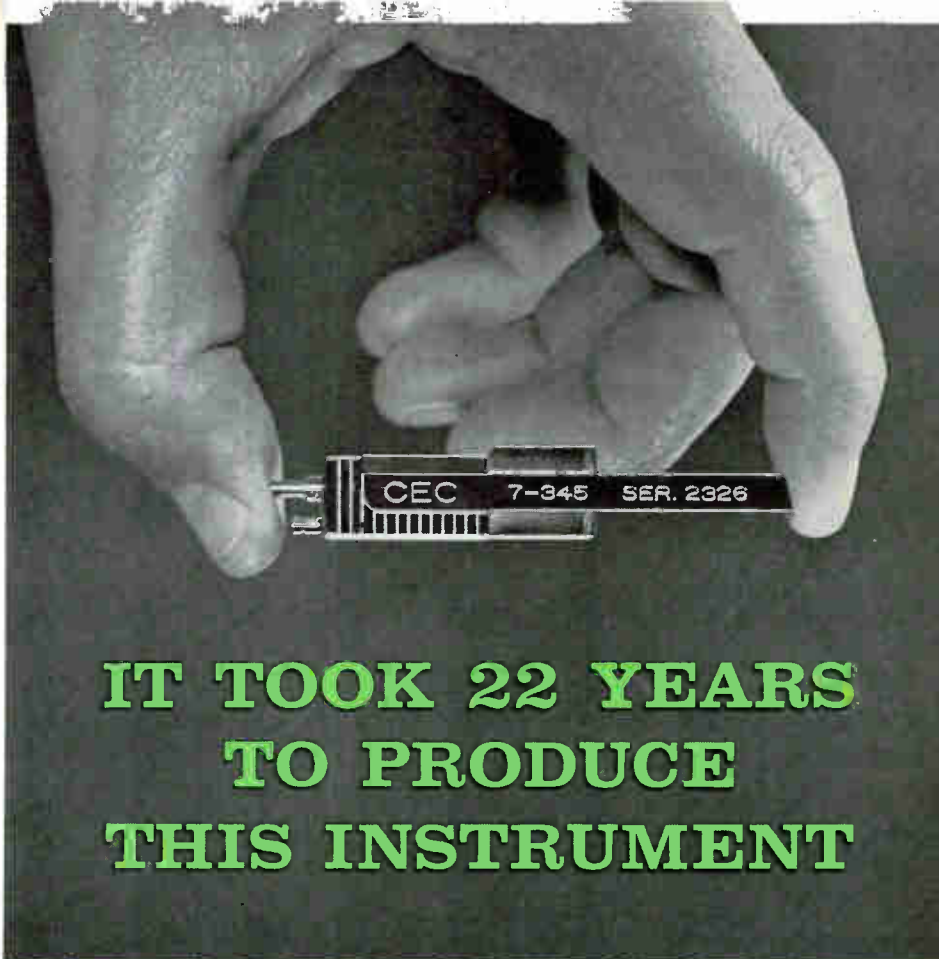
Commenting on the advantages of Type 2N404A over its prototype, Swanson listed the following characteristics:

Max Ratings at 25-C	2N404	2N404A
Coll. 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.

CIRCLE 155 ON READER SERVICE CARD →



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.

Transducer Division **CEC**

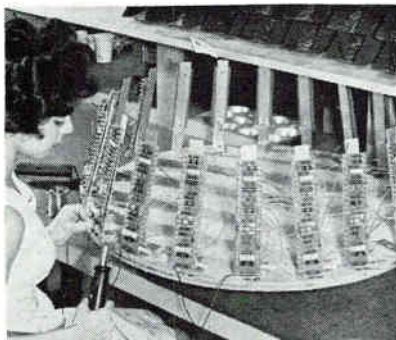
CONSOLIDATED ELECTRODYNAMICS / pasadena, california

A SUBSIDIARY OF BELL & HOWELL - FINES PRODUCTS THROUGH IMAGINATION

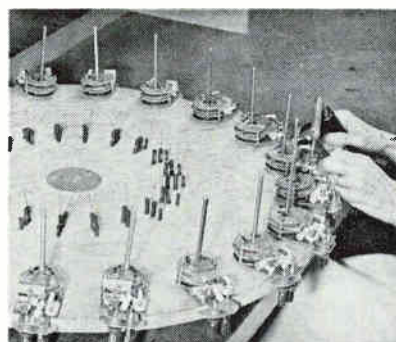
Swivel Chair Substitutes for Lazy Susan



Operators work around semicircle of assemblies



Plain turntable used for routine work



Radial holes keep matched components sorted



Revolving fixture for plug-in unit assembly

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 vtvm 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 PHOTOETCHED 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.

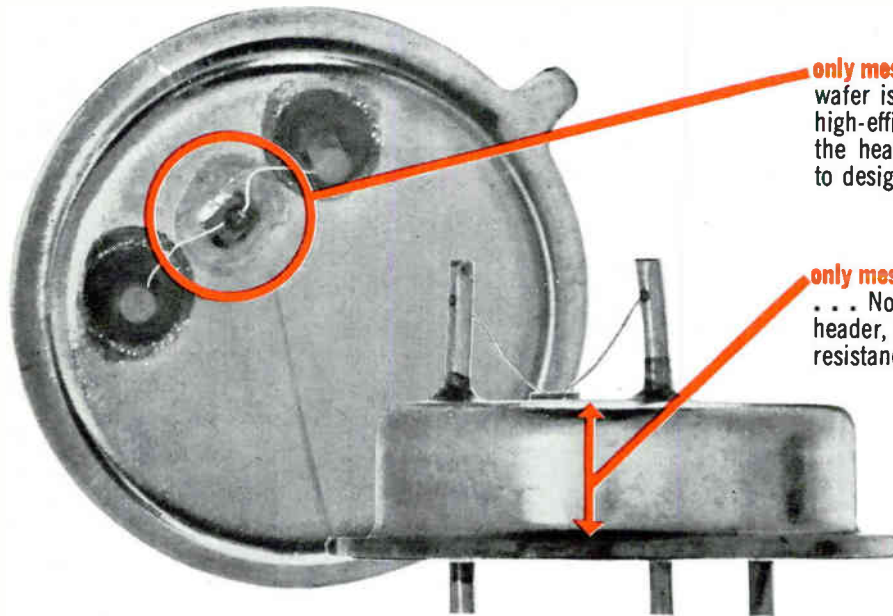
The sensitizing material used on the copper-clad laminate responds to ultraviolet light with a wavelength of 3,000 to 4,000 Angstrom units.

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.

Changing to black light lamps eliminated the need to change burned-out electrode tips each shift and also eliminated the dust created

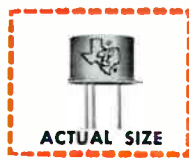
NEW TI GENERAL-PURPOSE SILICON MESA TRANSISTORS



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.

absolute maximum ratings at 25°C ambient (unless otherwise noted)

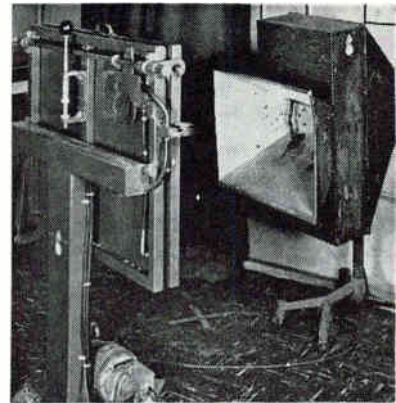
Collector-Emitter Voltage (see note 1)	60 v
Emitter-Base Voltage	5 v
Total Device Dissipation at 25°C Case Temperature (see note 2)	1.2 w
Total Device Dissipation at 25°C Ambient Temperature (see note 3)	0.6 w
Collector Junction Temperature	175°C
Storage Temperature Range	-65°C to +200°C

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.

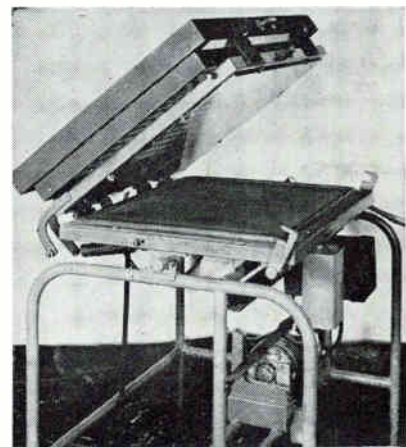
Available **TODAY** in production quantities through all TI Sales Offices and Authorized TI Distributors.

Parameter	Test Conditions	2N1564			2N1565			2N1566			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
I_{CBO} Collector Reverse Current	$V_{CB} = 40 \text{ v}$ $I_E = 0$			1			1			1	μa
BV_{CBO} Collector-Base Breakdown Voltage	$I_C = 10 \mu\text{a}$ $I_E = 0$	80			80			80			volt
BV_{CEO}^* Collector-Emitter Breakdown Voltage	$I_C = 10 \text{ ma}$ $I_E = 0$	60			60			60			volt
h_{FE} A-C Common-Emitter Forward Current Transfer Ratio	$V_{CE} = 5 \text{ v}$ $f = 1 \text{ kc}$ $I_E = -5 \text{ ma}$	20		50	40		100	80		200	
	$V_{CE} = 5 \text{ v}$ $T_A = -55^\circ\text{C}$ $f = 1 \text{ kc}$ $I_E = -5 \text{ ma}$	12			20			40			
	$V_{CE} = 5 \text{ v}$ $f = 30 \text{ mc}$ $I_E = -5 \text{ ma}$	1	4		2	4.5		2	5.0		





Carbon arc lamp printing required more power, space and printing time



P-c printing table has 14 black light lamps in frame

It costs less to RENT AN ELECTRONICS LABORATORY than to buy one

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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We are equipped to take over your peak loads *immediately* at a fraction of what it would cost your company to maintain a staff of the necessary calibre.

Product Qualification

Tests run by United States Testing Company are recognized by military and government procurement agencies in placing a product on the Qualified Product list.

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Electronic Laboratory—evaluates electronic components and systems in communications and industrial fields; includes automated facilities for low-cost collection of reliability data.

Environmental Laboratory—simulates high-low temperatures, humidity, altitude, immersion, salt spray, sand and dust, rain, fungus, vibration, shock, acceleration, etc.

Materials Testing Laboratory—conducts tension, compression and transverse tests on metals, ceramics, plastics, rubber and wood materials; spectrographic analysis and X-ray also available.

Mechanical Laboratory—evaluates mechanical, electro-mechanical hydraulic and pneumatic devices.

Chemical Laboratory—covers all fields including physical and biological chemistry; also infrared spectrophotometry.



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by tip burning. The black light lamps were incorporated in the printing frame, which was counter-balanced 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-

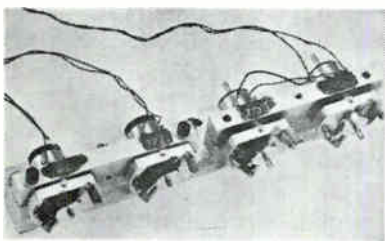
cal crystal pulling.

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.

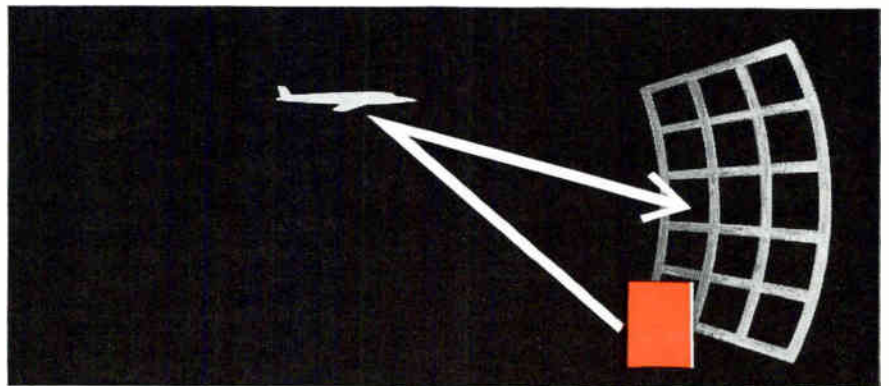
Fixture Indicates Torque During Vibration Testing

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



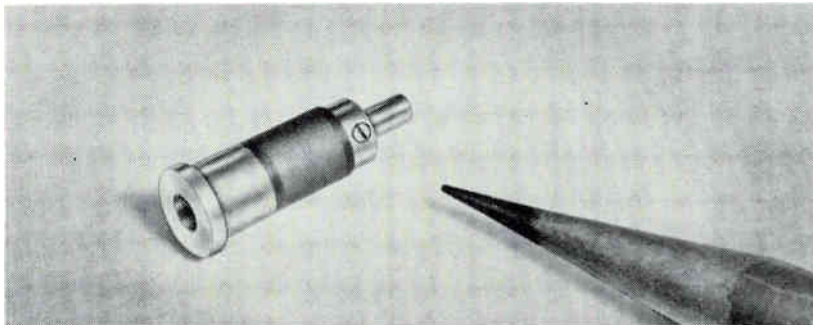
Large static radar power supplies for d-c output call for regulated high power, high voltage. Westinghouse delivers it. Positively precise. Typical equipment now furnished by Westinghouse includes switchgear, voltage regulator, rectifier, resistor and capacitor assemblies, and associated controls. Unlimited 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.

J-92502

Westinghouse



New On The Market at WESCON Show



Crystal Resistors

AID CHECKING

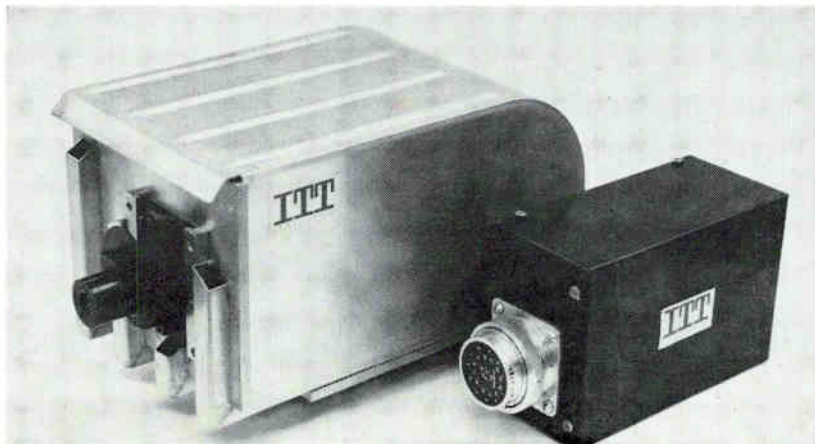
CRYSTAL TYPE resistors made by Filmohm Corp., 48 West 25th St., New York, N. Y., use a metal resistance film and plug in to any component normally using the equivalent crystal type. The plug-in feature allows checking and standardizing independently of crystal impedance.

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.

CIRCLE 377 ON READER SERVICE CARD



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, titan-

ium 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.

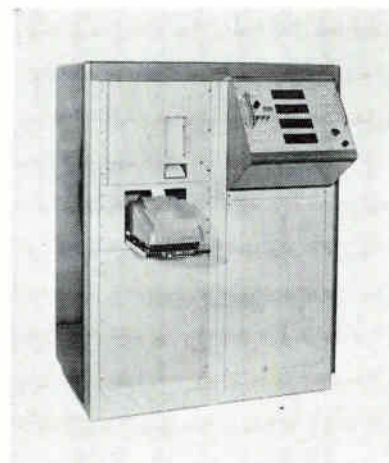
Named the CM-40, it will be first used in the Atomic Energy Commission's ramjet program. The camera will observe the operation of Tory II-A, an engineering test reactor, during tests, scheduled for later this year at the AEC's Nevada

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.

CIRCLE 378 ON READER SERVICE CARD



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 sequential



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.

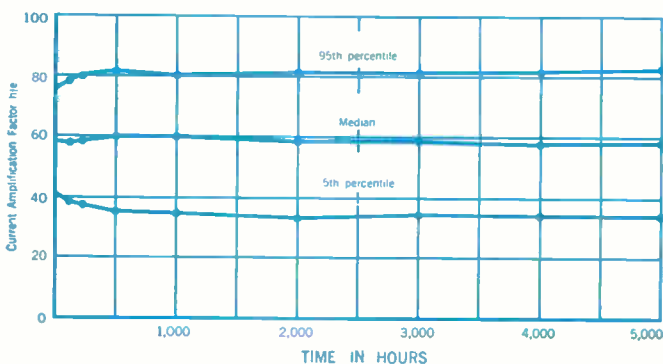
This devotion to cleanliness shows up in the characteristics, stability, and reliability of NEC semiconductors. After a perfect seal, 100% tested in Krypton isotopes, they offer a failure rate suitable for the most critical applications.

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.

Reliability

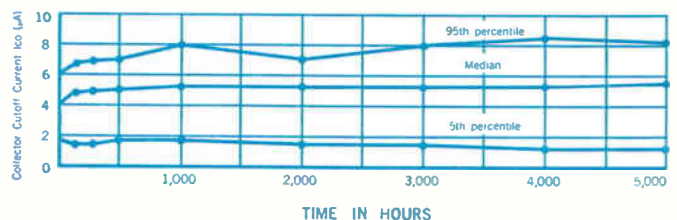
The first NEC transistorized carrier telephone system was an NT & T installation in 1958 between Toyama and Takaoka, a distance of 15 miles. It consists of two terminal stations and a repeater station with 240 channels using 1,600 transistors.

During last 14,000 hours of operation transistor failure has caused only two channel faults. This corresponds to a failure rate of 0.009% per 1,000 hours.



Life Test Results

NEC Germanium Transistor 2SB101
 Sample size: 40 units
 Test conditions: 125 mW continuous
 25°C ambient



Visit NEC at Wescon Booths No. 2412 - 2413



Components / Systems

Nippon Electric Company Ltd.

Tokyo, Japan

events occurring within a 3-sec span can be automatically timed.

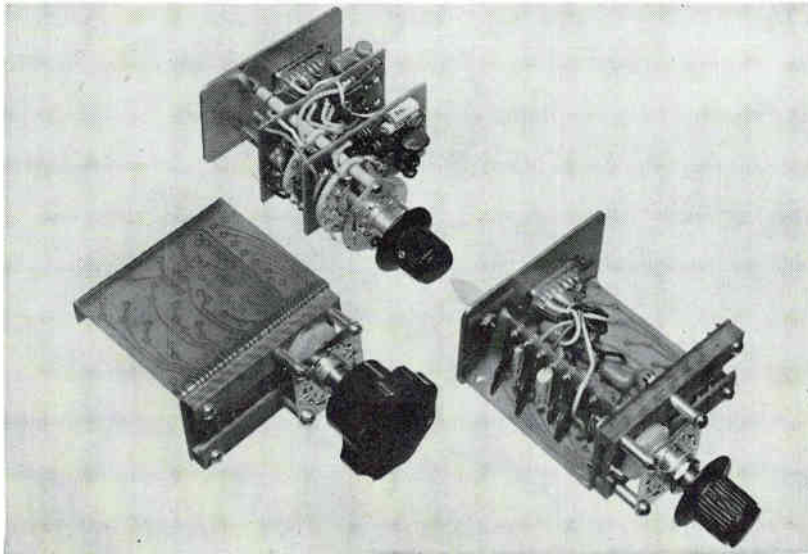
In timing the operation of a solenoid valve, the analyzer gets signals from the discontinuity in electrical wave form caused by energization or de-energization of the solenoid and by completion of solenoid travel. In timing hydraulically or pneumatically operated valves, limit switches at the extremes 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 preprogram-

med 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

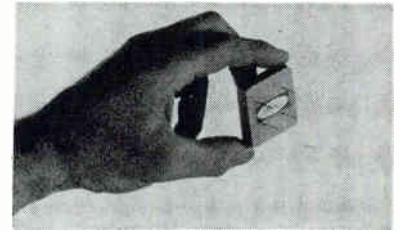
Voltage Reference

FOR PRINTED CIRCUITS

VOLTAGE reference standards are designed to mount directly on

printed circuit boards with standard $\frac{1}{2}$ 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 ± 0.0005



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.

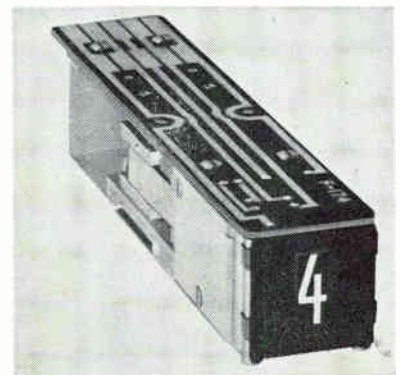
The entire package is $1\frac{1}{8}$ by $1\frac{1}{8}$ by $\frac{3}{8}$ inch; price range is \$60.00, with delivery in one to three weeks.

CIRCLE 381 ON READER SERVICE CARD

Digital Readout Device

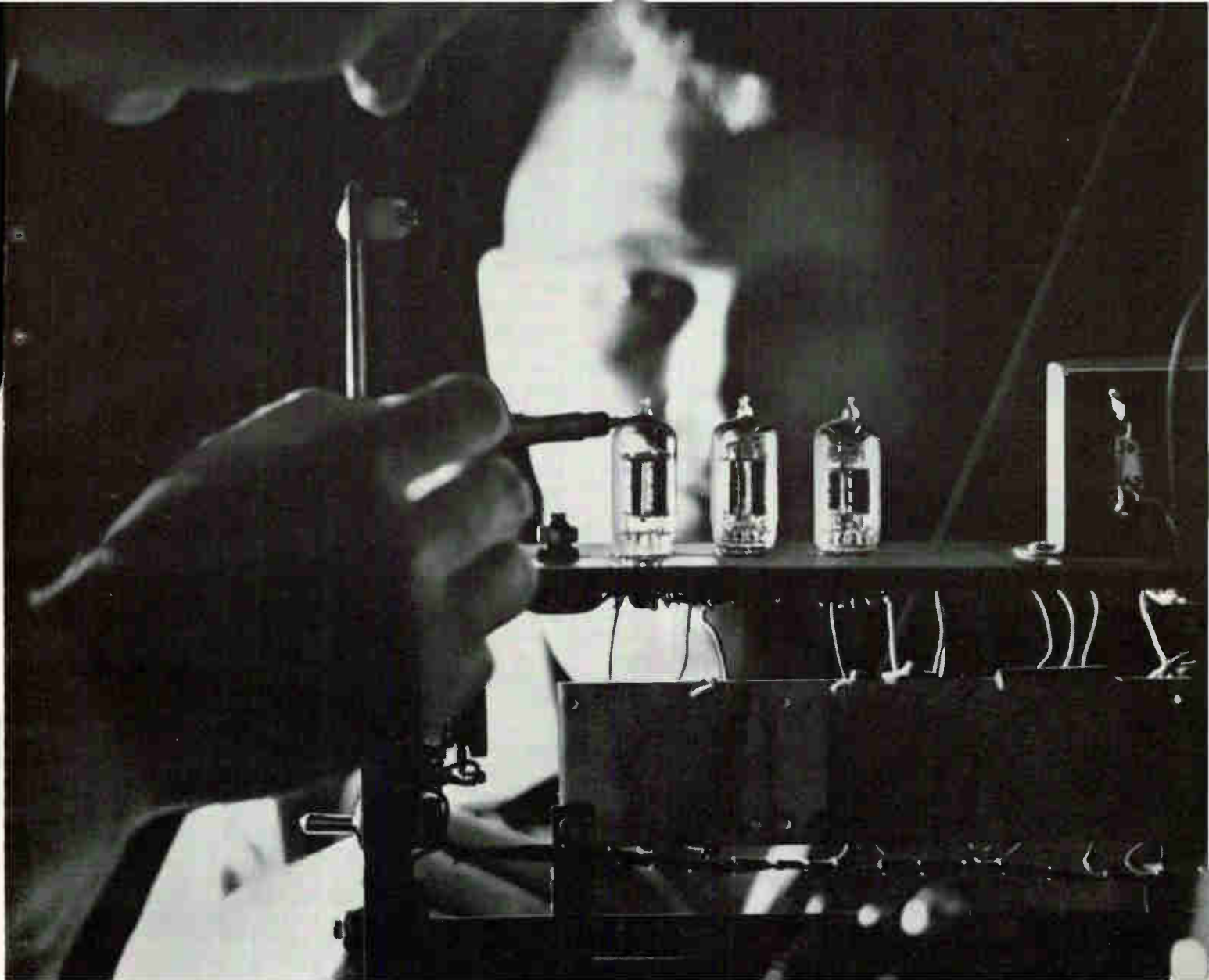
USES STEPPING MOTOR

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 ac-



curate 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 servo mechanism 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.



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transistors

Toshiba Electron Tubes and Semiconductors

1) Semiconductors

Transistor PNP

For LF
General 2SB46, 47, 54, 55,
56, 90, 91, 94
Power 2SB25, 26, 62, 63,
189, 200, 202
For HF
General 2SA37, 38, 39, 49,
51, 52, 53
Drift 2SA57, 58, 59, 60,
72, 73, 74, 75, 76,
77, 92, 93
Mesa M8032, 8033,
8034

Diode

Ge. General 1S20, 32, 33, 34,
1N60
Single 1S50
Combination 1S35, 58
Gold bond 1S73, 82
Si. High Volt 1S71, 72, 81,
Zenner 1S51, 52, 53,
54, 55, 56
Vari-Cap 1S54, 55, 56
Metal-Silicon 1S57, 58, 59

million voltage data conversions per second has been announced by Epsco, Inc., 275 Mass. Ave., Cambridge, Mass.

Although basically similar in function to Epsco's Datrac analog to digital converter, the family of high speed units incorporates new circuits and logical approach. A 7-bit megacycle converter, exclusive of power supply, has a volume of 7 cubic inches.

The units operate on a completely asynchronous principle and continuously digitize varying input, providing a parallel coded output. The converter is not an incremental device but makes totally independent full scale to full scale measurements in millimicroseconds.

The analog to digital converter has applications in video and space communication, experimental neurophysiological study, radar data analysis, high speed transient pulse signal detection. Custom orders are presently scheduled for early delivery.

CIRCLE 384 ON READER SERVICE CARD



Pr.1

West Concord, Mass.
A Strobotac is a measuring instrument designed for the measurement and study of high speeds of up to 250,000 rpm. It features a specially-built strotron lamp, housed in a swivel-

electronics

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Craftsmanship
at work for you
**BENDIX RUGGEDIZED REFLEX KLYSTRONS
WITH THERMAL TUNING**

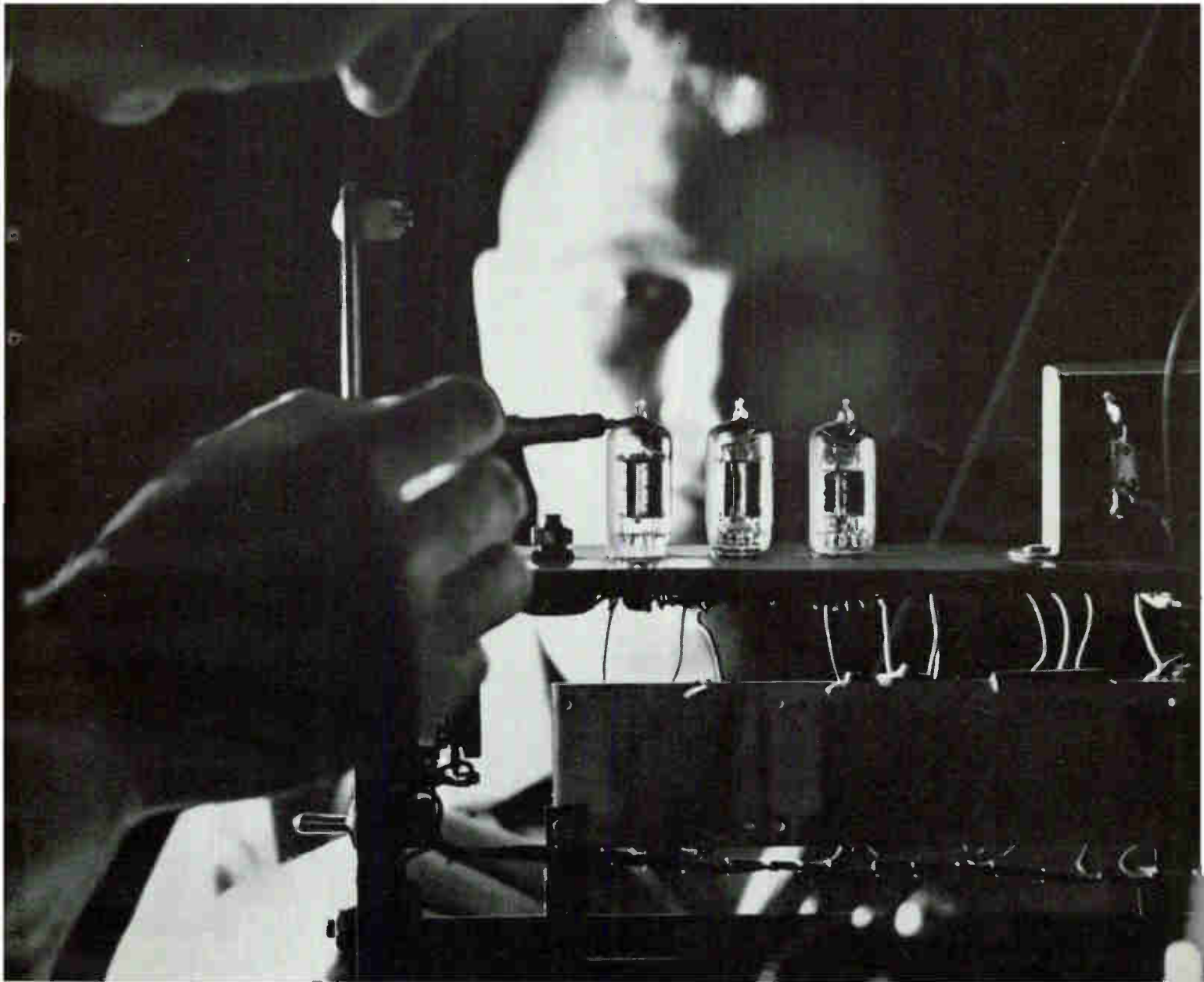
The 6116/TE-39 Klystron tube combines ruggedized construction and thermal tuning. The combination provides a desirable tube for use in airborne radar and similar applications. Ruggedization makes possible a frequency jitter of less than ± 1.3 MC ... at vibration levels up to 10 G at 50 cps. Thermal tuning 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.



The 6116/TE-39 ruggedized klystron tube is thermally tuned.



Instructor G. E. Olsen explains servo mechanism control principles to student L. P. Hilton in laboratory of nationally-known Electronics Institute, Detroit.

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climate for
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Mesa M8079



Germanium Diode



Switching Power
2SB124

Toshiba Electron Tubes and Semiconductors

1) Semiconductors

Transistor PNP

For LF
General 2SB46, 47, 54, 55,
56, 90, 91, 94
Power 2SB25, 26, 62, 63,
189, 200, 202

For HF
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72, 73, 74, 75, 76,
77, 92, 93

Mesa M8032, 8033, 8034,
8079, 2SA92, 93, 94

Switching General
2SA50, 2SB62, 63,
2SA65, 66, 67, 150,
201

Switching Drift
2SA78, 128, 129

Switching Power
2SB25, 26, 122, 124,
125, 149

Photo OS13, OS14

NPN 2SC11
M8062, M8084

Diode

Ge. General 1S20, 32, 33, 34,
1N60

Single 1S50

Combination 1S36, 58

Gold bond 1S73, 82

Si. High Volt 1S71, 72, 81,

Zenner 1S51, 52, 53,
54, 55, 56

Vari-Cap 1S48, 49

Meter protect. 1S57

Thermistor M8601, 02, 03

Rectifier

Si. 1CC04, 2CC18, 3CC12

4CC19, 6CJ14R, 8CJ15

High Volt M8317A

Ferrite

TV Flyback Trans. Core

CU60B1-3D1

TV Deflection Core C05038B-3A

9000 MC Gyrator Core

Garnet for Microwave

Solidicon SDF160, MD-80,

BV50, RC20

2) Electron Tubes

TV use 6R-HH2, 6M-HH3,

6DK6 Radio use 50EH5

Reliable Tubes

5654, 5670, 5702NA, 5718

5726, 5749, 5750, 5751

5814, 5814A, 5899, 5993

6005, 6100, 6101, 6136

6186, 6189, 6201

3) Transmitting Tubes

7F31R, 5F20RA, 8T54 Magnetron 2M20

4) Special Tubes

Ignitron 5550

Image Amplifier 7018

Rotanode DR-76

Transmitting Tube (Triode)

6130 Oc3W

Beam Switching Tube

(Trochotron) MK11, MK12

Counting Tube (Dekatron)

DK20, 22

Vidicon Tube 7038

Multiplier Photo Tube 7309

Neon Glow Lamp NE-2, NE-48

Traveling Wave Tube 8W23

Image Orthicon Tube 5820

Analix A15CU

Statron D-15-2

Cathode Ray Tube for Observation

75LB1, 75RB4, 5CNP16

Cathode Ray Tube for Color TV

430AB22 & Mount

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.

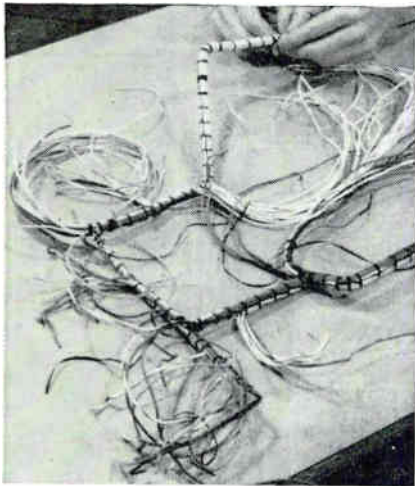
See Toshiba semiconductors and electron tubes at WESCON Booth 2410.

Toshiba

Tokyo Shibaura Electric Co., Ltd.

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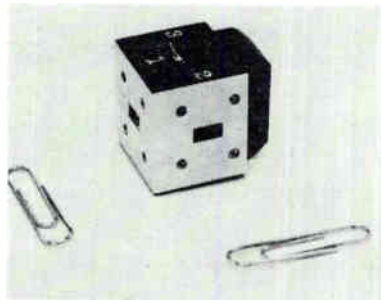
Executive Offices
12 South 12th Street, Philadelphia 7, Pa.

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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— $\frac{5}{8}$ in. high by $\frac{3}{2}$ in. or 1 in. high by $\frac{1}{2}$ in. depending on model.

CIRCLE 382 ON READER SERVICE CARD



Ferrite Circulator

20 KW PEAK FOR K_a-BAND

A COMPACT K_a-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 1 $\frac{1}{4}$ 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 UG 600/U flange.

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Analog to Digital

MULTI-MC CONVERTER

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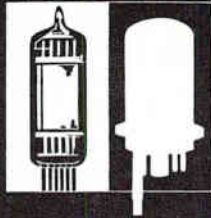
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165



ONE IN A SERIES

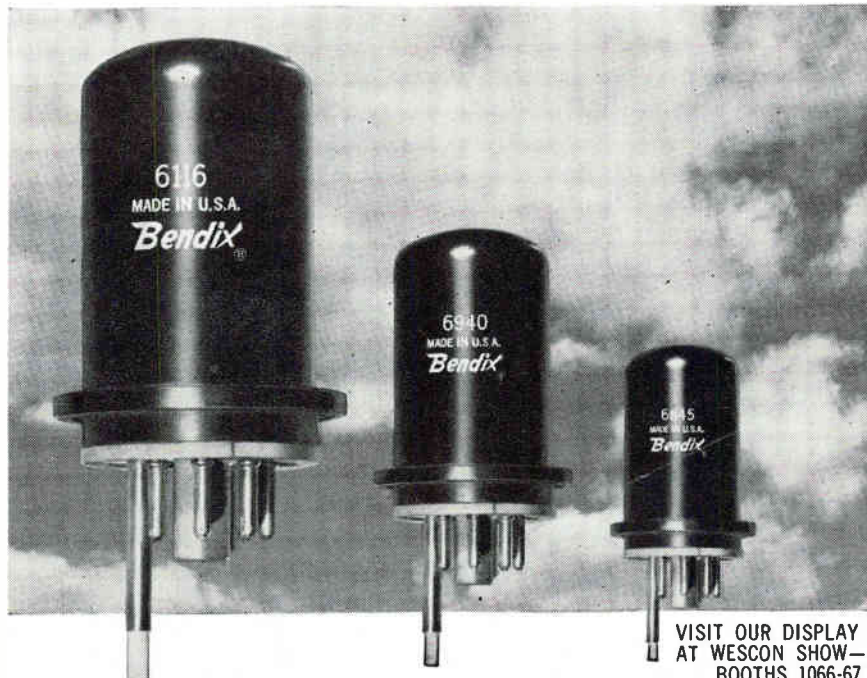
*Bendix
Craftsmanship
at work for you*

BENDIX RUGGEDIZED REFLEX KLYSTRONS WITH THERMAL TUNING

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The 6116/TE-39 ruggedized Reflex Klystron thermally tunes a band of 8500 to 9660 MC by means of a diode within the vacuum envelope. Tuning speed over the required frequency range is 0.7 seconds min. to 3.0 seconds max.

The 6940/TE-58 is identical to the 6116, but has special characteristics limiting spectrum width and spectrum continuity under adverse load conditions.

The 6845/TE-59 is similar in electrical and mechanical characteristics to the 6116 but may be operated under pulsed conditions with minimum frequency modulation.

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SPECIAL-PURPOSE TUBES DEPARTMENT

Red Bank Division

EATONTOWN, NEW JERSEY



West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ontario

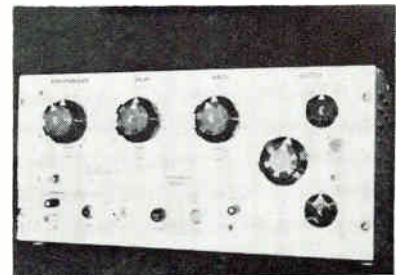
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The analog to digital converter has applications in video and space communication, experimental neurophysiological study, radar data analysis, high speed transient pulse analysis, and submarine warfare signal detection. Custom orders are presently scheduled for early delivery.

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Pulse Generator HIGH REPETITION RATE

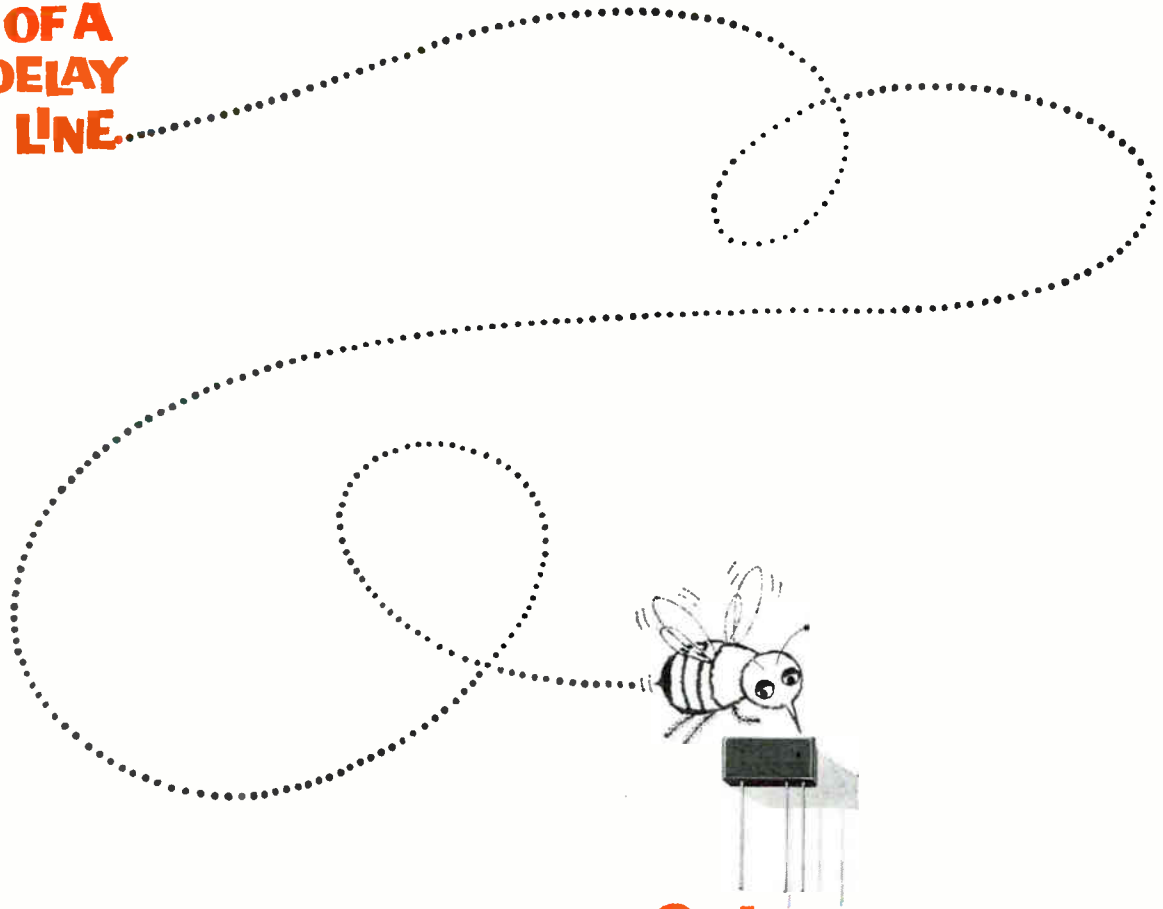
RUTHERFORD ELECTRONICS CO., 8944 Lindglade St., Culver City, Calif. Model B-7B high repetition rate, low cost pulse generator is rack mountable and compact. Amplitude is 50 v delivered into a 50 ohm load; delay with respect to sync out, 0-10,000 μ sec; width, 0.5 μ sec — 10,000 μ sec; repetition rate, 20 cps to 2 Mc.

CIRCLE 385 ON READER SERVICE CARD

Tachometer STROBOSCOPIC

GENERAL RADIO CO., West Concord, Mass. Type 1531-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-

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**ESC'S NEW
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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.

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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

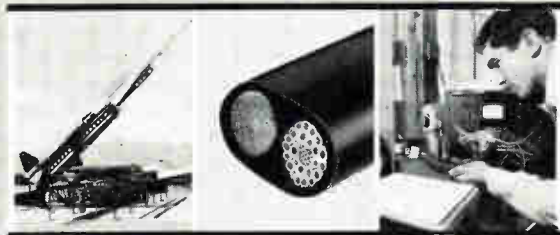
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MIL-C-13777B
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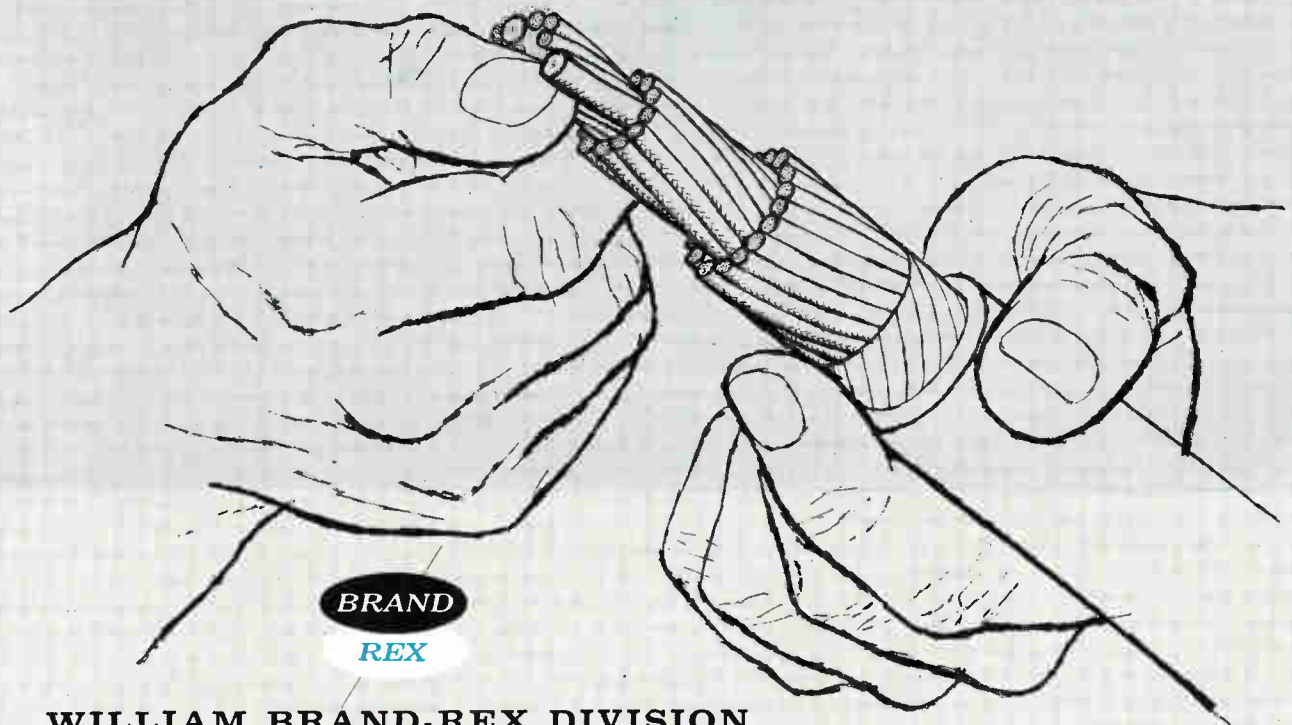
Missilemen, especially, know the advantages of neoprene jacketed cables . . . low temperature flexibility, abrasion resistance, and resiliency. And missilemen who are also cablemen know it pays at the count down to count on Brand-Rex **Cablemanship!** And you should too. For there's more to the absolute 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.

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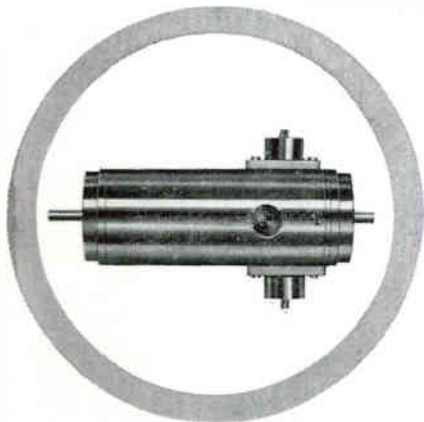
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CIRCLE 301 ON READER SERVICE CARD

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  $\mu$ sec 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  $\pm 1$  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  $\pm 3$  percent, 1 Mc to 50 Mc, and  $\pm 6$  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

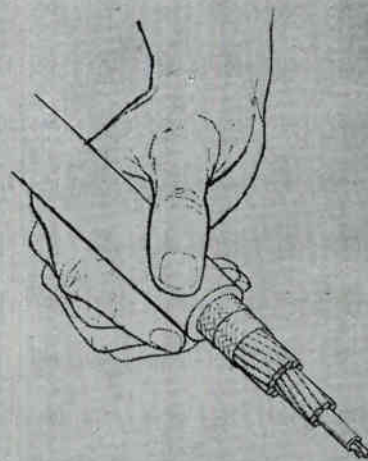
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CIRCLE 169 ON READER SERVICE CARD 169

# DELTEX

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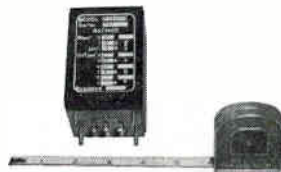


### OPERATIONAL AMPLIFIERS

Metal enclosure insures physical rigidity and electromagnetic isolation. These modules are physically and electrically interchangeable with equivalent amplifiers presently in use.

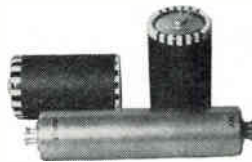
### TRANSISTORIZED POWER SUPPLIES

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.



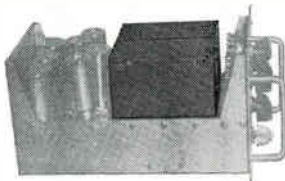
### MINIATURE HI-VOLTAGE SUPPLY

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.



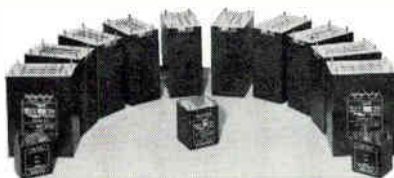
### LOW FREQUENCY FILTERS

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 millisecond 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. Drower 2666

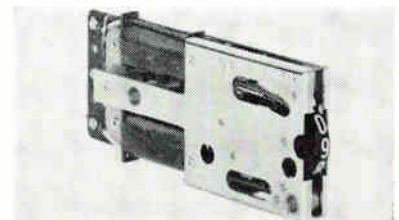


JACKSON, MISSISSIPPI  
Fleetwood 5-9636

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

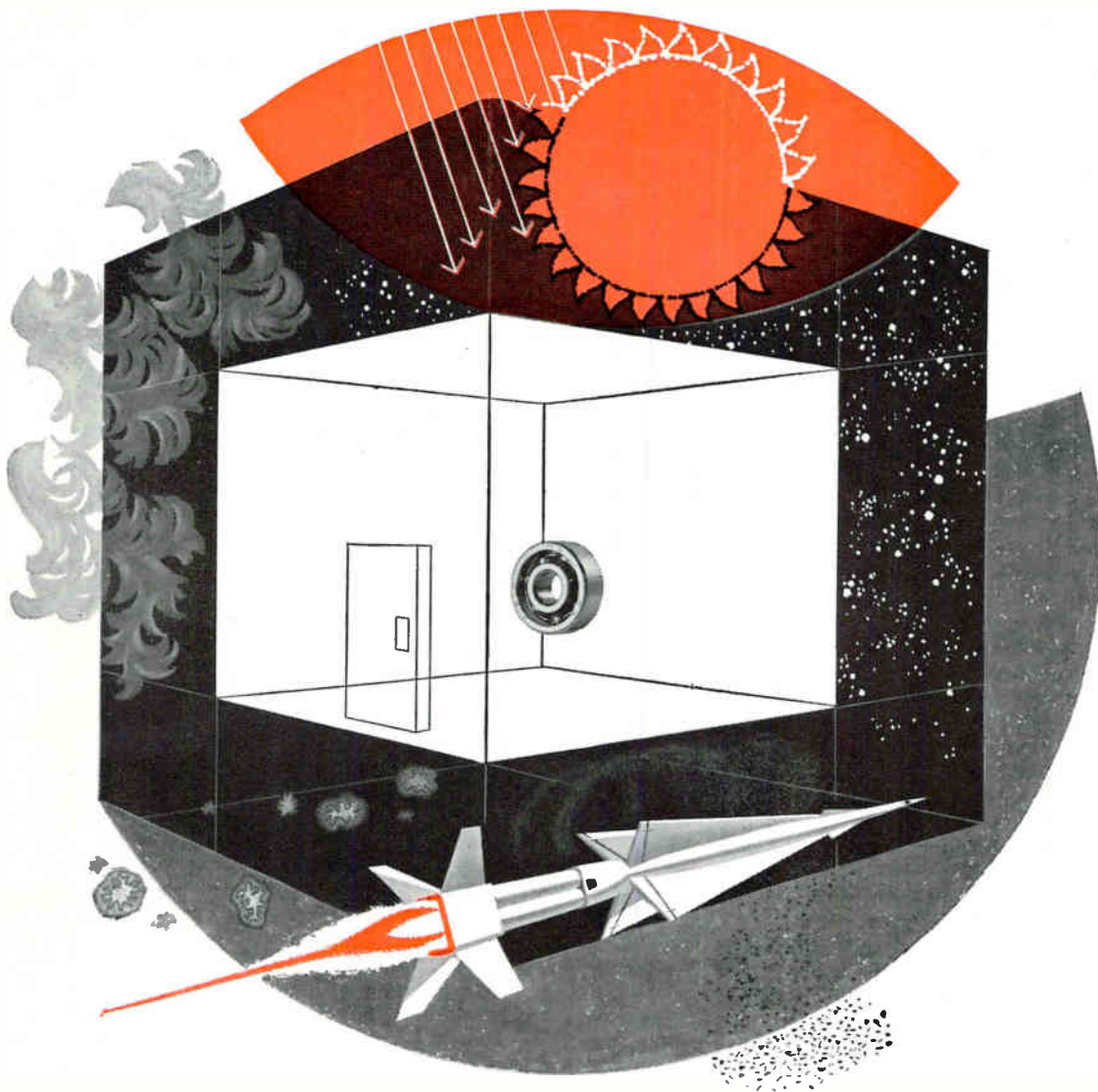
PRESIN CO., 2014 Broadway, Santa Monica, Calif. EZ 10/0 is a single wheel electromagnetic counter designed for parallel entry. These elements, only  $\frac{3}{8}$  in. wide,  $1\frac{1}{2}$  in. high and  $3\frac{3}{8}$  in. deep, may be stacked on common studs to the number of decades desired. The number wheels with digits 0-9,  $\frac{3}{8}$  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



- THOR
- MACE
- TITAN
- HAWK
- ATLAS
- SNARK
- NIKE B
- BOMARC
- NIKE ZEUS
- SPARROW I
- SPARROW II
- SPARROW III
- NIKE HERCULES
- SIDEWINDER
- REGULUS II
- VANGUARD
- REDSTONE
- JUPITER C
- PERSHING
- BULL PUP
- MERCURY
- TERRIER
- POLARIS
- TARTAR
- CORVUS
- FALCON

## **N/D's Unique "White Rooms"** *Improve Miniature Ball Bearing Reliability!*

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.

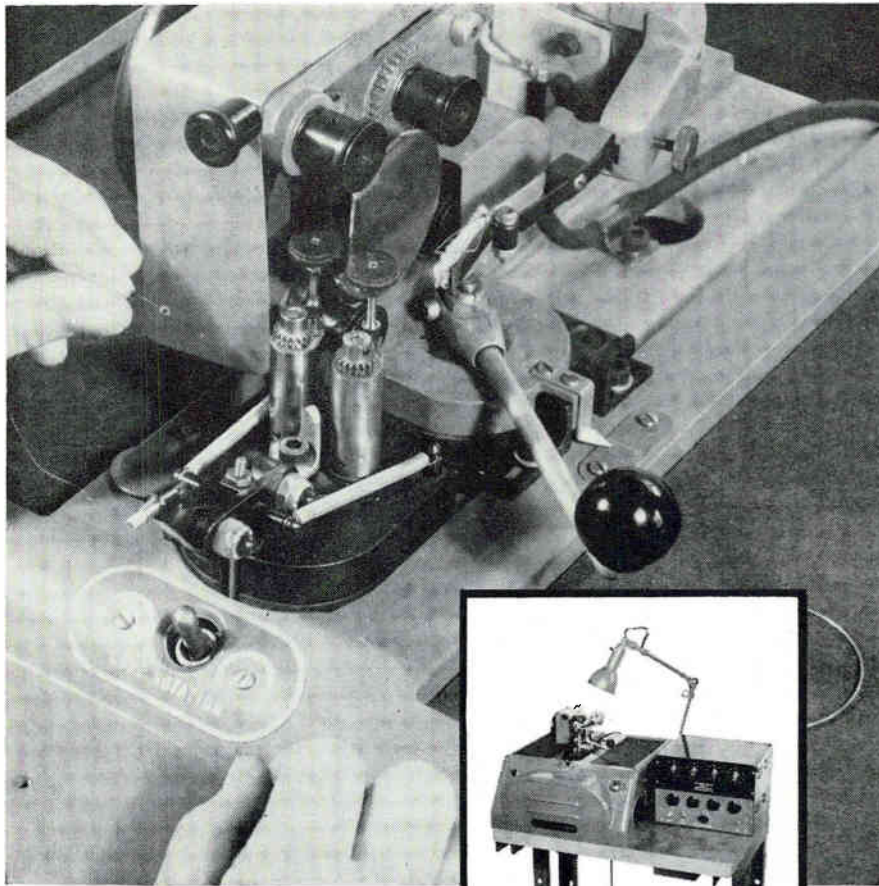
At N/D, miniature ball bearings are completely assembled in properly humidified, temperature controlled atmospheres. Advanced air filter systems completely change the air in these spotless rooms every few minutes. In addition, pressurized access

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.

  
**NEW DEPARTURE**  
**MINIATURE & INSTRUMENT BALL BEARINGS**  
*proved reliability you can build around*



## NEW BOESCH MINITOR

. . . machine - winds  
1/32" toroids

The coil shown above is a 1/32" 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 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.

SEE  
A  
DEMONSTRATION  
WESCON  
SHOW  
BOOTH  
231

WRITE TO US TODAY for complete specifications, delivery schedules and prices on MINITOR.

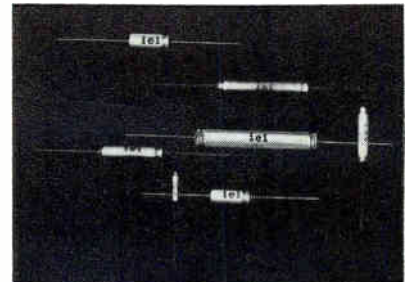


**BOESCH MANUFACTURING  
COMPANY, INCORPORATED**  
**DANBURY, CONNECTICUT**



three waveguide bands extends its usefulness for either coaxial line or waveguide setups. Absolute accuracy is 0.10 percent. Unit is a reaction type instrument, absorbing power only at the resonant frequency of a half wavelength resonant cavity. The mirror-finished cavity surface is silver plated and rhodium flashed. The tuning plunger is a noncontacting choke type with a high resonant Q. Backlash has been eliminated in the instrument's drive mechanism and smooth operation is further assured by supporting the spring-loaded drive on a precision ball bearing.

**CIRCLE 395 ON READER SERVICE CARD**



## 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 vdc to 150 vdc 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.

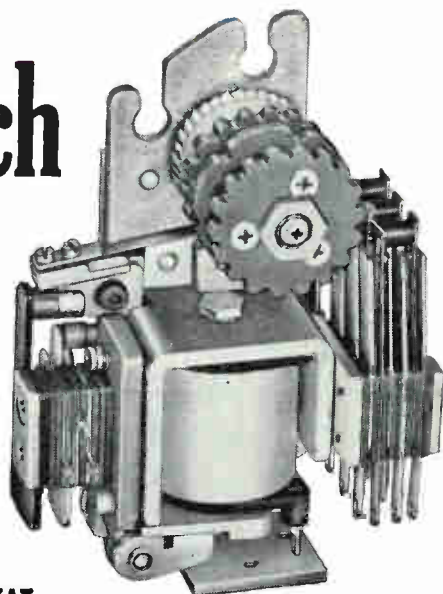
**CIRCLE 396 ON READER SERVICE CARD**



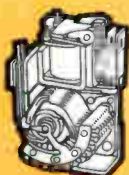
## Miniaturized Pot WIREWOUND

BORG EQUIPMENT DIVISION, Amphe-nol-Borg Electronics Corp., 120 S. Main St., Janesville, Wisc. The

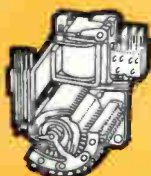
# Here's a Memory Switch You Won't Forget...



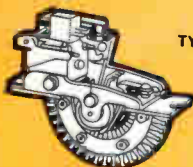
A FULL LINE OF CLARE STEPPING SWITCHES  
WITH MANY IMPROVED FEATURES



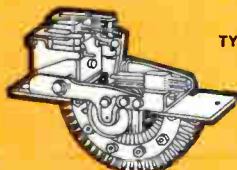
**TYPE 210**  
Has 10 points, with as many as 120 contacts in twelve 10-point levels or four 30-point levels.



**TYPE 211**  
Offers up to 132 contact points on twelve 11-point levels or four 33-point levels.



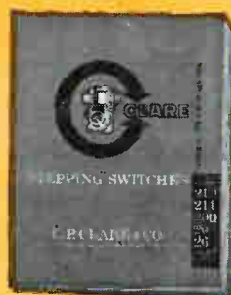
**TYPE 20**  
Up to 480 contact points in twelve 40-point levels or 320 in sixteen 20-point levels.



**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.



**new!**

**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.

the New

**CLARE**

**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

**CLARE**

*Relays and Related Control Components*

# Measures **100 $\mu$ v** to **100 v** at frequencies 10 cps to 2 mc

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.

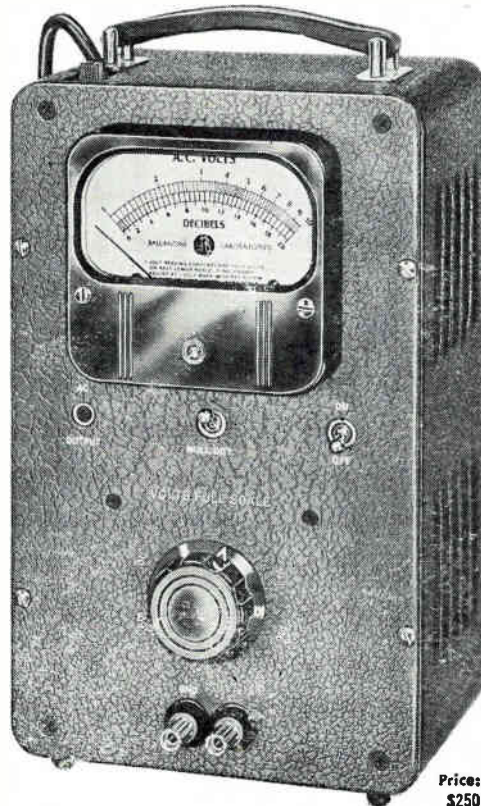
#### Special Versions

19 inch relay rack is Model 310A-S2. Ask about other versions.

Write for brochure  
giving many more details

## BALLANTINE SENSITIVE ELECTRONIC VOLTMETER

Model 310-A



Price:  
\$250

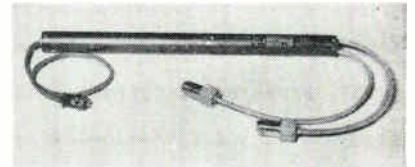
— Since 1932 —

**B** BALLANTINE LABORATORIES INC.  
Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES.

2100 series  $\frac{1}{8}$  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 servo-mount 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

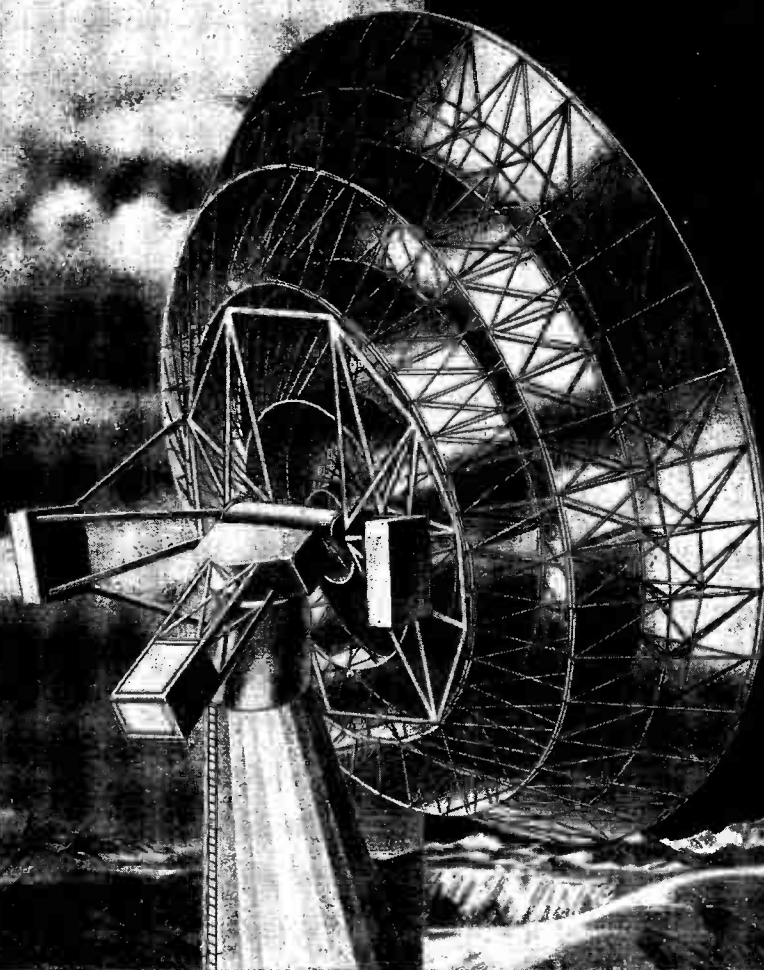


### Elapsed Time Indicator MINIATURE UNIT

BOWMAR INSTRUMENT CORP., 8000 Bluffton Rd., Ft. Wayne, Ind. A decimal type counter with large



# ANTENNABILITY



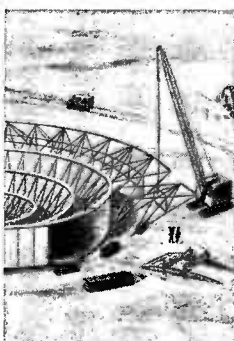
**TETRAC**... *The first truly advanced large parabola design—  
engineered for operational accuracy in any environmental condition!*



*Advanced Tension-Truss  
Antenna Design*



*Exceptional Surface  
Contour Fidelity*



*Simplified Transport  
and Assembly*

**TETRAC** design and construction is a technological breakthrough for larger, highly accurate radar reflectors. ■ **TENSION TRUSS ANTENNA CONCEPT** means efficient utilization of materials, combining sandwich construction face panels with pre-stressed space frame. **TETRAC** has stiffness-to-weight characteristics and multi-application capabilities which are far superior to conventional antenna designs. ■ **TETRAC** is highly modular, resulting in low manufacturing costs and simplified transportation and assembly. **ANTENNABILITY**—in a word, describes **TETRAC**'s Produce-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  
5159 Baltimore Drive, La Mesa, California • Phone: HOpkins 9-0171

**T** TETRAC IS A DEVELOPMENT OF NARMCO MANUFACTURING AND THE MONROVIA AVIATION SUBSIDIARY OF TELECOMPUTING CORPORATION • OTHER MEMBERS OF THE TELECOMPUTING FAMILY ARE: WHITTAKER CONTROLS • WHITTAKER GYRO • NARMCO R & D • TELECOMPUTING SERVICES, INC. • NARMCO MATERIALS • COOK BATTERIES ELECTRONIC SYSTEMS • DATA INSTRUMENTS • ELECTRONIC COMPONENTS • PHOENIX ENGINEERING • VALUE ENGINEERED PRODUCTS • CONOLON SPORTING GOODS

See us at Wescon Booth 447-448

CIRCLE 175 ON READER SERVICE CARD

**Hermetic Seal**  
transformer co.



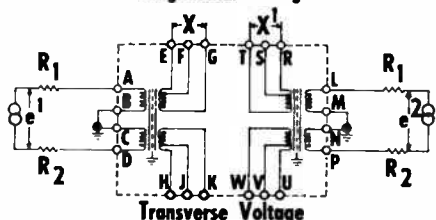
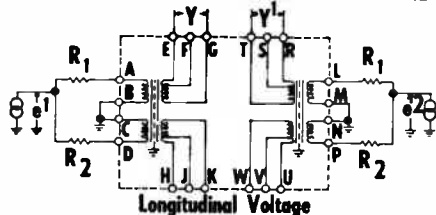
# HST HYBRID-ISOLATION TRANSFORMER

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



$$R_1 = R_2 \pm 0.1\% \quad R_1 + R_2 = 600 \pm 0.5\% \text{ OHMS}$$

$$\text{Longitudinal Balance} = 20 \text{ LOG } \frac{X}{Y} \text{ db} \ \& \ 20 \text{ LOG } \frac{X1}{Y1}$$

### Specifications—Model HI-0394

Designed in Accordance with EIA Standard RS-174 and/or Mil-T-27A Class R Grade 4

**Frequency Response:**

200 cps  $\pm$  0.5 db

1000 cps  $\pm$  0.0 db

4000 cps  $\pm$  0.5 db

**Power:** + 15 dbm max

**Impedance:** 600/600:600

**DC Resistance:**

Total Primary 60 ohms max

Total Secondary 60 ohms max

**Maximum Rated Current:**

Total Primary 60 ma DC

Total Secondary 60 ma DC

**Ambient Temperature:** -10°C to + 65°C

**Duty Cycle:** Continuous

**Total Harmonic Distortion:**

< 0.2% @ + 15 dbm Input

**Frequency Response, Distortion, Input & Output**

**Impedances, and Trans-Hybrid Loss Requirements Are Met with up to 60 ma DC**

**Electro-static Shielding—Internally Grounded**

**To Case**

**Size:** 2 1/4 x 2 1/4 x 3 3/8 Including Terminals

**Trans-Hybrid Loss:**

**Nominal Input**

200 cps > 25 db

300 cps > 32 db

800 cps > 40 db

1000 cps > 45 db

2000 cps > 43 db

2800 cps > 43 db

3600 cps > 37 db

4000 cps > 20 db

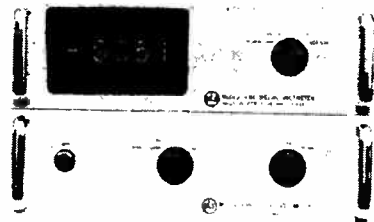
**Longitudinal Balance:**

40 db 200-2000 cps

35 db 2000-4000 cps

characters for easy readout at distances up to 6 ft, model 1440 indicator simplifies the inherent reading problems in some miniature devices by presenting only four digits at a time, instead of many. It displays four white 0.109-in. numerals on a dull black counter drum. The counter provides readings from 0000 to 9999 hours with return to 0000. Completely self-contained, including the motor, the hermetically sealed unit is 0.670 in. in diameter, 1.680 in. long excluding terminals, and weighs 1.8 oz. Nominal input requirement is 115 v at 400 cps, single phase. Current is approximately 10 ma. Various mountings and flange arrangements can be supplied, according to user requirements.

CIRCLE 399 ON READER SERVICE CARD



## 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  $\pm 9.999/99.99/999.9$  v d-c. Accuracy is  $\pm 1$  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 400 ON READER SERVICE CARD

## Ratio Bridge

SELF-NULLING

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-

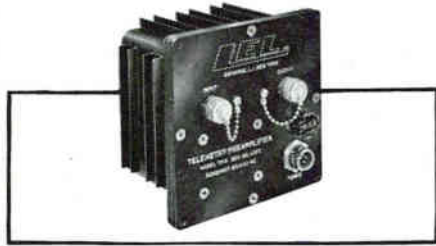
Visit Our WESCON Booths 2423 and 2424

|                                                                                                                                                    |                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <p><b>Hermetic Seal</b><br/>transformer co.</p> <p>MAGNETIC IRON-CORE COMPONENTS<br/>ENVIRONMENTAL TESTING<br/>POWER SUPPLIES—SERVO AMPLIFIERS</p> | <p><b>DRESSER</b><br/>INDUSTRIES<br/>INC.</p> <p>ELECTRONIC<br/>OIL • GAS<br/>CHEMICAL<br/>INDUSTRIAL</p> |
|                                                                                                                                                    |                                                                                                           |

## TELEMETRY PREAMPLIFIER

for Reliable

### LOW NOISE RECEPTION



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:**

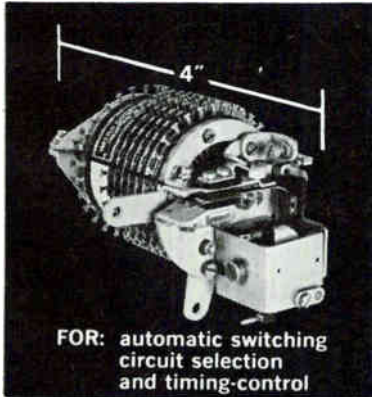
Gain ..... 23db  
 Bandpass ..... 215-260mc  
 Noise Figure ..... 3.5db Typical  
 Weight ..... .6 lbs.  
 Size ..... 7-7/8" x 8" x 4-3/4"



Send for comprehensive Microwave,  
 IF, RF Amplifier Catalog.  
 75 AKRON ST., COPIAGUE, N. Y.

CIRCLE 263 ON READER SERVICE CARD

# UNIQUE



FOR: automatic switching  
 circuit selection  
 and timing-control

The  
 Genalex  
 Miniature  
 High-Speed  
 Stepping Switch

**FEATURING: 80** steps per second on impulse drive **30** contacts per bank **12** banks maximum **17** oz. light-weight **7** levels sequence switching.

*Over 5,000,000 Steps Without Replacements*

Write today for complete data — Also, data available on Genalex one-way and two-way stepping switches.

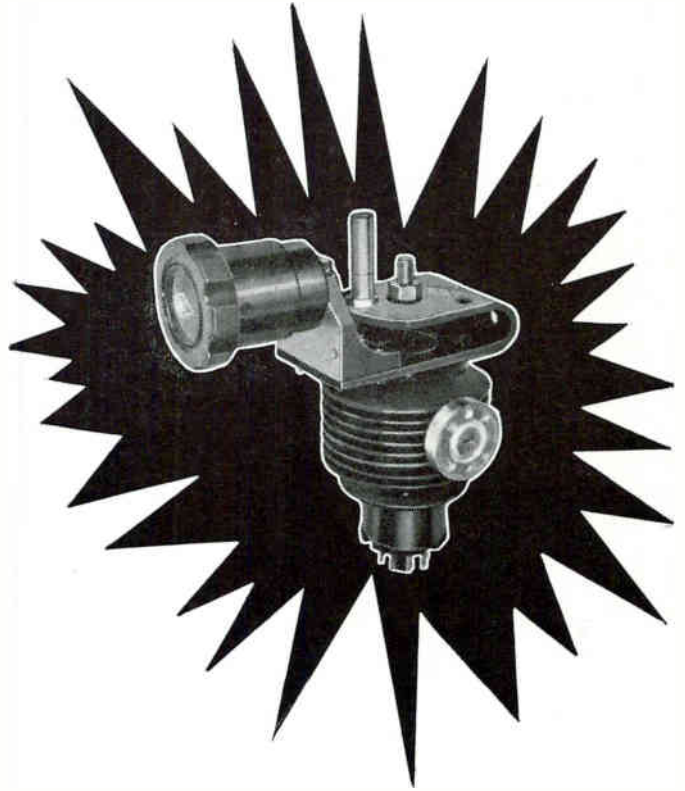


11 UNIVERSITY ROAD, CAMBRIDGE 38, MASS.  
 U. S. AGENTS FOR THE GENERAL ELECTRIC COMPANY, LTD. OF ENGLAND

CIRCLE 264 ON READER SERVICE CARD

# Now!

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.

※ Tentative data

| Item No.    | Model No | Frequency Range | Power Output | Operating Voltage | Operating Current |
|-------------|----------|-----------------|--------------|-------------------|-------------------|
| -Klystron-  | 1 35V10  | 33-37KMC        | 40mW         | 2,000V            | 12mA              |
|             | 2 35V11  | 33-37           | 100          | 2,000             | 25                |
|             | 3 50V10  | 43-51           | 40           | 2,300             | 25                |
|             | 4 ※70V10 | 65-75           | 14           | 3,500             | 30                |
| -Magnetron- | 1 24M10  | 24,000MC        | 50KW         | 13KV              | 15A               |
|             | 2 33M10  | 32,600          | 40           | 13                | 18                |
|             | 3 35M10  | 34,860          | 40           | 13                | 18                |
|             | 4 50M10  | 50,000          | 20           | 12                | 16                |

For further information write us, using Circle Reader Service Card.

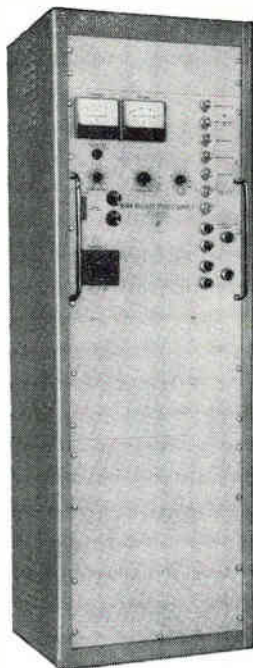


**OKI**  
 ELECTRIC INDUSTRY  
 CO., LTD. TOKYO JAPAN

*Safe. Easy to operate.  
Rate of voltage application conforms  
to ASTM standards. Portable  
models. Floor mounted models.*

# HIGH VOLTAGE

A-C AND A-C/D-C TESTERS

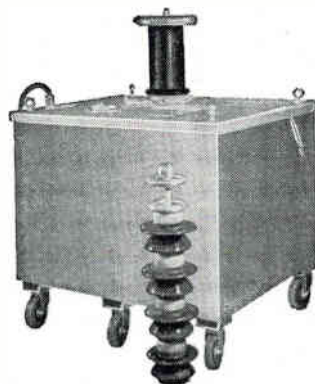


These Sorensen a-c and a-c/d-c testers completely cover the voltage range from 0-150,000 vac and 0-300,000 vdc with current capacities as high as 4000 milliamperes a-c (plus 5 milliamperes d-c for the a-c/d-c units).

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.

0.4



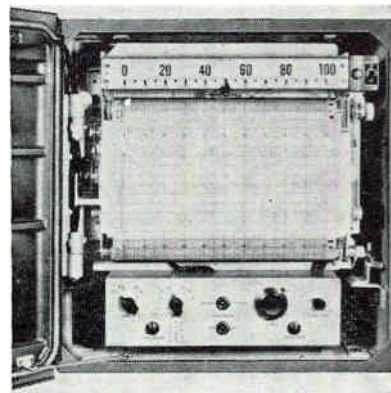
A SUBSIDIARY OF RAYTHEON COMPANY

**CONTROLLED  
POWER  
PRODUCTS**

**...the widest line lets you make the wisest choice**  
See us in Booths 509-510 at the Wescon Show

out is 10 seconds to obtain null. Frequency range: 50 to 3,000 cps; accuracy: as good as 0.002 percent; resolution: 6 place.

**CIRCLE 401 ON READER SERVICE CARD**



## 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, micro-ampere, 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.

**CIRCLE 402 ON READER SERVICE CARD**

## 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

Telephone  
Types

Midget  
Telephone  
Enclosed  
Plug-in

General  
Purpose

Antenna  
&  
Ceramic  
Terado

Power  
AM/MS  
RBM

Collins  
Chopper  
D.D.S.

Automatic  
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Steppers

Clare  
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Switches

"211"  
Stepping  
Switches

Mercury  
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HGS

Advance  
Relays

Potter  
&  
Brumfield

GV  
Controls

Struthers  
Dunn

Ebert  
Mercury

Leach  
Relays

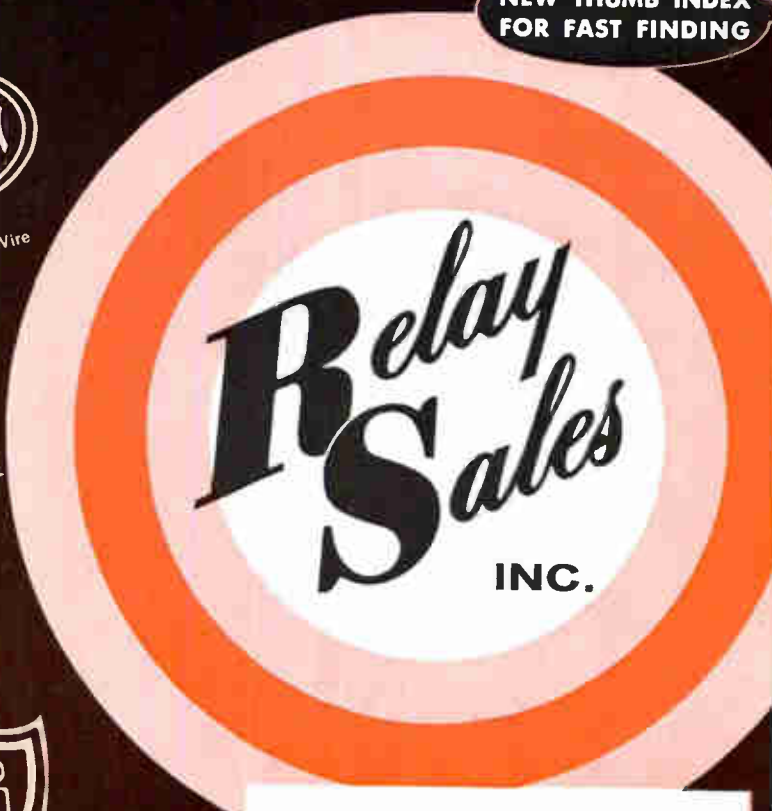
Phillips  
Control  
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Kurman  
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Electro  
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Buy All these leading  
lines of  
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*Immediate delivery from stock  
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**RELAY SALES, INC.**  
P. O. BOX 186-A, WEST CHICAGO, ILL.



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Div. Essex Wire



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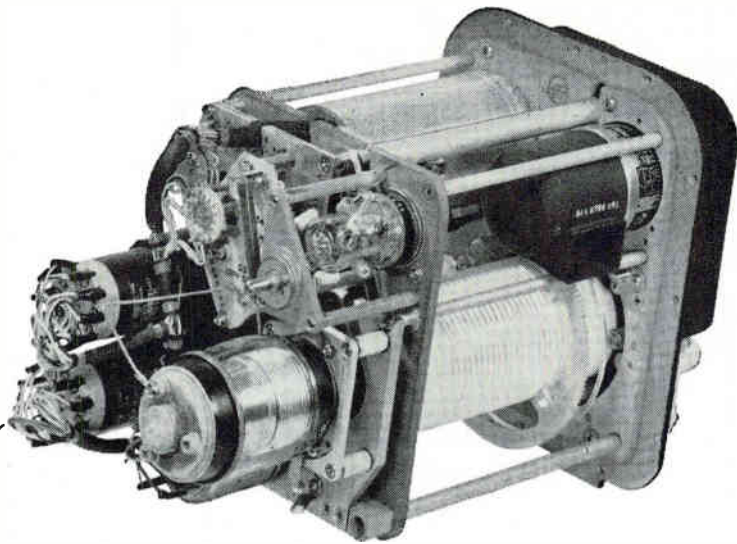
Advance Relays



Monitor Relays Inc.



Struthers



## 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 3¼ 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, 30G shock, and 50 hours salt spray.

**Send for catalog literature on Jennings complete line of vacuum capacitors and relays.**



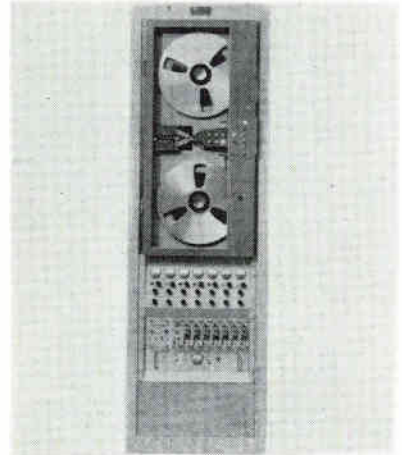
USL-S-465  
VACUUM  
VARIABLE  
CAPACITOR



TYPE RB3  
VACUUM  
TRANSFER  
RELAY

heat treated fiber glass, and featuring Isolastube, a fiber glass based isocyanate coated material, designated Class F, guaranteed for continuous performance of 155 C.

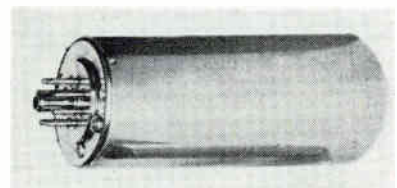
**CIRCLE 403 ON READER SERVICE CARD**



### 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 unsusceptible 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

JENNINGS RADIO MANUFACTURING CORPORATION  
970 McLAUGHLIN AVE., P. O. BOX 1278 SAN JOSE 8, CALIF

*Jennings*<sup>®</sup>

# 67

... good reasons why  
you can standardize with



MODEL TO36-5M

# REGATRAN<sup>®</sup> 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.

### \* WIDE RANGE MODELS

| D-C OUTPUT |       | MODEL NUMBER | DIMENSIONS IN INCHES           |    |                                |
|------------|-------|--------------|--------------------------------|----|--------------------------------|
| VOLTS      | AMPS  |              | H                              | W  | D                              |
| 0-7        | 0-30  | *TO7-30      | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 0-7        | 0-15  | *TO7-15      | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-7        | 0-10  | *TO7-10      | 7                              | 19 | 15                             |
| 0-7        | 0-5   | *TO7-5       | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-7        | 0-3   | *TO7-3       | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 0-14       | 0-20  | *TO14-20     | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 0-14       | 0-10  | *TO14-10     | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-14       | 0-7.5 | *TO14-7.5    | 7                              | 19 | 15                             |
| 0-14       | 0-5   | *TO14-5      | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-14       | 0-3   | *TO14-3      | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 0-32       | 0-30  | TO32-30      | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 0-32       | 0-15  | TO32-15      | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-32       | 0-10  | TO32-10      | 7                              | 19 | 15                             |
| 0-32       | 0-5   | TO32-5       | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-32       | 0-3   | TO32-3       | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 0-36       | 0-30  | TO36-30      | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 0-36       | 0-15  | TO36-15      | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-36       | 0-10  | TO36-10      | 7                              | 19 | 15                             |
| 0-36       | 0-5   | TO36-5       | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-36       | 0-3   | TO36-3       | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 0-60       | 0-15  | TO60-15      | 15 <sup>3</sup> / <sub>4</sub> | 19 | 15                             |
| 0-60       | 0-7.5 | TO60-7.5     | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-60       | 0-5   | TO60-5       | 7                              | 19 | 15                             |
| 0-60       | 0-2.5 | TO60-2.5     | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 0-60       | 0-1.5 | TO60-1.5     | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |

\*MODELS MARKED WITH AN ASTERISK ARE PROGRAMMABLE.

### † NARROW RANGE MODELS

|         |       |         |                                |    |                                |
|---------|-------|---------|--------------------------------|----|--------------------------------|
| 5-7.5   | 0-30  | T6-30   | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 5-7.5   | 0-15  | T6-15   | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 5-7.5   | 0-10  | T6-10   | 7                              | 19 | 15                             |
| 5-7.5   | 0-5   | T6-5    | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 5-7.5   | 0-3   | T6-3    | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 7-11    | 0-15  | T9-15   | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 7-11    | 0-10  | T9-10   | 7                              | 19 | 15                             |
| 7-11    | 0-5   | T9-5    | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 11-14   | 0-30  | T12-30  | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 11-14   | 0-15  | T12-15  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 11-14   | 0-10  | T12-10  | 7                              | 19 | 15                             |
| 11-14   | 0-5   | T12-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 11-14   | 0-3   | T12-3   | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 14-17   | 0-15  | T16-15  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 14-17   | 0-10  | T16-10  | 7                              | 19 | 15                             |
| 14-17   | 0-5   | T16-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 17-20   | 0-15  | T19-15  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 17-20   | 0-10  | T19-10  | 7                              | 19 | 15                             |
| 17-20   | 0-5   | T19-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 20-23   | 0-15  | T22-15  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 20-23   | 0-10  | T22-10  | 7                              | 19 | 15                             |
| 20-23   | 0-5   | T22-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 22.5-27 | 0-30  | T25-30  | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 22.5-27 | 0-12  | T25-12  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 22.5-27 | 0-10  | T25-10  | 7                              | 19 | 15                             |
| 22.5-27 | 0-5   | T25-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 22.5-27 | 0-3   | T25-3   | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 25-31   | 0-30  | T28-30  | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 25-31   | 0-12  | T28-12  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 25-31   | 0-10  | T28-10  | 7                              | 19 | 15                             |
| 25-31   | 0-4.5 | T28-4.5 | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 25-31   | 0-3   | T28-3   | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 31-33.5 | 0-30  | T32-30  | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 31-33.5 | 0-12  | T32-12  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 31-33.5 | 0-10  | T32-10  | 7                              | 19 | 15                             |
| 31-33.5 | 0-5   | T32-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 31-33.5 | 0-3   | T32-3   | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |
| 33.5-36 | 0-30  | T35-30  | 15 <sup>3</sup> / <sub>4</sub> | 19 | 16                             |
| 33.5-36 | 0-12  | T35-12  | 8 <sup>3</sup> / <sub>4</sub>  | 19 | 15                             |
| 33.5-36 | 0-10  | T35-10  | 7                              | 19 | 15                             |
| 33.5-36 | 0-5   | T35-5   | 5 <sup>1</sup> / <sub>4</sub>  | 19 | 15                             |
| 33.5-36 | 0-3   | T35-3   | 3 <sup>1</sup> / <sub>2</sub>  | 19 | 12 <sup>1</sup> / <sub>2</sub> |

† ALL NARROW RANGE MODELS ARE PROGRAMMABLE.



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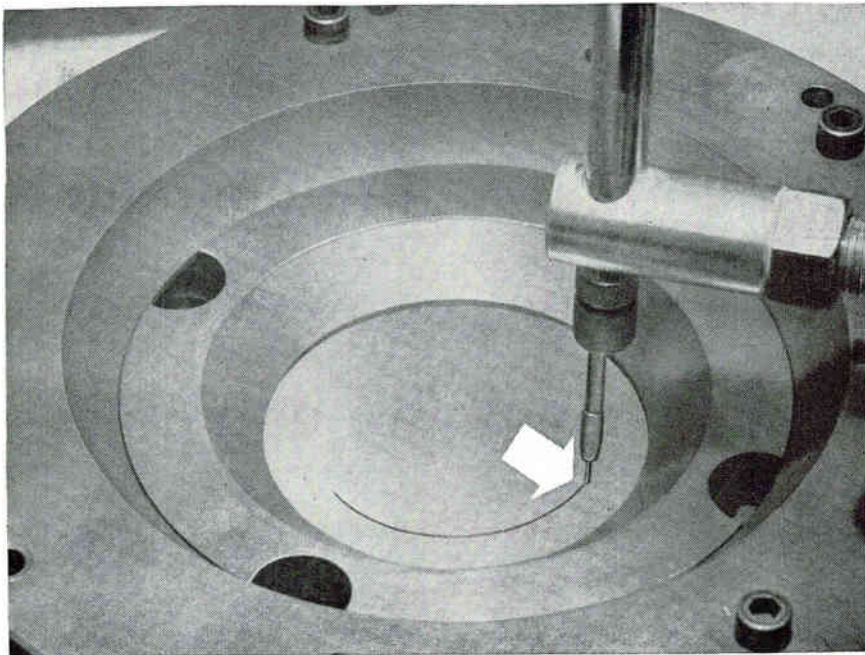
WESCON BOOTH 837

# 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.

New dual  
Model D!

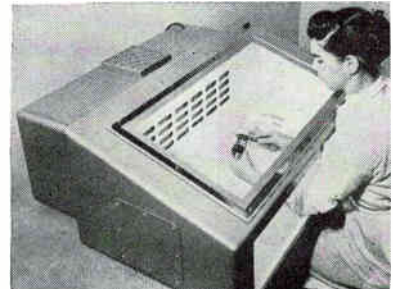


# S. S. White

S. S. White Industrial Division  
Dept. EU 10 East 40th Street, New York 16, N. Y.

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  $\pm 0.005$  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  $10^8$ , with precision 100 Kc crystal, 2 part  $10^8$ .

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 Micanite filters, with filtration to 2 microns.

CIRCLE 406 ON READER SERVICE CARD

## Transmitter Tube

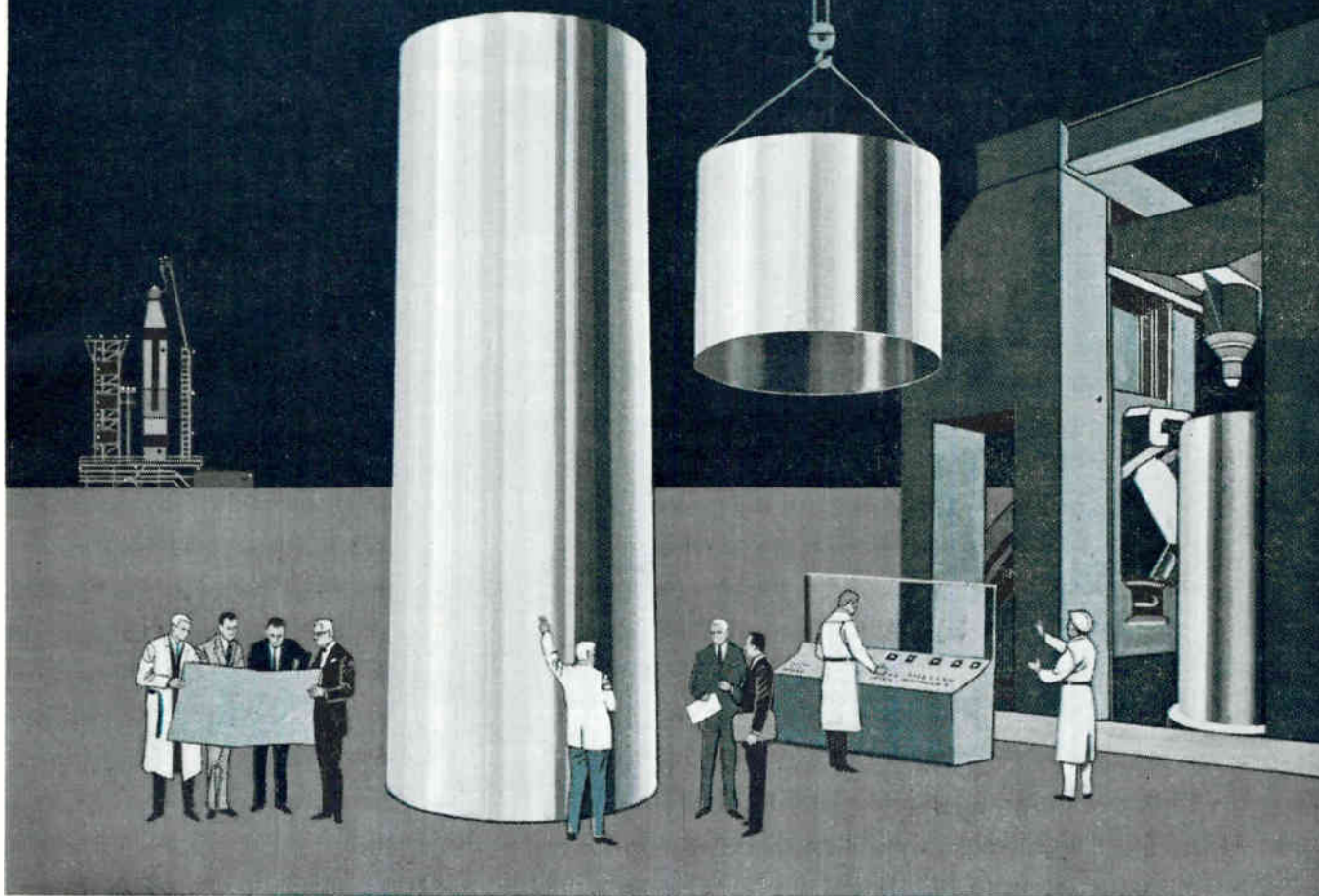
HIGH CATHODE CURRENT

MACHLETT 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:

*...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.

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

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# 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 |                                |
|-------------------------------------|--------------------------------|
| *Drive: 6.3 volts, 60 CPS           | Phase: $25^\circ \pm 10^\circ$ |
| Dwell: Average, $175^\circ$         | Balance: Within $15^\circ$     |
| Contact Rating: 2 ma, 10 v.         | Contact Action: SPDT BBM       |

\*Nominal. Non-resonant armature construction permits wide drive frequency span.

WESCON BOOTHS 711 - 712

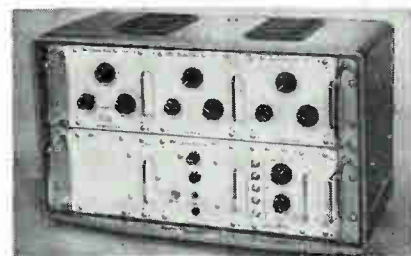


CAMBRIDGE DIVISION  
CAMBRIDGE, MARYLAND

SEMINOLE DIVISION  
FORT LAUDERDALE, FLA.

available a complete line of insulated stand-off terminals and feed-throughs. Terminals, set in molded phenolic, melamine or ceramic, are silver plated with cadmium plated bases, except those on ceramic items which are gold over silver plated. A wide range of miniature insulated stand-offs is also being offered.

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  $\mu$ sec, duration variable 0.05 to 1,000  $\mu$ sec, rise time less than 10 nanoseconds, output amplitude 12 v open circuit, 8 v into 180 ohm load.

CIRCLE 410 ON READER SERVICE CARD

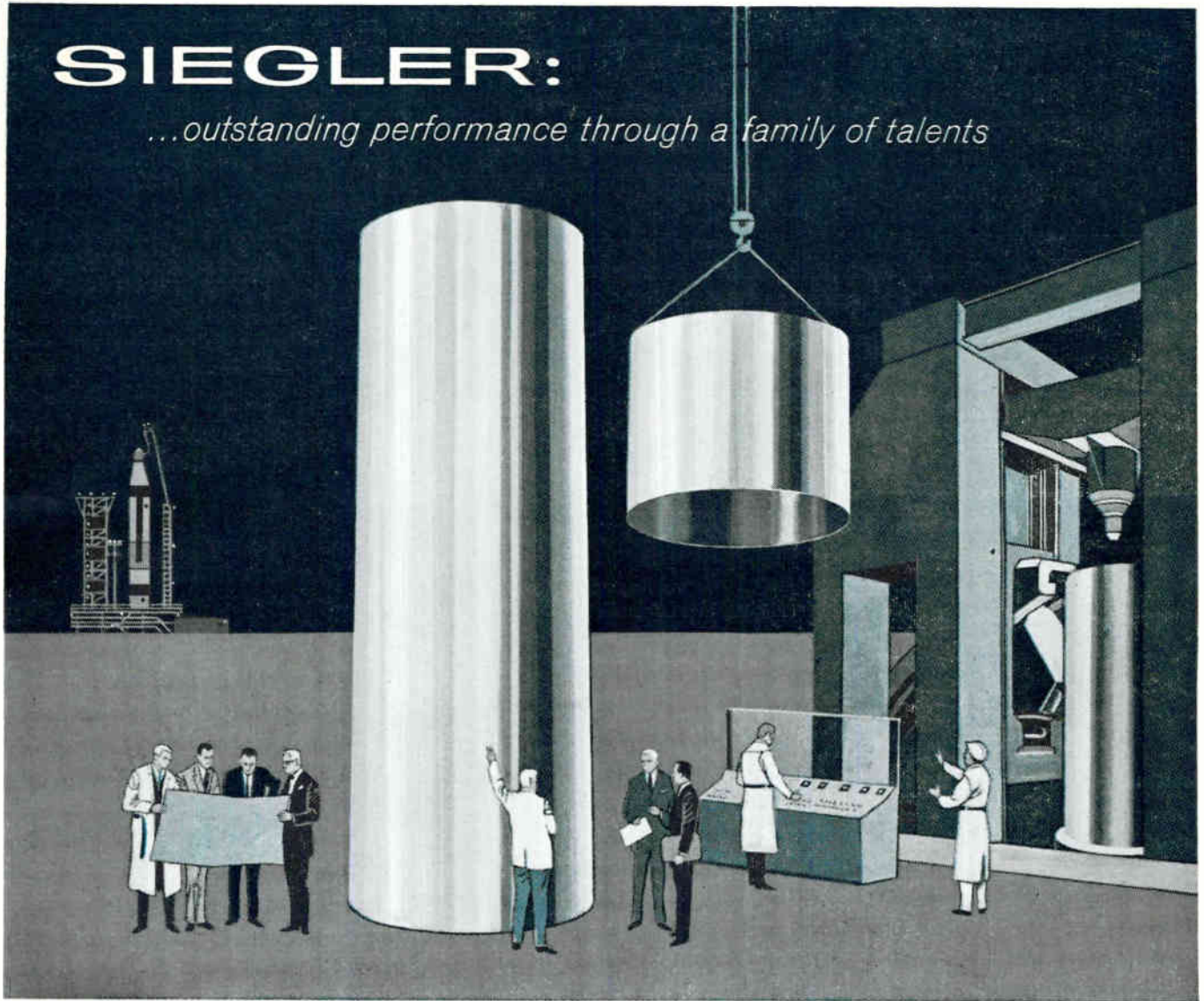
### Filters

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-measuring band pass filters in this

# SIEGLER:

*...outstanding performance through a family of talents*



*— forms giant units  
to precision tolerances...  
with no metal waste!*

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**WESCON**

**BOOTHS**

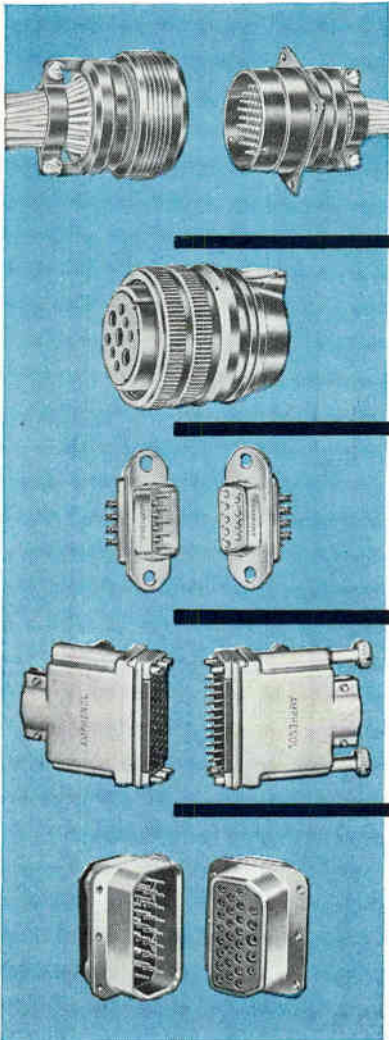
**848 & 849**

**NEW** from

**AMPHENOL**

**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.

**WESCON  
Extra!**

Come see how small connectors are getting—special display of new Micro-Miniature components!

at **WESCON**

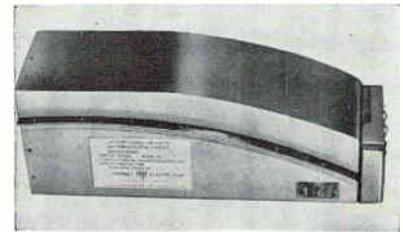
**AMPHENOL**

Booths 848 & 849

Amphenol Connector, Cable & Wire and Western Divisions  
Amphenol-Borg Electronics Corporation  
Broadview, Illinois

as an oscillator, frequency multiplier or amplifier. The tube will deliver designed specifications at frequencies up to 2,500 Mc. It may be operated at still higher frequencies with reduced ratings. The tube is a high-mu, planar triode of ceramic and metal construction, featuring a low interelectrode capacitance, high transconductance and is capable of sustained operation at elevated temperatures. The anode is air-cooled and the cathode is an indirectly-heated, oxide-coated disk. The heater characteristics are 6.3 v, 1.3 amperes d-c.

**CIRCLE 407 ON READER SERVICE CARD**



## 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.

**CIRCLE 408 ON READER SERVICE CARD**



## Stand-Off Terminals

AND FEED-THROUGHS

GOE ENGINEERING CO., 219 S. Mednik Ave., Los Angeles 22, Calif., has

# TANTALUM

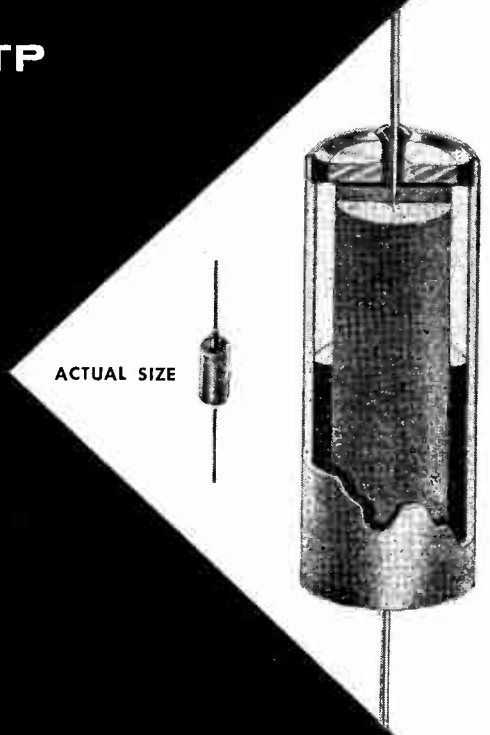
## 4 Exclusive Quality Features for Optimum User Conditions of Solid Electrolyte Tantalum Electrolytic Capacitors - Type STP

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:

- $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  operation
- $\pm 10\%$ ,  $\pm 20\%$  tolerance
- Polar operation
- **Positive** hermetic seal
- Meets or exceeds MIL-C-26655A electrically and mechanically
- Low power loss, high insulation resistance
- Minimum size, long life and stable operation



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New catalogs

- Solid Tantalum
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- High Temperature Teflon
- Miniature Polystyrene

# EFCON

# 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 |                                |
|-------------------------------------|--------------------------------|
| *Drive: 6.3 volts, 60 CPS           | Phase: $25^\circ \pm 10^\circ$ |
| Dwell: Average, $175^\circ$         | Balance: Within $15^\circ$     |
| Contact Rating: 2 ma, 10 v.         | Contact Action: SPDT BBM       |

\*Nominal. Non-resonant armature construction permits wide drive frequency span.

WESCON BOOTHS 711 - 712



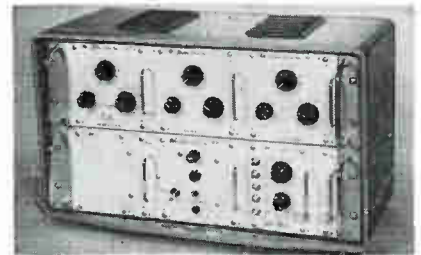
CAMBRIDGE DIVISION  
CAMBRIDGE, MARYLAND

SEMINOLE DIVISION  
FORT LAUDERDALE, FLA.

CB24

available a complete line of insulated stand-off terminals and feed-throughs. Terminals, set in molded phenolic, melamine or ceramic, are silver plated with cadmium plated bases, except those on ceramic items which are gold over silver plated. A wide range of miniature insulated stand-offs is also being offered.

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 TB301 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  $\mu$ sec, duration variable 0.05 to 1,000  $\mu$ sec, 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

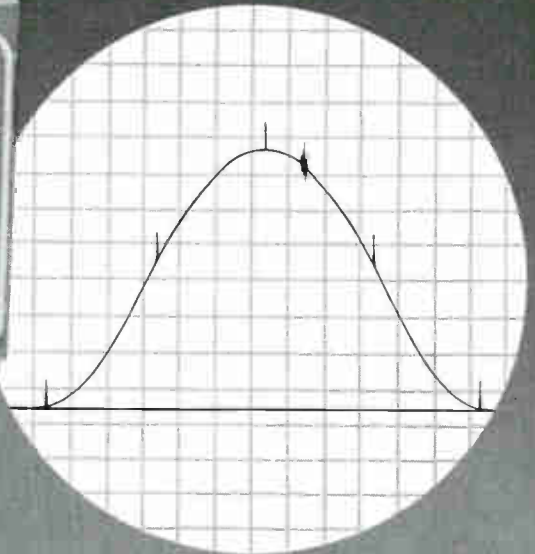
MEET MIL-F-18327A

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-measuring band pass filters in this

# Complete Sweeping Oscillator and Frequency Marker Systems



- SWEEPING OSCILLATOR
- FIXED "CRYSTAL" MARKERS
- VARIABLE FREQUENCY MARKER



## 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  $\pm 0.5$  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  $\pm 0.05\%$ .  
**Variable Marker:** "Birdie pip" marker continuously variable from 2 to 135 mc in 6 overlapping bands. Direct-reading frequency dial accurate to within  $\pm 1.0\%$ .  
**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:** \$985.00 f.o.b. factory, including cabinet and eleven crystal markers. Rack Mount deduct \$20.00.

#### 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 nom. 70 ohms (50 ohms upon request). AGC'd to  $\pm 0.5$  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 H

**VARIABLE MARKER:** (CW or "Birdie pip").  
**Frequency Range:** 1.7 to 230 mc in ten overlapping bands.  
**RF Level:** 1.0 V rms into 70 or 50 ohms, metered.  
**Flatness:**  $\pm 0.5$  db, AGC'd.  
**Attenuators:** Switched 20, 10, 6, 3 db, continuous 6 db.  
**Frequency Dial:** Direct reading, accurate to  $\pm 1\%$ .  
**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:**  $\pm 0.01\%$ .  
**Price:** \$845.00 f.o.b. factory.  
 Other Vari-Marker Models — Fixed and Variable Markers.

WRITE FOR  
CATALOG INFORMATION.

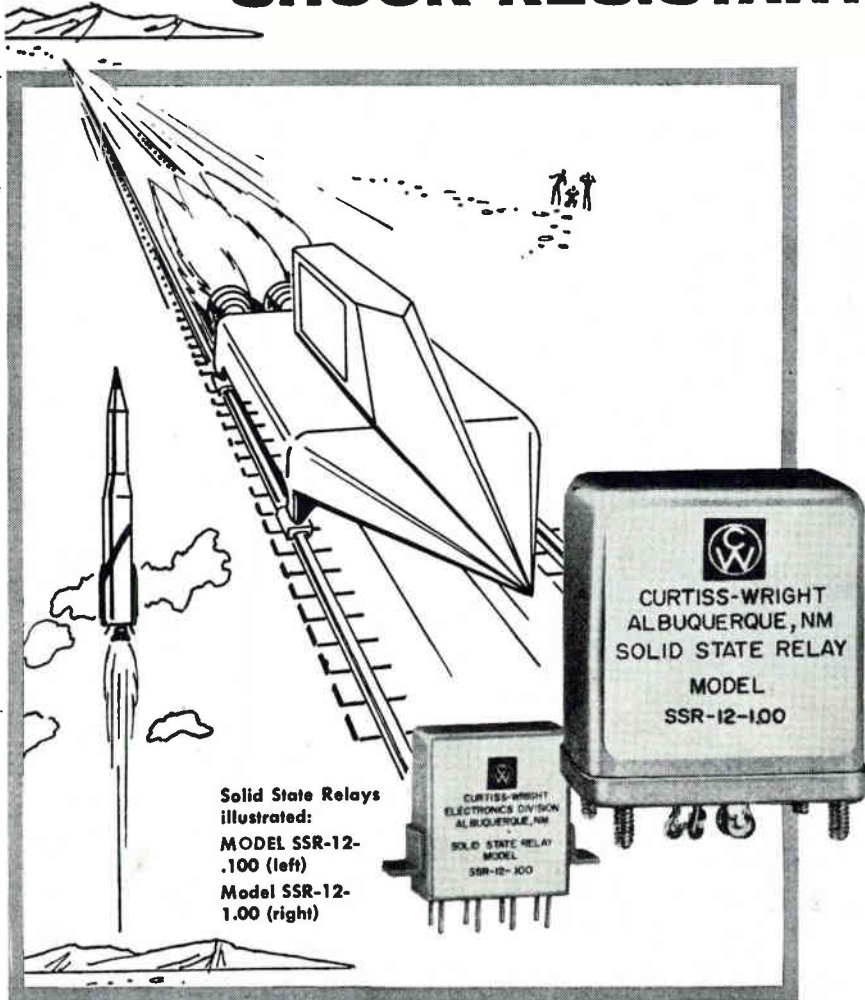
**KAY ELECTRIC COMPANY**  
DEPT. E-8 MAPLE AVE., PINE BROOK, NEW JERSEY CAPITAL 6-4000

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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.

**TRANSISTOR TEST EQUIPMENT**—Curtiss-Wright has wide experience in engineering and building test equipment to meet your needs.



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INTER MOUNTAIN INSTRUMENTS BRANCH • ELECTRONICS DIVISION

**CURTISS WRIGHT**

CORPORATION • P. O. BOX 8324, ALBUQUERQUE, N. M.

SOLID STATE RELAYS • TRANSISTOR TEST INSTRUMENTS AND SYSTEMS • DIGITAL DATA ACQUISITION AND PROCESSING SYSTEMS

group, as well as 90 cycle and 150 cycle glide slope indicator filters. High, low, band pass and discriminator filters are also included. They range in price from \$15 to \$90 and delivery is approximately four weeks.

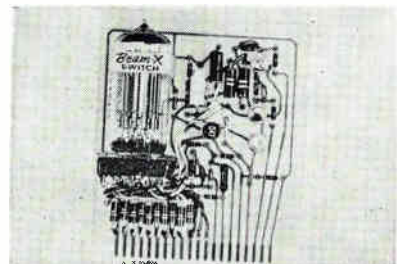
**CIRCLE 411 ON READER SERVICE CARD**



## 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.

**CIRCLE 412 ON READER SERVICE CARD**



## 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<sup>3</sup>/<sub>4</sub>" 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<sup>1</sup>/<sub>2</sub>" 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<sup>3</sup>/<sub>4</sub>" 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 of 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 PDA-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.



C. C. 2900



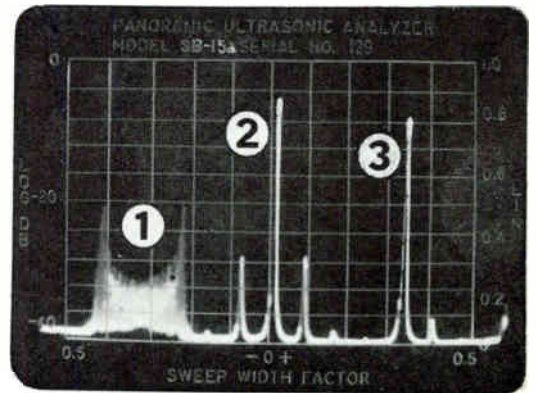
**PANORAMIC RADIO PRODUCTS, INC.**

530 So. Fulton Avenue, Mount Vernon, N. Y.

Phone: OWens 9-4600 TWX: MT-V-NY-5229 Cables: Panoramic, Mt. Vernon, N.Y. State



CIRCLE 189 ON READER SERVICE CARD



Lab setup shows SB-15a versatility. (1) FM display measures dynamic deviation; (2) & (3) are AM and SSB signals, respectively, with sine wave modulation.

**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.

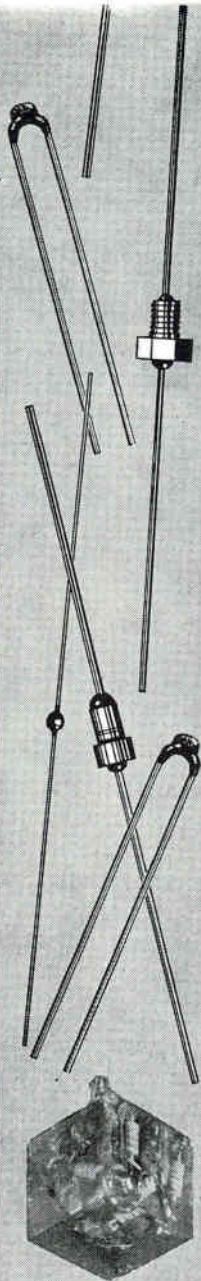
**Sensitivity:** 200  $\mu$ v to 200 v full scale deflection.

**Accuracy:**  $\pm$  0.5 db.

**Input Impedance:** 50,000 ohms.



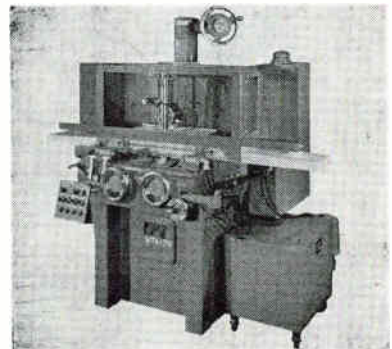
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Actual Size  
CHANNEL-PAK  
Courtesy of LEAR ASTRONICS

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  $\pm 0.0002$  in.

**CIRCLE 414 ON READER SERVICE CARD**

## Potentiometers

FOUR NEW TYPES

CLAROSTAT MFG. CO., INC., Dover, N. H., announces a new series 42

## PACKAGING PROBLEMS?

SOLVED!!

## WITH KI CAPACITORS

Radial lead—axial lead & feed-through capacitors at 200WDVC & 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:

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MUrray 2-1491



**ELECTRONICS INC.**

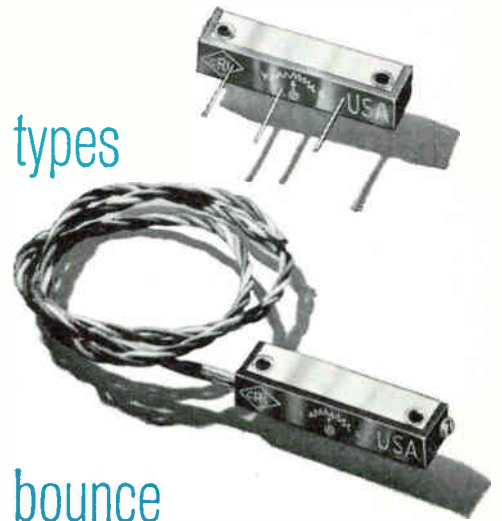
915 Meridian Ave., South Pasadena, Calif.

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.

| DESCRIPTION                | MODEL  | TERMINAL LEADS  | RESISTANCE RANGE | POWER RATING (Watts) | MAXIMUM OPERATING TEMP. | ENCAP-SULATED |
|----------------------------|--------|-----------------|------------------|----------------------|-------------------------|---------------|
| Gen. Purpose (Composition) | BA-701 | Nylon or Teflon | 10K to 2.5 Meg   | 0.25@50°C            | +125°C                  | No            |
| Gen. Purpose (Wirewound)   | BA-702 | Nylon or Teflon | 10Ω to 20K       | 0.25@50°C            | +125°C                  | No            |
| Gen. Purpose (Composition) | BA-703 | Printed Circuit | 10K to 2.5 Meg   | 0.25@50°C            | +125°C                  | Yes           |
| Gen. Purpose (Wirewound)   | BA-704 | Printed Circuit | 10Ω to 20K       | 0.25@50°C            | +125°C                  | Yes           |
| Gen. Purpose (Composition) | BA-705 | Nylon or Teflon | 10K to 2.5 Meg   | 0.25@50°C            | +125°C                  | Yes           |
| Gen. Purpose (Wirewound)   | BA-706 | Nylon or Teflon | 10Ω to 20K       | 0.25@50°C            | +125°C                  | Yes           |
| Gen. Purpose (Composition) | BA-707 | Printed Circuit | 10K to 2.5 Meg   | 0.25@50°C            | +125°C                  | No            |
| Gen. Purpose (Wirewound)   | BA-708 | Printed Circuit | 10Ω to 20K       | 0.25@50°C            | +125°C                  | No            |
| High Temp. (Wirewound)     | BA-712 | Teflon          | 10Ω to 20K       | 1.0 @ 70°C           | +175°C                  | No            |
| High Temp. (Wirewound)     | BA-714 | Teflon          | 10Ω to 20K       | 1.0 @ 70°C           | +175°C                  | Yes           |
| High Temp. (Wirewound)     | BA-716 | Printed Circuit | 10Ω to 20K       | 1.0 @ 70°C           | +175°C                  | Yes           |

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".

**Resistances:** Wirewound: 10-20-50-100-200-500-1K-2K-5K-10K-20K ohms. Composition: 10K-20K-50K-100K-500K, 1 Meg, 2.5 Meg.

**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.**

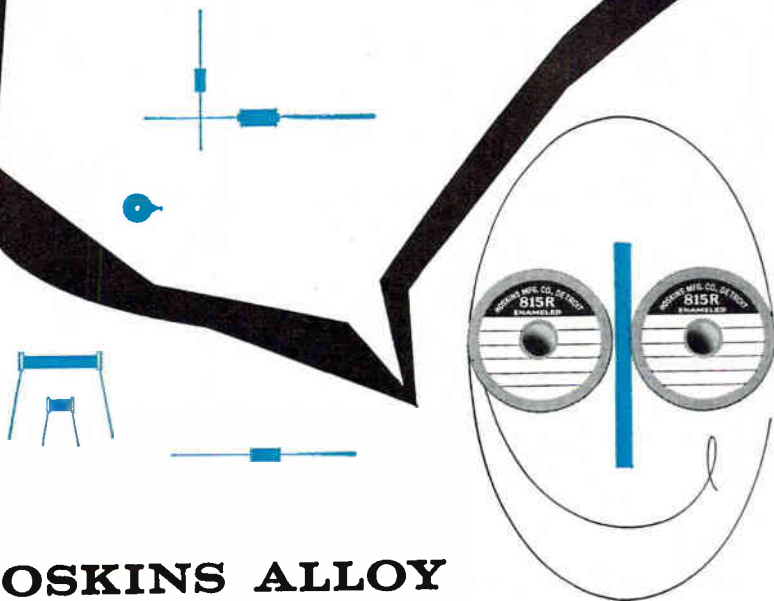


The Electronics Division of Globe-Union Inc.  
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Centralab Canada Limited • Ajax, Ontario

ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS • PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

"SEE US AT WESCON, BOOTH 664"

*lower in density,  
more ohms per pound,  
less cost per megohm!*



**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 ( $0 \pm 10$ ppm per °C. from  $-65^{\circ}$  to  $+150^{\circ}$ 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.



**Yours 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!**

\*Wire controlled to  $0 \pm 20$ ppm/°C. also available at greater savings—up to 19.6% lower cost/megohm.

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In Canada: Hoskins Alloys of Canada, Ltd., 45 Racine Rd., Rexdale P.O., Toronto, Ontario

Producers of Custom Quality Resistance, Resistor and Thermo-Electric Alloys since 1908

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 ½ 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. Coaxial 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.



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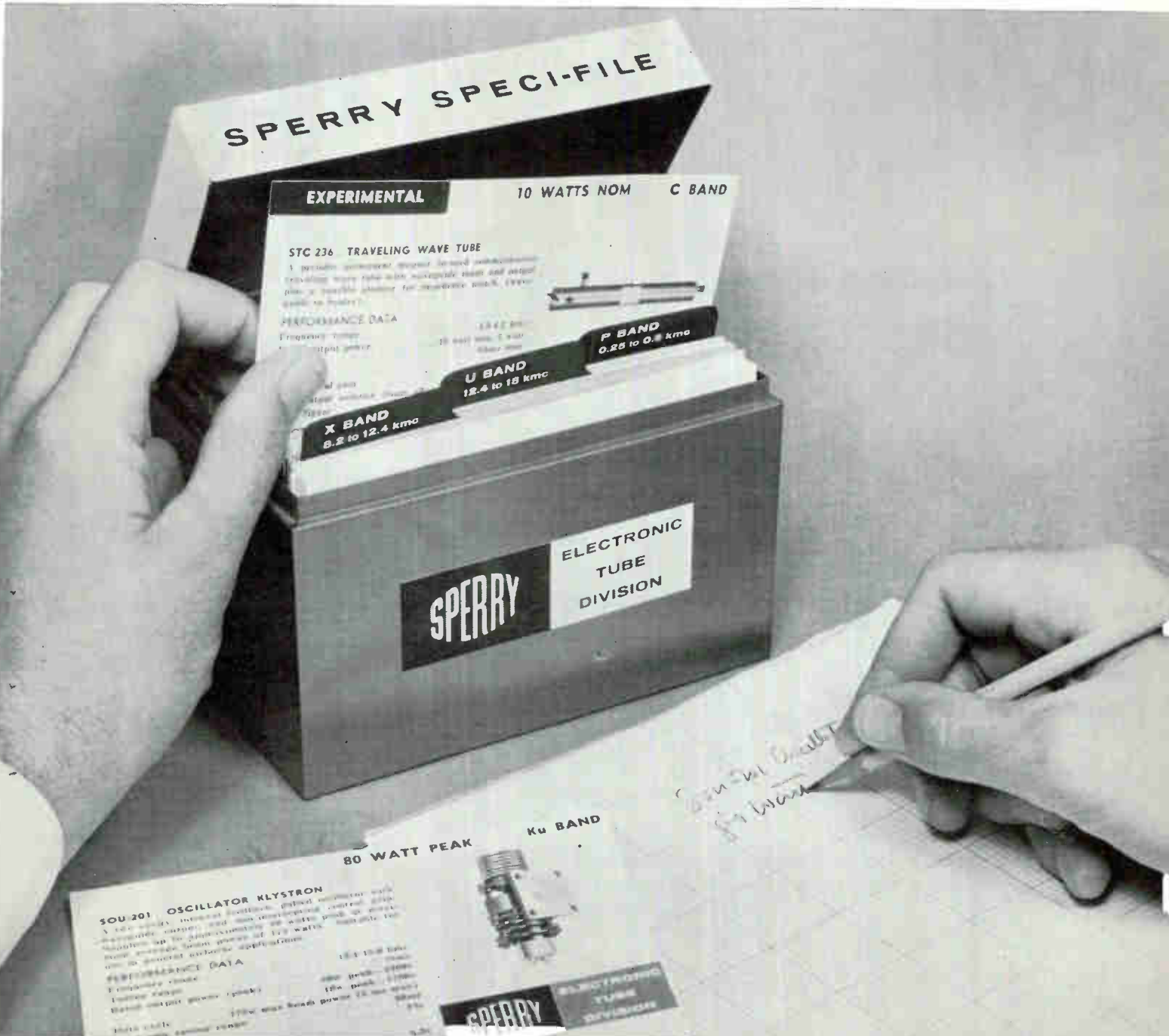
TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_

STATE \_\_\_\_\_



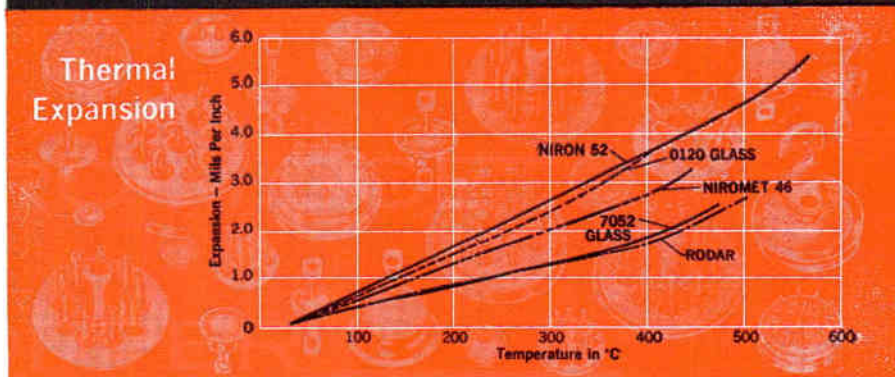


specialized alloys  
for glass hermetic seals

**RODAR<sup>®</sup>**  
**NIRON<sup>®</sup> 52**  
**NIROMET<sup>®</sup> 46**

Specified Industry-wide for

**PERMANENTLY-BONDED  
VACUUM-TIGHT SEALS!**



**RODAR<sup>®</sup>**

**NOMINAL ANALYSIS: 29% Nickel, 17% Cobalt, 0.3% Manganese, Balance-Iron**

Rodar matches the expansivity of thermal shock resistant glasses, such as Corning 7052 and 7040. Rodar produces a permanent vacuum-tight seal with simple oxidation procedure, and resists attack by mercury. Available in bar, rod, wire, and strip to customers' specifications.

| Temperature Range | Average Thermal Expansion<br>*cm/cm/°Cx10-7 |      |
|-------------------|---------------------------------------------|------|
| 30° To 200°C.     | 43.3 To 53.0                                |      |
| 30 300            | 44.1                                        | 51.7 |
| 30 400            | 45.4                                        | 50.8 |
| 30 450            | 50.3                                        | 53.7 |
| 30 500            | 57.1                                        | 62.1 |

**COEFFICIENT OF LINEAR EXPANSION**  
\*As determined from cooling curves, after annealing in hydrogen for one hour at 900° C. and for 15 minutes at 1100° C.

**NIRON<sup>®</sup> 52**

**NOMINAL ANALYSIS: 51% Nickel, Balance-Iron**

This Wilbur B. Driver nickel iron alloy contains 51% nickel. Niron 52 sealing alloy is exceptionally well adapted, and widely employed, for making seals with 0120 glass.

**NIROMET<sup>®</sup> 46**

**NOMINAL ANALYSIS: 46% Nickel, Balance-Iron**

A 46% nickel-balance iron alloy with expansion properties between Niron 52 and Rodar. It is used extensively as terminal bands for vitreous enameled resistors.

Call or write for Sealing Alloy Bulletin

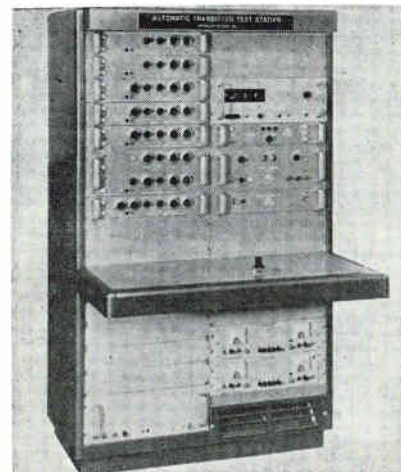
**WILBUR B. DRIVER CO.**  
NEWARK 4, NEW JERSEY, U.S.A.

IN CANADA: Canadian Wilbur B. Driver Company, Ltd.  
50 Ronson Drive, Rexdale (Toronto)

Precision Electrical, Electronic, Mechanical and Chemical Alloys for All Requirements

agement allow 1,800 ft of one mil tape or 12 minutes recording at 30 ips. Recorder also accommodates standard NARTB instrumentation hub for interchangeability with existing laboratory equipment. Prices vary between \$5,000 and \$10,000 depending on number of channels and specific requirements.

**CIRCLE 417 ON READER SERVICE CARD**



**Automatic Tester  
FOR SEMICONDUCTORS**

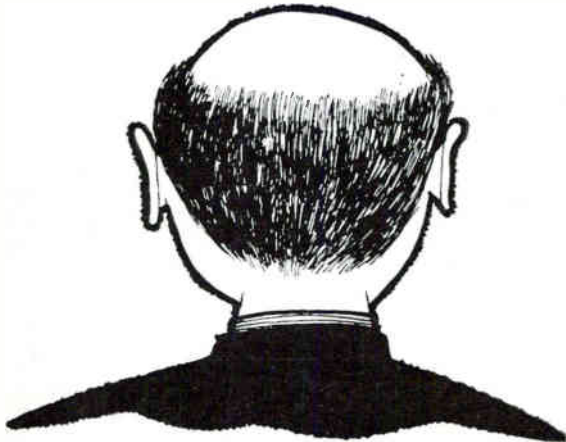
OPTIMIZED DEVICES, INC., 864 Franklin Ave., Thornwood, N. Y. This automatic semiconductor test station was developed to meet the need for increased quality in production and incoming inspection testing. Unit features completely automatic high speed testing with evaluation of transistor or diode performance accomplished by means of a precision GO, 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.

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Mail reply to: *electronics*, 330 West 42nd Street, New York 36, N. Y.

August 12, 1960

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EQUIPMENT



Test Equipment for Precision Computing Resolvers now in production — Instruments to measure Function Error, Inter-Axis Error, Null Spacing Error, Fundamental Null, Total Null, Electrical Zero, Winding Phasing, Phase Shift, and Transformation Ratio.

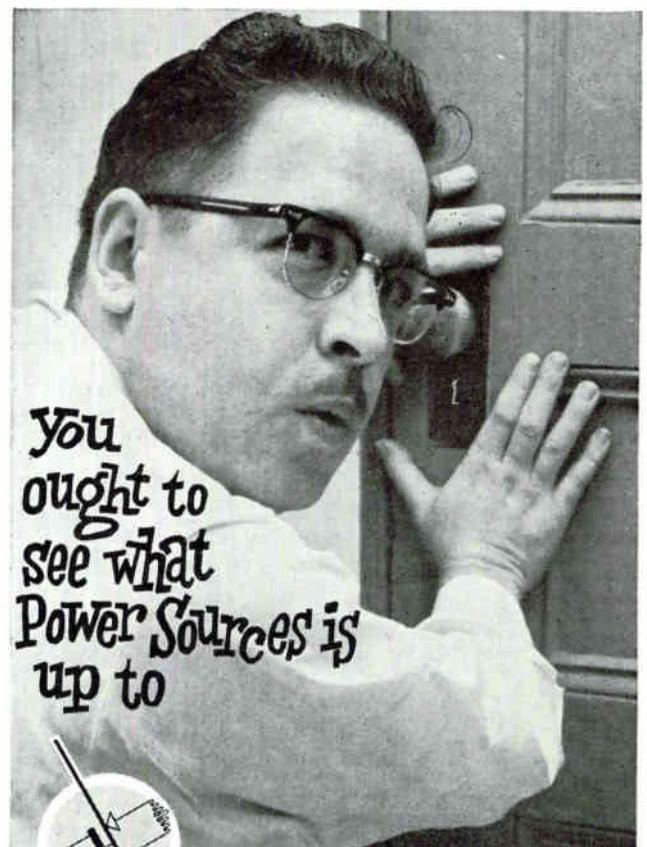
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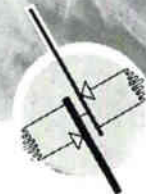
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up to



POWER SOURCES, INC.

Burlington, Massachusetts

(See Page 112 for Additional Information)

CIRCLE 195 ON READER SERVICE CARD 195

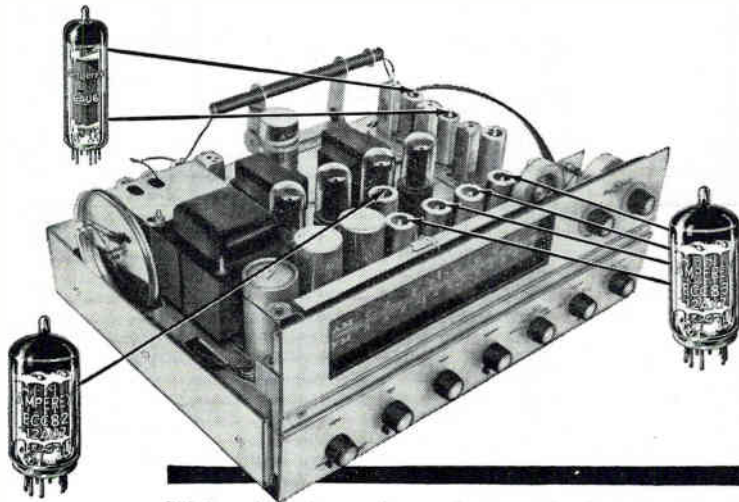
# 2 for the money

circuit by

tubes by

harman kardon

Amperex®



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 '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.

These and many other Amperex 'preferred' tube types have proven their reliability and unique design advantages in the world's finest audio components.



about hi-fi tubes  
for hi-fi circuitry

## OTHER AMPEREX TUBES FOR QUALITY HIGH-FIDELITY AUDIO APPLICATIONS

### POWER AMPLIFIERS

6CA7/EL34: 60 w. distributed load  
7189: 20 w., push-pull  
6BQ5/EL84: 17 w., push-pull  
6CW5/EL86: 25 w., high current, low voltage  
6BM8/ECL82: Triode-pentode, 8 w., push-pull

### VOLTAGE AMPLIFIERS

6Z67/EF86: Pentode for pre-amps  
12AT7/ECC81: Twin triodes, low hum, noise and microphonics  
12AU7/ECC82: Twin triodes, low hum, noise and microphonics  
12AX7/ECC83: Triode-pentode, low hum, noise and microphonics

### RF AMPLIFIERS

6ES8: Frame grid twin triode  
6ER5: Frame grid shielded triode  
6EH7/EF183: Frame grid pentode for IF, remote cut-off  
6EJ7/EF184: Frame grid pentode for IF, sharp cut-off  
6AQ8/ECC85: Dual triode for FM tuners  
6DC8/EBF89: Duo-diode pentode

### RECTIFIERS

6V4/EZ80: Indirectly heated, 90 mA  
6CA4/EZ81: Indirectly heated, 150 mA  
5AR4/GZ34: Indirectly heated, 250 mA

### INDICATORS

6FG6/EM84: Bar pattern  
IM3/OM70: Subminiature "exclamation" pattern

### SEMICONDUCTORS

2N1517: RF transistor, 70 mc  
2N1516: RF transistor, 70 mc  
2N1515: RF transistor, 70 mc

### IN542:

Matched pair discriminator diodes

### IN87A:

AM detector diode, subminiature

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# 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

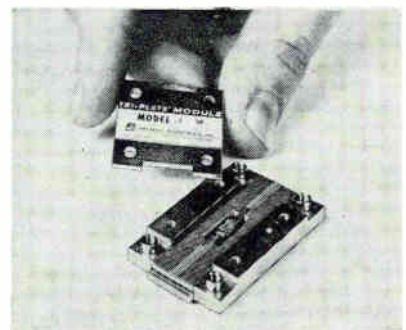
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# electronics

ting high-pitched, silent sound waves at 25,000 cps, the ultrasonic joining unit can join materials previously considered extremely difficult or impossible to "wet" with fluxless solder or weld, such as aluminum, silicon, germanium, and ferrites. The unit ultrasonically excites the molten solder on the surface of these substances and breaks down the oxide film. Generator converts a 60-cycle current into a 0.001 stroke at 25,000 cps. These rapid strokes are transmitted to the tool tip which excites the molten solder on the surface of the weld-piece; thus breaking down the oxide film and permitting a solder flow. The ultrasonic joining unit is rugged and portable, weighing only 45 lb. It will operate on a power input of 115 v a-c.

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## 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.

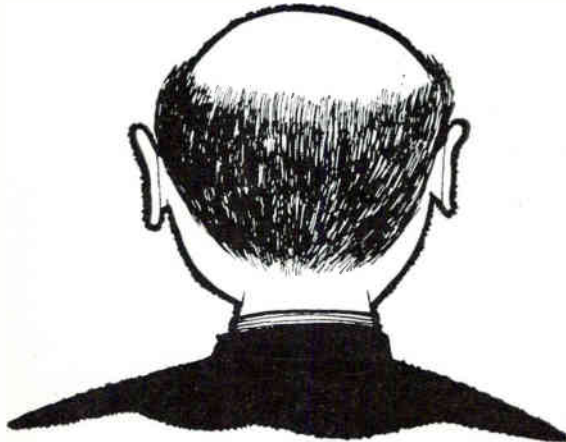
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Mail reply to: *electronics*, 330 West 42nd Street, New York 36, N.Y.

August 12, 1960

NEW design

COMPUTING  
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EQUIPMENT



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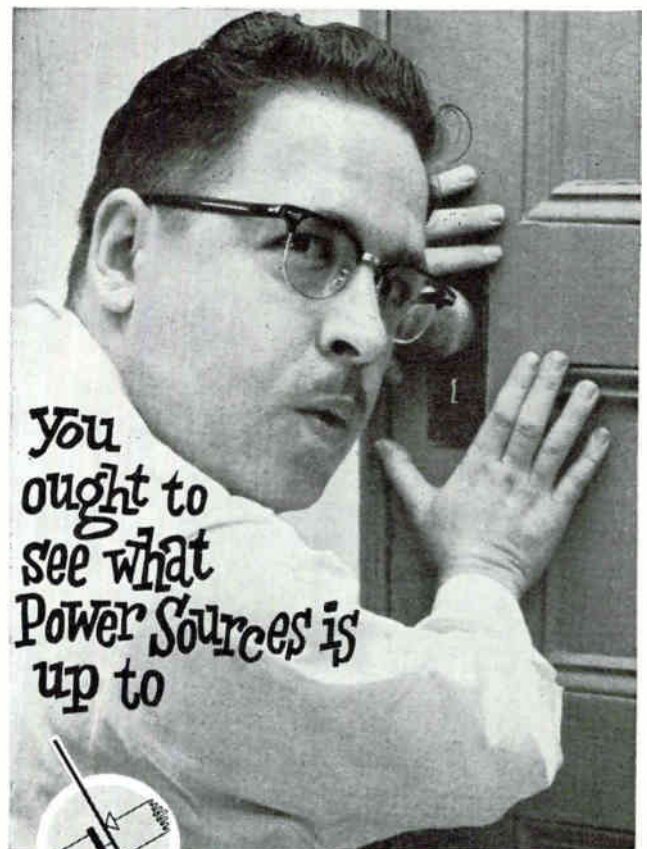
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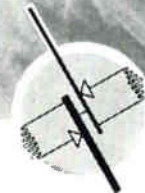
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POWER SOURCES, INC.

Burlington, Massachusetts

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195

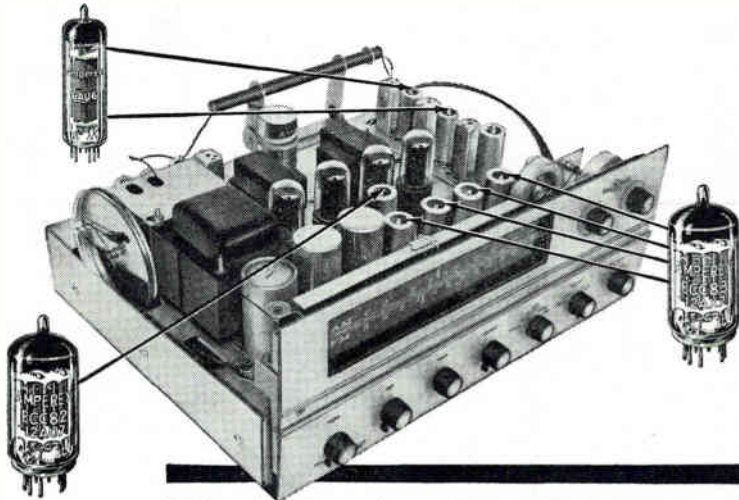
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circuit by

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Amperex®



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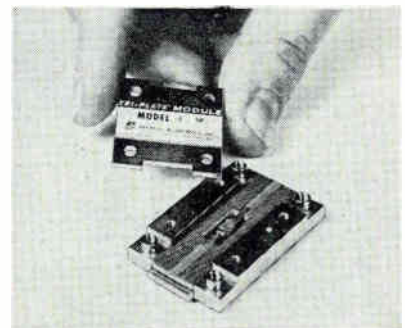
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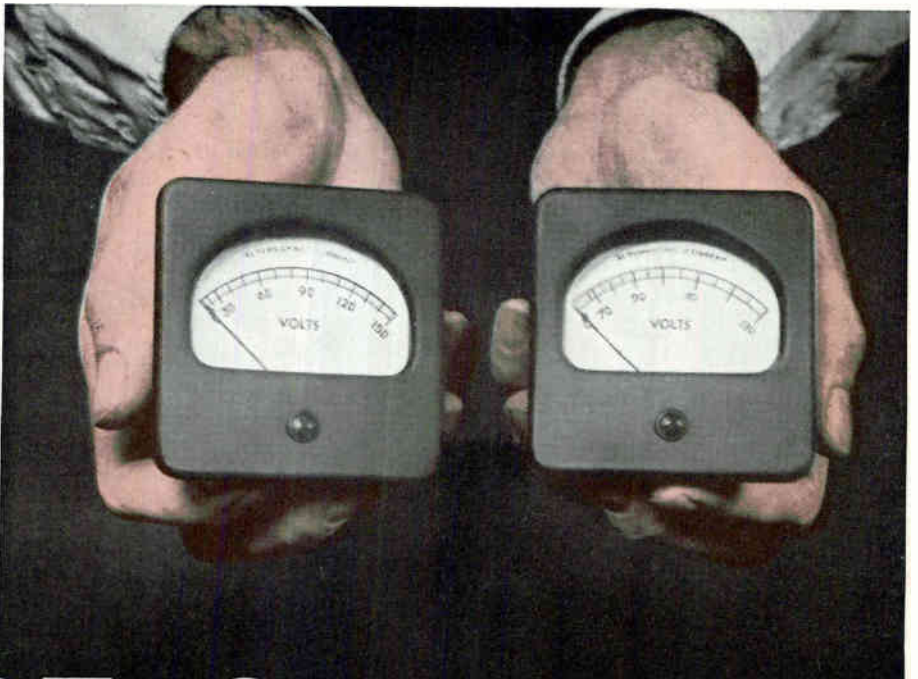
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TO GET**



# MORE SENSITIVE

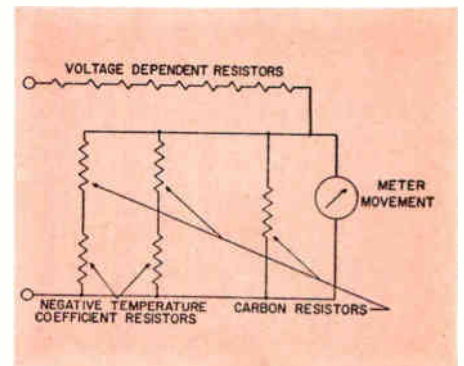
**LINE  
VOLTAGE  
READ-  
INGS?**

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.



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## Design for Reliability with the Hardwick, Hindle "Gray Line"\*

These high reliability components incorporate special design and construction features that assure the highest degree of dependability under the most adverse operating conditions. Non-crazing high temperature gray enamel, stronger core, welded wire connections, higher shock resistance, immunity to salt spray and humidity are advantages inherent in all H-H resistors. Fixed, ferrule and adjustable types comply with MIL-R-26 specifications and meet EIA standards.



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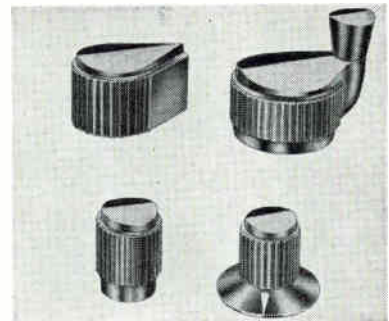
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proved readability and precise indication of true rms values. Both the model 1761 a-c voltmeter and the model 2531 ruggedized unit have an accuracy of  $\pm 0.5$  percent of center-scale value, are temperature compensated from  $- 55$  C to  $+ 70$  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.

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## Control Knobs

MEET MS-91528

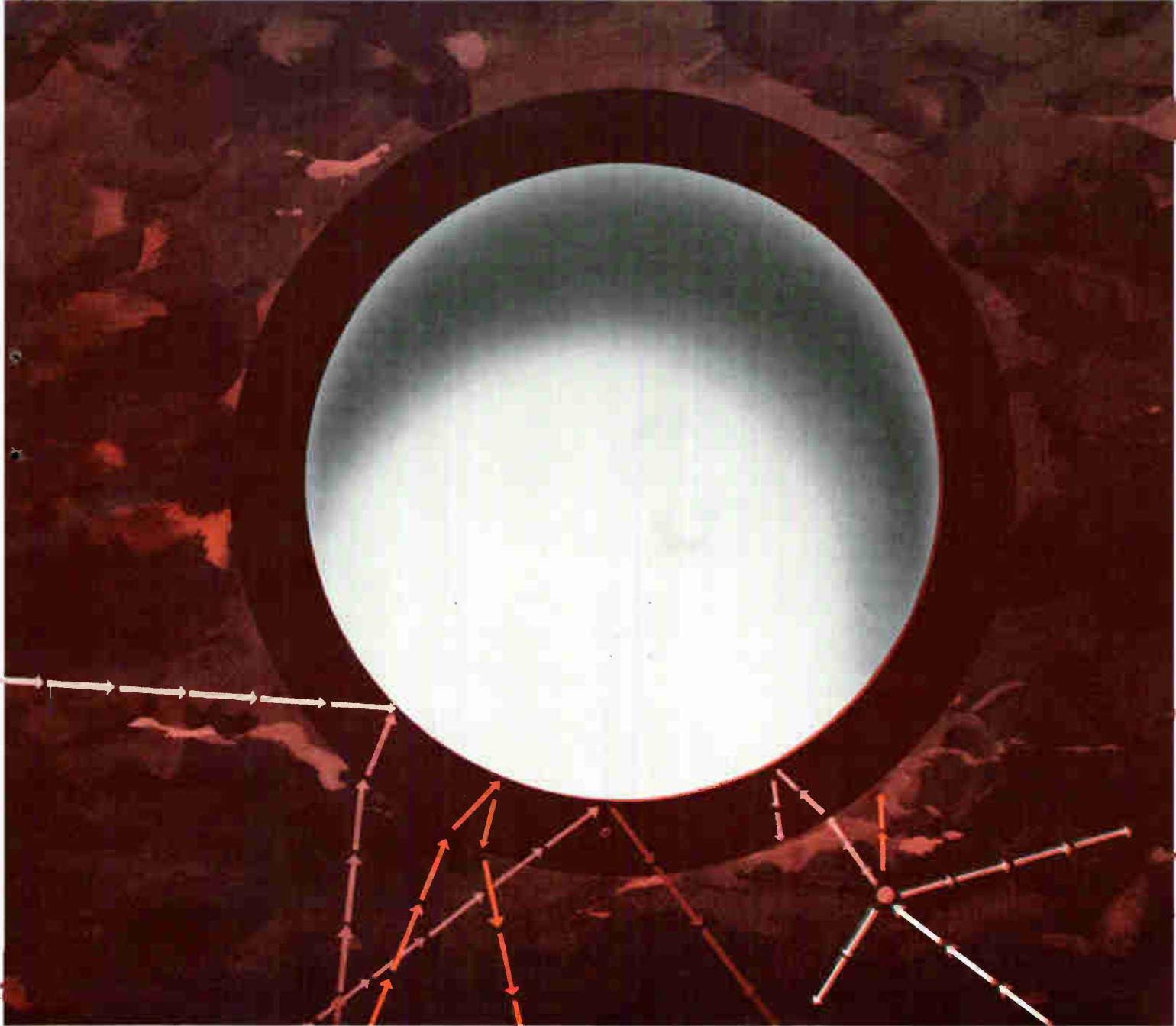
LERCO ELECTRONICS, INC., 501 S. Varney St., Burbank, Calif. Series 500 instrument control knobs are designed to MS-91528 specifications for military applications. They are available in six types—rounds, skirted rounds, dial-skirted rounds, plain and skirted pointers, and crank-types. Six different sizes 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  $\frac{1}{4}$  in. shaft hole is provided in MIL-Spec knobs, with  $\frac{1}{8}$  in. hole available on special order.

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## 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 (bifurcated) contacts. The receptacle will accept series No. 53 taper pins. The insulator body is of glass-filled



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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 engi-

neers 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.

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ACCURATE, HIGH SPEED  
**COUNTING** by  
REMOTE CONTROL

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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)



Ideal for PANEL MOUNT  
(placed and mounted from front)  
on machine or at control center



Tumbler Lock Key Reset  
for "tamper control"



"YE" Electric Series  
Push Button Reset  
(Model 5-YE-8947-Q)  
1500 CPM



"Y" Electric Series  
4 figure  
(Model 4-Y-9434-B)  
600 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

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diallyl phthalate or high-impact general purpose phenolic; has integrally molded board guides; and a single row of contacts on 0.200 in. centers. The plug, or male member of series 5011, comprises Vari-con contacts staked and soldered to the printed circuit board.

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### 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.

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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

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Accurately Count Everything . . . EVERYWHERE



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HERMETICALLY  
SEALED FOR  
MILITARY



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COUNTERS  
ONE FRAME



MODEL 6-Y  
ELECTRIC  
PREDETERMINING  
COUNTER



PUSH BUTTON  
RESET ELECTRIC  
FOR MILITARY  
APPLICATION

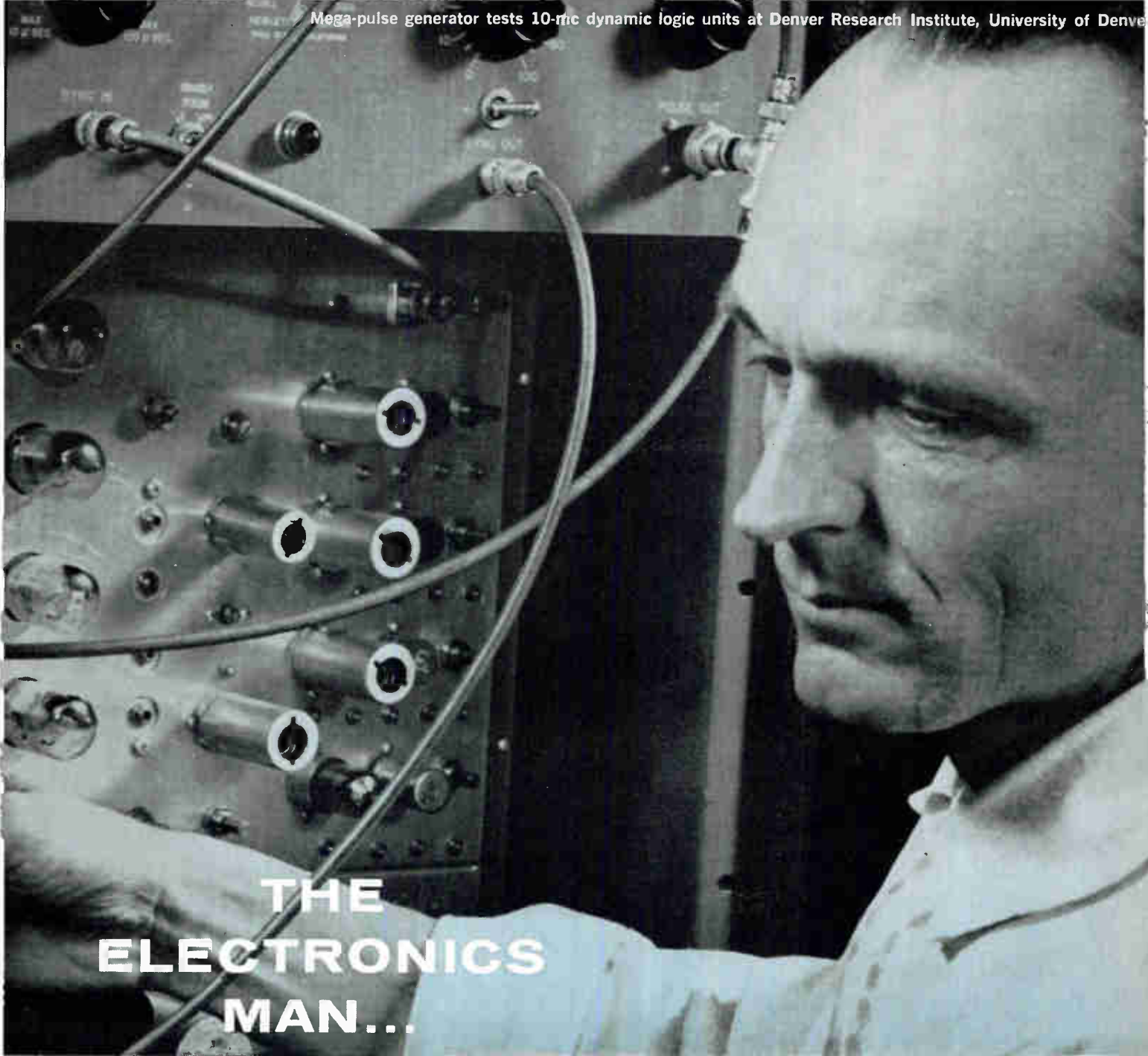


4 FIGURE  
"Y" ELECTRIC  
PANEL  
MOUNT



"SP-MF"  
ELECTRIC  
PREDETERMINED  
COUNTER

REPRESENTATIVES IN ALL PRINCIPAL CITIES



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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 supplies.

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10 ohms to 10 megohms  
±5% center scale

# E

**AC** 1 mv to 1 kv ±3%  
20 cps to 1 mc

**DC** 1 mv to 1 kv ±2%



Model 810 IRE Meter • Price: \$445.00

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 1/3 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 7 1/2" 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.

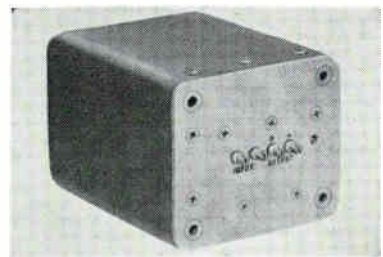
WESCON — See this instrument at Booth #903A

**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**



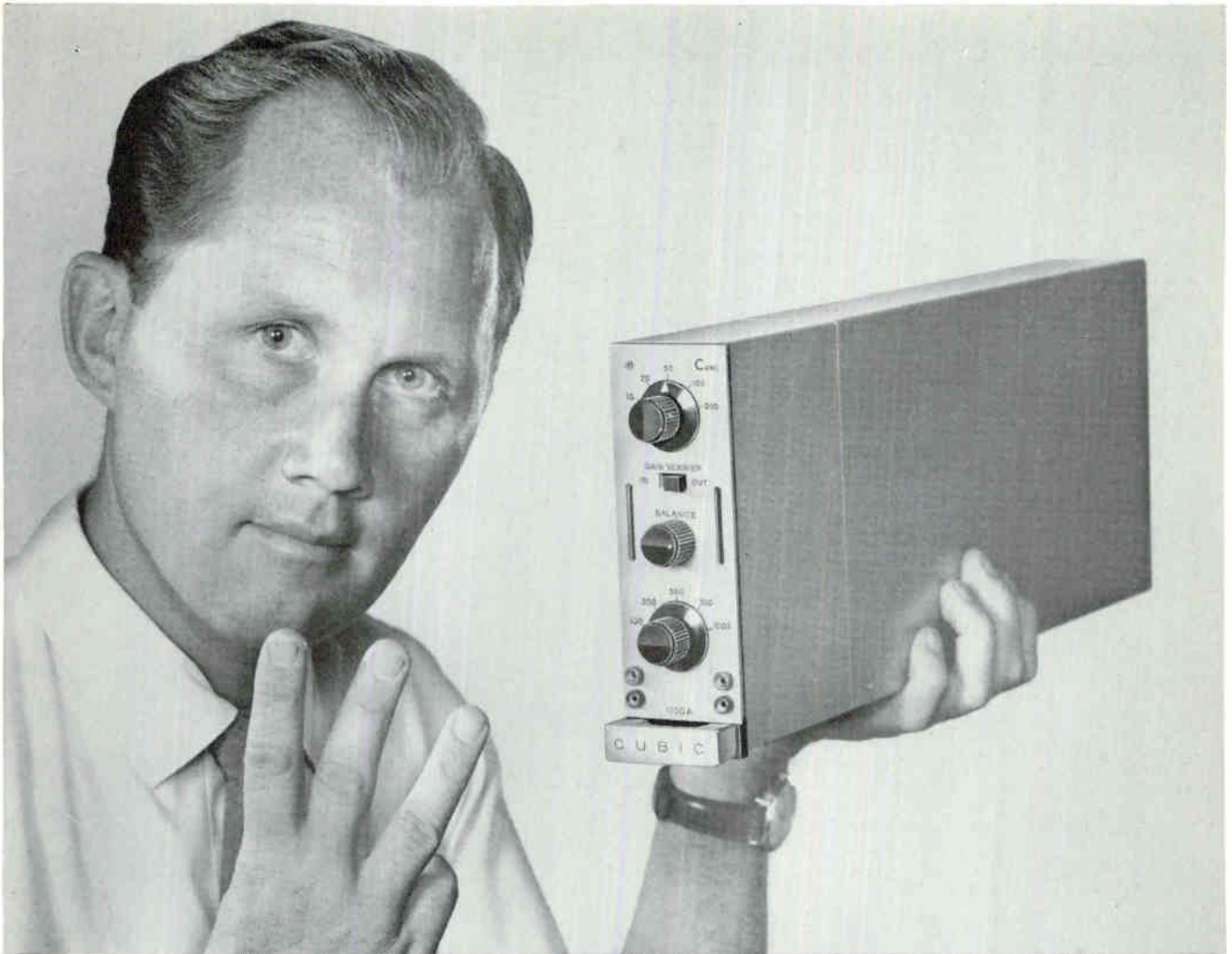
## Latch-In Relay

MINIATURE DEVICE

MAGNECRAFT ELECTRIC CO., 3352 W. Grand Ave., Chicago 51, Ill. Class 11LHS versatile enclosed latch-in relay requires only 2 1/2 by 1 1/2 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.



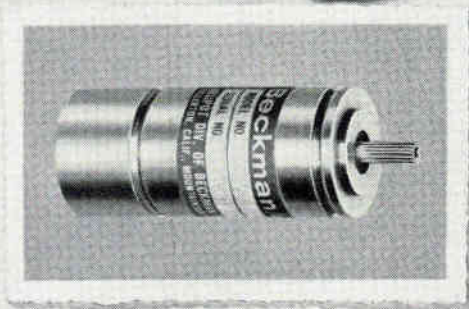
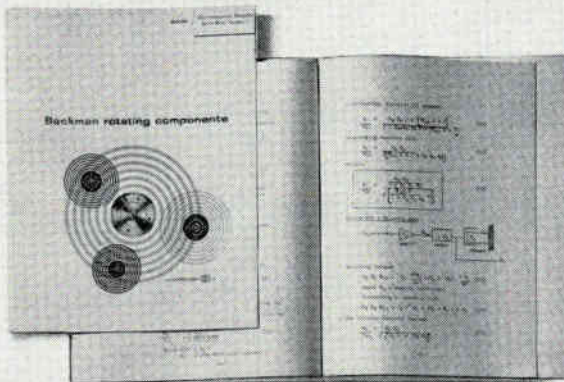
**HERE'S WHY VELOCITY DAMPING IMPROVES SERVOSYSTEM RELIABILITY...** The velocity-damp servomotor is a replacement for complicated rate-feedback loops—it achieves stability by simple and self-contained electromagnetic means.

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"



**Beckman Helipot®**

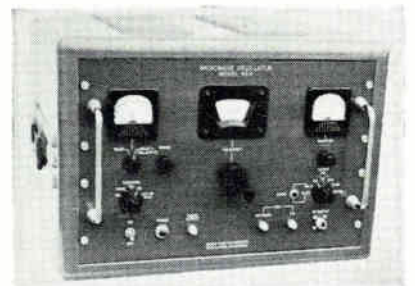
POTS : MOTORS : METERS  
Helipot Division of  
Beckman Instruments, Inc.  
Fullerton, California



©1960 B.I.I. 61045

panel space. It consists of two complete, miniature type relays mounted together. Armatures of the two relays are mechanically interlocked so that energizing one armature latches it in and releases the other armature. Coils and contact mechanisms of each relay are complete and entirely independent of the other relay except for the latch-in levers. Available hermetically sealed or with removable cover for d-c continuous or intermittent duty with up to four form C's per relay; for a-c intermittent duty with up to two form C's per relay. Furnished with miniature solder terminals with up to 27 pins or with miniature plug-in headers with up to 20 pins. Overall dimensions with solder terminal header, 4½ in. by 2¾ in. by 1½ in.

**CIRCLE 427 ON READER SERVICE CARD**



## 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.

**CIRCLE 428 ON READER SERVICE CARD**

## Transformers

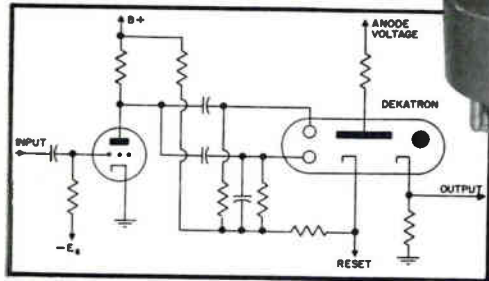
### ISOLATION TYPE

UNITED TRANSFORMER CORP., 150 Varick St., New York 13, N. Y., announces hermetically sealed shielded isolation transformers designed to give the ultimate in isola-

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 38, MASS.



Instrumentation for Better Analysis  
CIRCLE 305 ON READER SERVICE CARD



**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 306 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.

**HYDRO-AIRE**

3000 WINONA AVE., BURBANK, CALIF.

DIVISION OF **CRANE** CO.

Solid-state devices include time delay devices, voltage regulators, power supplies, inverters

CIRCLE 205 ON READER SERVICE CARD

205

# 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 miniature 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.

*Silmar F. Schjeldahl*

Please send me further information about the Radio Command System and other miniature electronic equipment for balloon flights.

Name \_\_\_\_\_ Title \_\_\_\_\_

Firm name \_\_\_\_\_

Address \_\_\_\_\_

PRODUCTS



SERVICES

## G.T. Schjeldahl Co.

NORTHFIELD, MINNESOTA

Visit Schjeldahl at WESCON — Booth 2627

### 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 users 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

Environmental—-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 mis-firing, since a series of two precise frequencies, plus a time constant are necessary in command signal.

Power requirements—45 v. 1 ma and 6 v. 100 ma

Output—2 sets of relay contacts

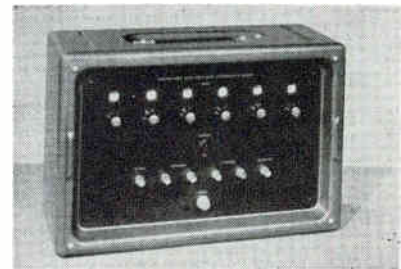
Size—2 x 6 x 1 inches

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!

tion for line-powered equipment. Isolation, which formerly could only be obtained from battery power, can now be realized by the use of these transformers. The effective capacity coupling between primary and secondary windings is less than 0.1  $\mu\mu\text{f}$ . (Even this minute capacitance can be substantially reduced by optimum circuit design suited to the individual application.) For this purpose shields are individually terminated to allow maximum flexibility. Input and output terminals are brought out on opposite sides of a special housing in order to maintain the excellent isolation between line and load.

CIRCLE 429 ON READER SERVICE CARD



## Comparator

HIGH IMPEDANCE

WAYNE KERR CORP., 1633 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 0.33:1 and 3:1. Frequency range is 400 cps to 10 Kc; range of comparison—0-3; and discrimination, 1 in  $10^5$  (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  $\mu\mu\text{f}$ .

CIRCLE 430 ON READER SERVICE CARD

## Transistor Tester

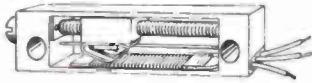
COMPACT AND RUGGED

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

# TIC TRIMMERS

are dependable because they are designed and manufactured by

**TECHNOLOGY Instrument Corp.**



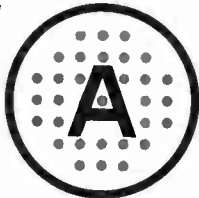
## TIC SERVICE

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**

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 AVNET•45 Winn St., Burlington, Mass. - BR 2-3060  
 AVNET•4180 Kettering Blvd., Dayton 39, Ohio. - AX 8-1458  
 AVNET•2728 N. Mannheim Rd., Melrose Park, Ill. - GL 5-8160  
 AVNET•1262 N. Lawrence Sta. Rd., Sunnyvale, Cal. - RE 6-0300

CIRCLE 51 ON READER SERVICE CARD

August 12, 1960

# 'TWIXT TRIMMERS...

*there's little difference in shape*

*not much difference in size*

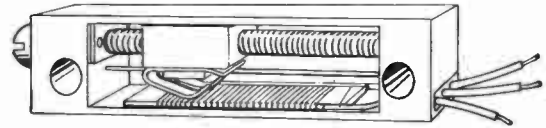
*but a **BIG DIFFERENCE INSIDE***

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  $-55^{\circ}\text{C}$  to  $-225^{\circ}\text{C}$ .

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 ( $9000^{\circ}$ ). 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.

37 turn lead screw adjustment

( $13320^{\circ}$ ). 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 ( $9000^{\circ}$ ).

Commercial type, low cost trimmers have a temperature range of  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . 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

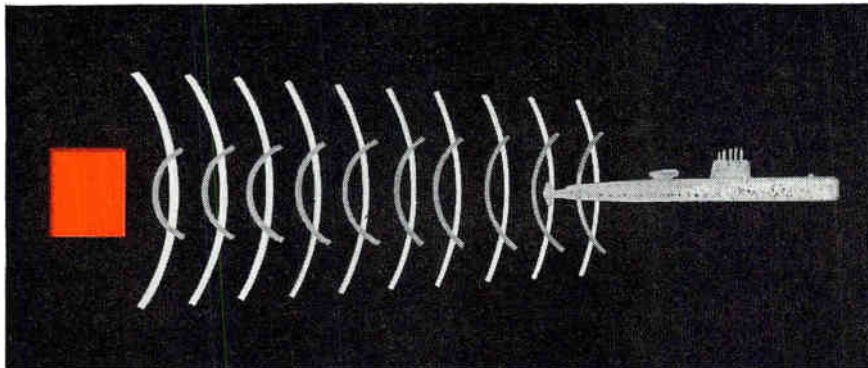


VISIT US AT BOOTHS 548 & 549 AT WESCON

CIRCLE 207 ON READER SERVICE CARD

207

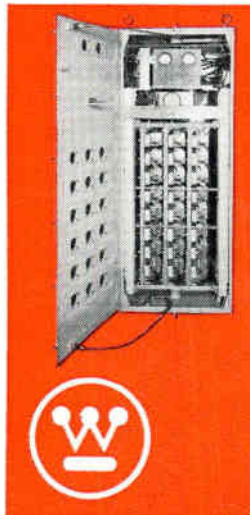
# NEW FROM WESTINGHOUSE: STATIC POWER SUPPLIES FOR SONAR



Static power packages from Westinghouse supply unflinching 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.

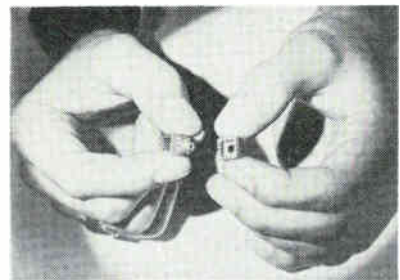
J-92503

## Westinghouse



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  $V_b$ ,  $I_b$ ,  $V_c$ , and  $I_c$  under pulse conditions and giving readings of leakage current and floating potential by standard techniques.

**CIRCLE 431 ON READER SERVICE CARD**



### Connectors

#### MICROMINIATURE

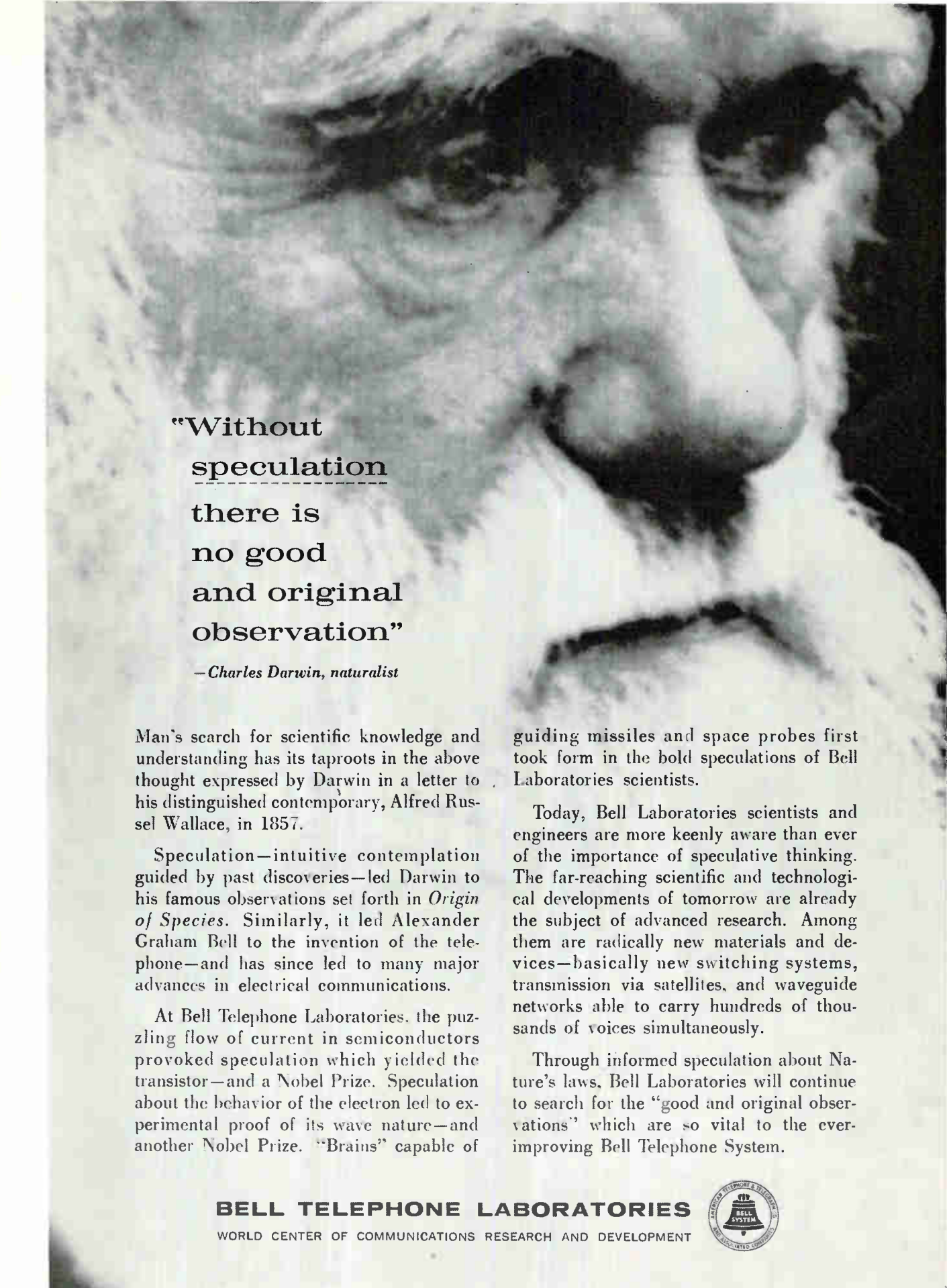
AMPHENOL-BORG ELECTRONICS CORP., 1830 S. 54th Ave., Chicago 50, Ill. The Micro Mod series of microminiature connectors provides a means of interconnection and quick removability for "stick" or module packaged circuits. Two versions are available. One mating pair consists of a receptacle and receptacle 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**

### 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-



**“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.

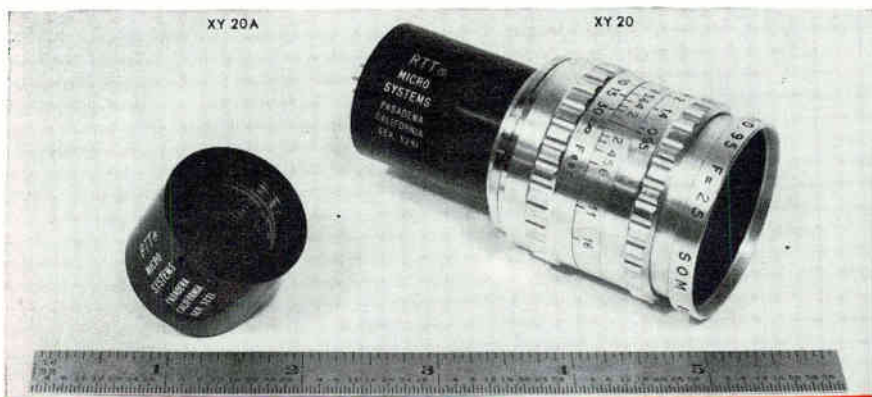
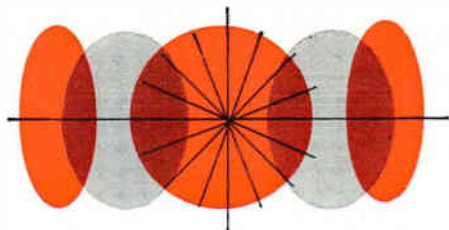
Today, Bell Laboratories scientists and engineers are more keenly aware than ever of the importance of speculative thinking. The far-reaching scientific and technological developments of tomorrow are already the subject of advanced research. Among them are radically new materials and devices—basically 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





## A REVOLUTIONARY SEMICONDUCTOR DEVICE

The Radiation Tracking Transducer detects the position of a source of radiation in two axes in microseconds with no moving parts.

**FEATURES**—Wide field—plus or minus .2 inches • High resolution—less than .000001 inch • Fast response—5 microseconds • Visible to near infrared—.5 to 1.1 microns • Single silicon element • Self-generating • Simple—only four output leads

**2 MODELS — IMMEDIATELY AVAILABLE FOR EVALUATION AND APPLICATION DEVELOPMENT**

**XY-20A** in sealed, anodized aluminum package, with calibration plot and connecting cable.

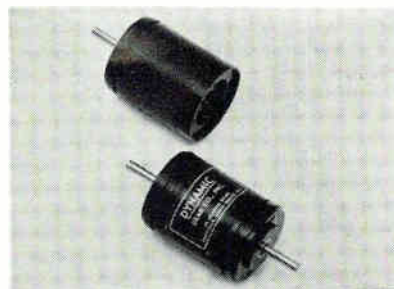
**XY-20** as above, with 25°,  $f:0.95$ ,  $F=1''$  lens.

*For detailed literature and additional information, write or phone*

**M**  
**S**  
**MICRO SYSTEMS INCORPORATED**  
 2925 East Foothill Boulevard, Pasadena, Calif.  
 SYcamore 5-5689

ponents. 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**

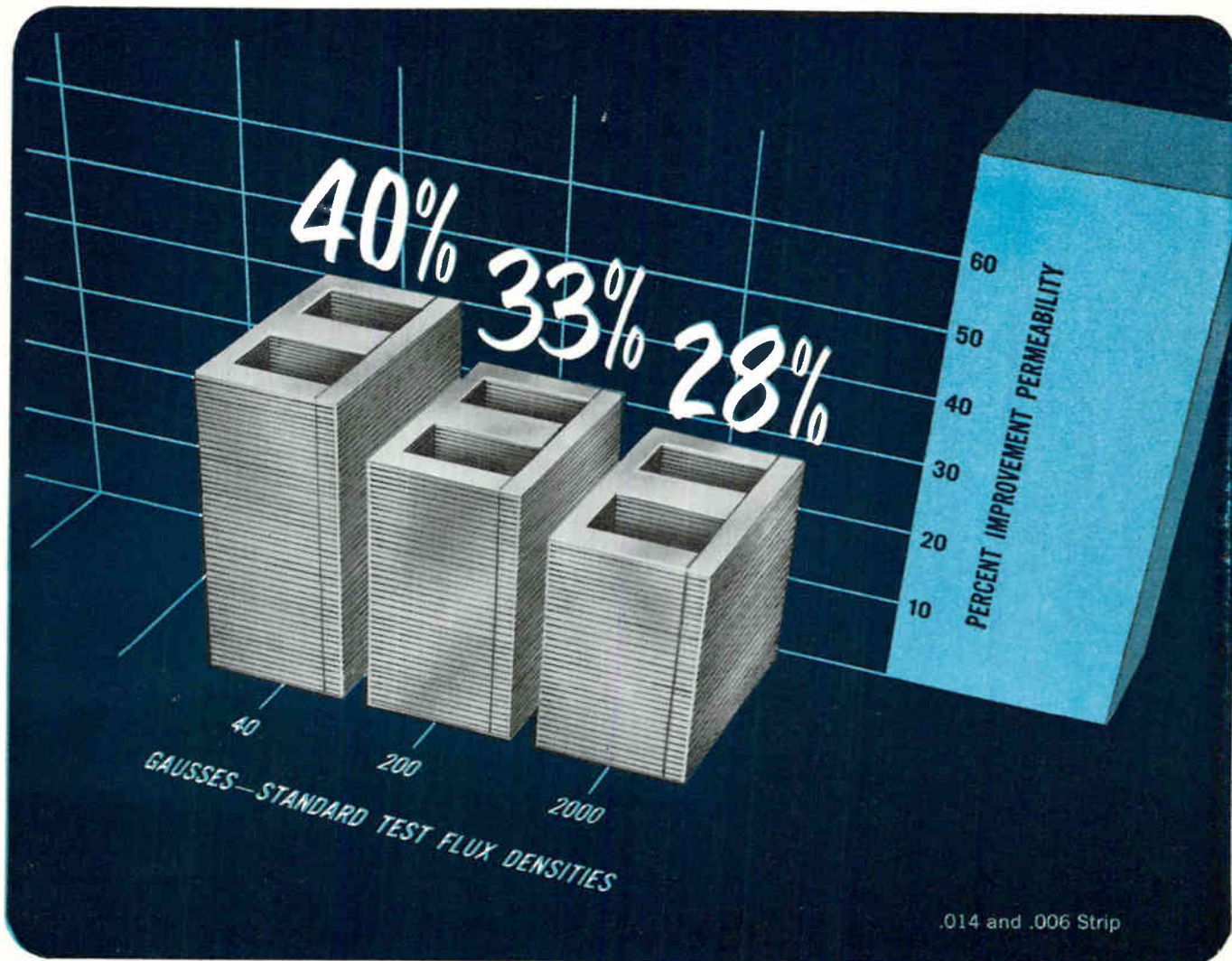
## Components

### 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



Experience—the added alloy in A-L Electrical Steels



## 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.*

WSW 7490

# ALLEGHENY LUDLUM

STEELMAKERS TO THE ELECTRICAL INDUSTRY

Export distribution, Electrical Materials: AIRCO INTERNATIONAL INC., NYC 17

Export distribution, Laminations: AD. AURIEMA, NYC 4



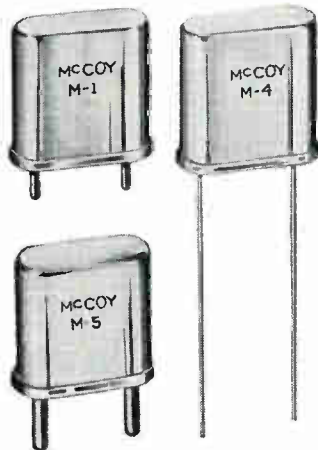
# See McCoy

## CRYSTALS and CRYSTAL FILTERS

### AT BOOTH 743

## "WESCON" SHOW

AUGUST 23-26 • LOS ANGELES, CAL.

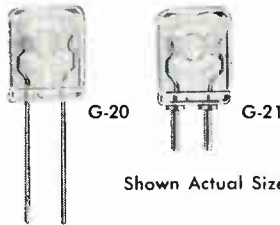


### STANDARD SIZE CRYSTAL UNITS

The crystals that made the name of McCoy a synonym for quality. Metal encased, the M-1, M-4, and M-5 are available in frequencies from 500.0 kc to 200.000 mc.

Shown Actual Size

### ALL-GLASS CRYSTAL UNITS

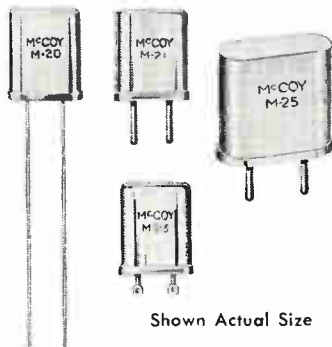


Shown Actual Size

HC-18/U type. Meet new CR-73/U and CR-74/U specs. Available 5000 kc to 200.0 mc.

### SUB-MINIATURE CRYSTAL UNITS

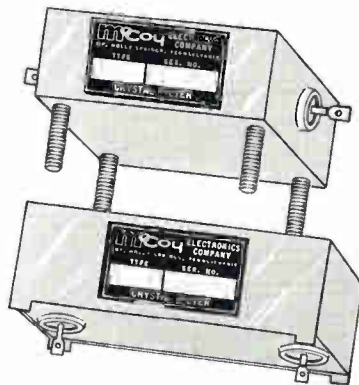
Fill the need for miniature crystals from 1.0 mc to 200.0 mc. Meet specs MIL-C-3098B and ARINC No. 401



Shown Actual Size

### CRYSTAL FILTERS

Band pass types from 1.0 mc to 30.0 mc center frequency with 6 db band widths of 0.01% to 4.0% of center frequency. Single side band types from 1.0 mc to 20.0 mc frequency with 3 db band-widths from 1.0 kc to 10.0 kc.



than ordinary rectangular waveguides, at various power levels and with a wider range of equipment. Waveguide cross section and flanges are in accordance with the proposed standards now being reviewed by the Electronic Industries Association. The new line of equipment includes adapters, tuneable detectors, variable attenuators, directional couplers, impedance meters, slide screw tuners, sliding terminals, high power terminals, 90 deg axial twists, and waveguide tubings.

CIRCLE 435 ON READER SERVICE CARD



### Electronic Timers

#### SOLID STATE

WECOR, INC., 816 N. Kedzie Ave., Chicago 51, Ill. 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  $\pm 3$  sec. Potted modular construction, transistorized circuitry with no moving parts, insure the units of faultless operation. Accuracy of  $\pm 5$  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

AMPEX 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

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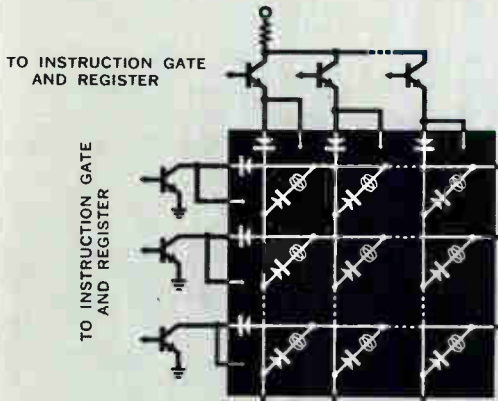


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Dept. EB  
MT. HOLLY SPRINGS, PA.  
Phone: HUnter 6-3411

# NEW



Typical n-junction matrix for n-stage matrix configuration. Fairchild 2N1613 transistors and FO200 diodes, used throughout, guarantee acceptable leakage, switching speed and conductance values up to 125°C.

# 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  $\mu\text{mA}$  maximum (2N1613) and 0.1  $\mu\text{A}$  maximum (FD200) at 25°C. Maximum values at 150°C are 10  $\mu\text{A}$  and 100  $\mu\text{A}$ .

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)

| Symbol        | Characteristic               | Min.              | Typical          | Max.             | Test Conditions                                                               |
|---------------|------------------------------|-------------------|------------------|------------------|-------------------------------------------------------------------------------|
| $h_{FE}$      | D.C. Current Gain            | 40                | 120              |                  | $I_C = 150 \text{ mA}$ $V_{CE} = 10 \text{ V}$                                |
| $V_{BE(sat)}$ | Base Saturation Voltage      |                   | 1.3V             |                  | $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$                                  |
| $V_{CE(sat)}$ | Collector Saturation Voltage |                   | 1.5V             |                  | $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$                                  |
| $C_{ob}$      | Collector Capacitance        | 18                | 25 $\mu\text{f}$ |                  | $I_E = 0$ $V_{CB} = 10 \text{ V}$                                             |
| $I_{CBO}$     | Collector Cutoff Current     | 0.8 $\mu\text{A}$ | 10 $\mu\text{A}$ | 10 $\mu\text{A}$ | $V_{CB} = 60$ $T = 25^\circ\text{C}$<br>$V_{CB} = 60$ $T = 150^\circ\text{C}$ |

FD200 ELECTRICAL SPECIFICATIONS (25°C except as noted)

| Symbol   | Characteristic                          | Min.  | Typical    | Max.                 | Test Conditions                                                   |
|----------|-----------------------------------------|-------|------------|----------------------|-------------------------------------------------------------------|
| $V_F$    | Forward Voltage                         |       |            | 1.0V                 | $I_F = 100 \text{ mA}$                                            |
| $I_R$    | Reverse Current                         |       |            | 0.1 $\mu\text{A}$    | $V_R = -150 \text{ V}$                                            |
| $I_R$    | Reverse Current (150°C)                 |       |            | 100 $\mu\text{A}$    | $V_R = -150 \text{ V}$                                            |
| $B_V$    | Breakdown Voltage                       | 200 V |            |                      | $I_R = 100 \mu\text{A}$                                           |
| $t_{rr}$ | Reverse Recovery Time                   |       |            | 50.0 $\mu\text{sec}$ | $I_f = 30 \text{ mA}$ $R_L = 150 \Omega$<br>$I_r = 30 \text{ mA}$ |
| $C_o$    | Capacitance                             |       |            | 5.0 $\mu\text{f}$    | $V_R = 0 \text{ V}$ $f = 1 \text{ mc}$                            |
| RE       | Rectification Efficiency                | 35%   |            |                      |                                                                   |
|          | Forward Voltage Temperature Coefficient |       | -1.8 mV/oC |                      | 100 mc                                                            |

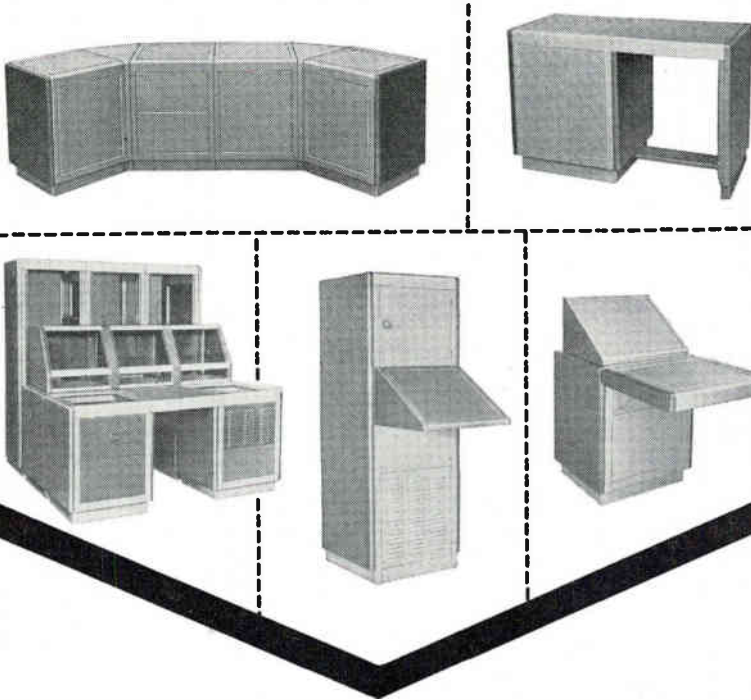


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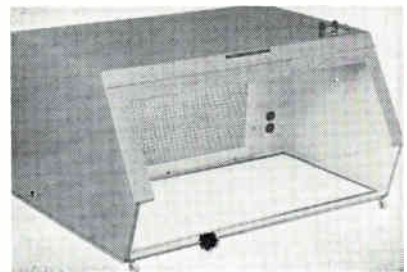
WESTERN SALES OFFICE: 1485 Bayshore Blvd., San Francisco 24, California  
EXPORT DEPARTMENT: EMEC, 127 Grace Street, Plainview, New York  
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MODULAR CONSOLE SYSTEM • WESCON SHOW — BOOTHS 340-341**

general laboratory application. It accommodates either  $\frac{1}{2}$  or 1-in.-wide tape on 10 $\frac{1}{2}$ -in. reels, and provides six tape speeds—1 $\frac{1}{2}$ , 3 $\frac{1}{2}$ , 7 $\frac{1}{2}$ , 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  $\pm 0.25$  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



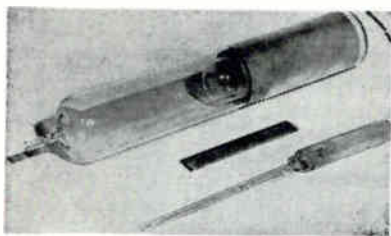
### Dust-Free Cabinet

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. Special-  
aire measures 36 in. by 28 in. by 18  
in.

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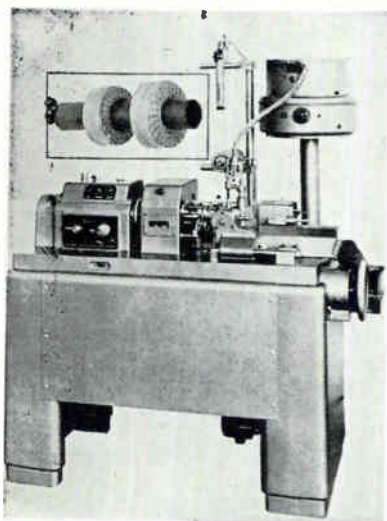


## T-R Tubes

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 suc-  
cessfully tested in air-cooled du-  
plexers at over 100 Kw average  
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cover a range from uhf to S-band.  
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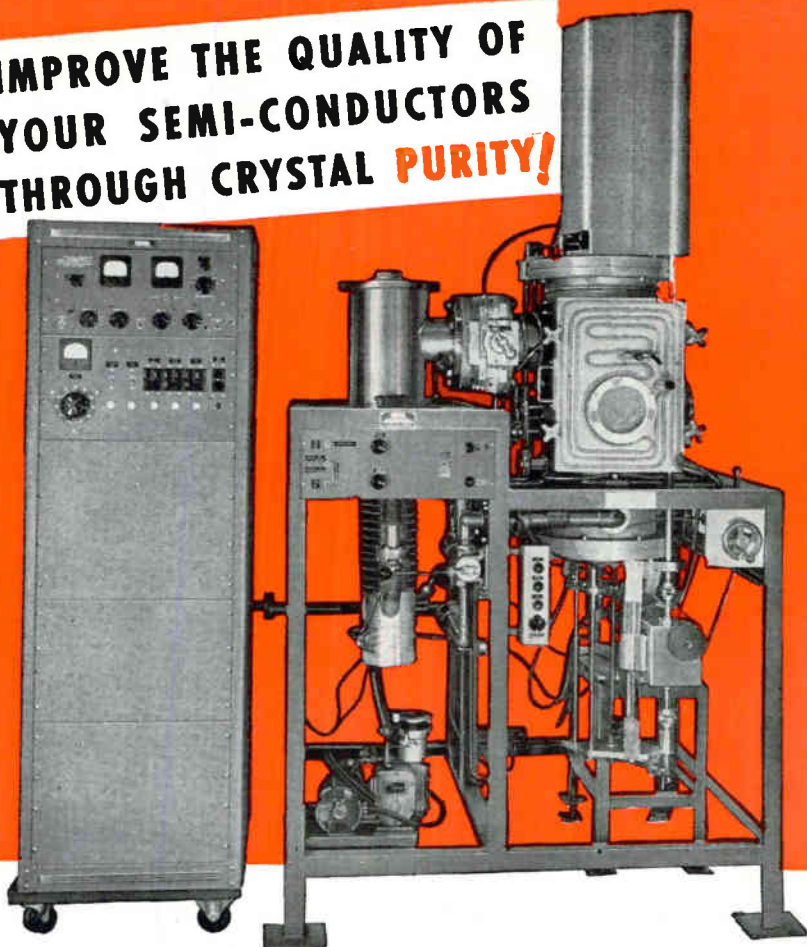
## Coil Winder

FULLY AUTOMATIC

ASSOCIATED AMERICAN WINDING MA-  
CHINERY, INC., 750 St. Ann's Ave.,  
New York 56, N. Y. New Blu-Red  
automatic winding machine will  
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ance. Model KWA-58 automatically  
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ing part per billion purity in the refined crystal to assure  
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tion runs of universal coils—such as cross-wound or lattice type windings—the coil winder has a speed of 200 to 3,000 rpm, steplessly adjustable. Wire diameter ranges from 0.004 in. to 0.020 in.; coil width can be up to 0.945 in. Maximum core length is 2½ in.; coil diameter is 2 in., maximum. Settings of coil width, crossover rate and progression are quickly and easily made from outside the machine, without calculation. Enamelled wire, cemented as wound, may be used.

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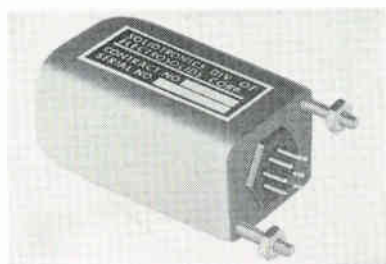


**Mixer-Preamplifier**

**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 9½ db. Gain is 25 db, and one milliwatt of local oscillator power is required.

**CIRCLE 441 ON READER SERVICE CARD**



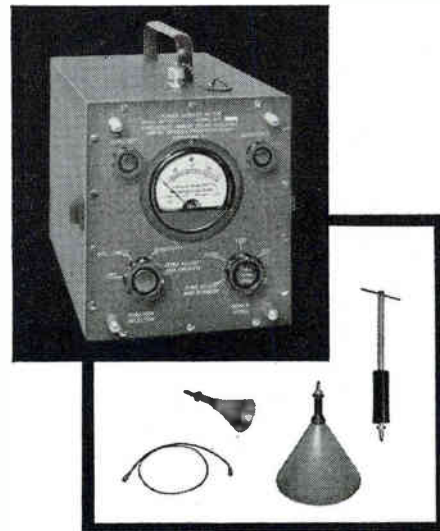
**Subcarrier Oscillator**

**TRANSISTORIZED**

SOLIDTRONICS DIVISION, Electro-solids Corp., 14751 Keswick St., Van Nuys, Calif. New, completely solid state subminiature subcarrier

**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/cm<sup>2</sup> to 1000 mw/cm<sup>2</sup> (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/cm<sup>2</sup> 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.
- Conservative design insures resistance to over-load.
- Main unit may be used independently as an accurate, rugged RF power meter over a wide power range.



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# THE ELECTRONICS MAN

## IDENTIFICATION

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## WHERE TO FIND HIM

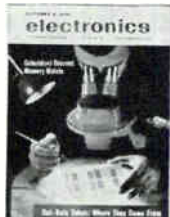
The electronics man may be found in any or all of the areas of research, design, production, management.

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.

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# electronics

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August 12, 1960

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- SIMPLIFY ASSEMBLY
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DIE CAST ZINC ALLOY & MOLDED NYLON

now! WASHER BASE WING NUTS from GRC STOCK



Integral wide-diameter washer base eliminates need for separate washer. Cuts your cost, saves assembly time and labor. Specially suitable for use with bolt holes, adjusting slots, soft surfaces. Holds better because of greater seating area. 14 thread sizes—#6 thru 3/8". GRC—world's most complete stock of standard and special wing nuts.

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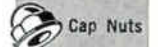
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Wing Nuts



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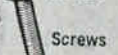


Thumb Nuts



Thumb & Wing Screws

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Screws



Hex Nuts



Washers



Screw Insulators

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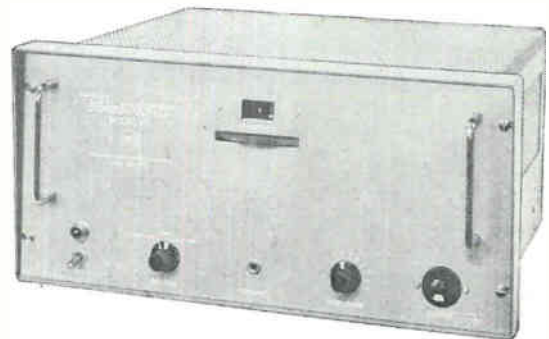
## NEW

# Powertron

## AC ELECTRONIC GENERATOR

MODEL 150  
\$525<sup>00</sup>

PRECISION AC POWER SUPPLY FOR LABORATORY & PRODUCTION USE



### SPECIFICATIONS

|                                              |             |                                        |                    |
|----------------------------------------------|-------------|----------------------------------------|--------------------|
| Power Output .....                           | 160 V.A.    | Total Distortion .....                 | Less than 1%       |
| Fixed Frequency 400 CPS (other freq. avail.) |             | Regulation .....                       | Less than 1%       |
| Variable Frequency .....                     | 350-450 CPS | Operates with load of any power factor |                    |
| External Frequency .....                     | 50-4000 CPS | Small size .....                       | 8 3/4" x 19" Panel |

Also Available — Model 250 — 250 VA Power Output

Representatives in Principal Cities



**INDUSTRIAL TEST EQUIPMENT CO.**  
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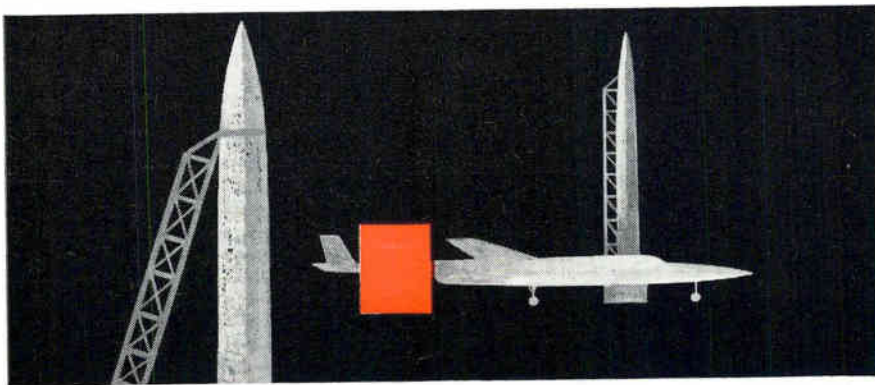
VISIT OUR BOOTH NO. 433—WESCON 1960

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217

# NEW FROM WESTINGHOUSE:

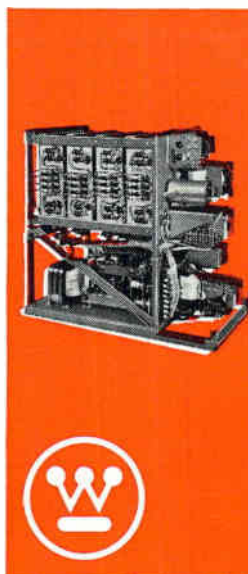
## STATIC POWER SUPPLIES FOR GROUND SUPPORT EQUIPMENT



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. Box 868, Pittsburgh 30, Pennsylvania.

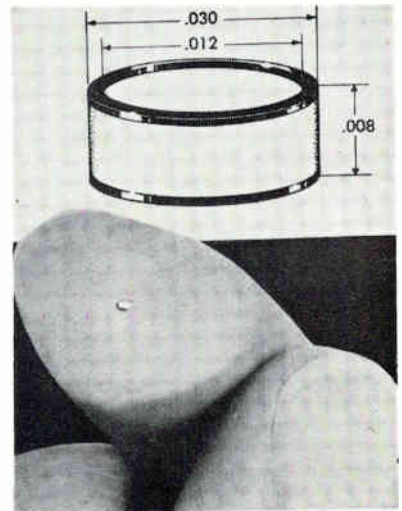
J-92504

## Westinghouse



oscillator utilizes a sine wave oscillator which eliminates the necessity for output filters. It also employs reactive current feedback to insure against overdriving. It features: no warmup time; a maximum drift of  $\pm 0.5$  percent over the bandwidth over an eight hour period and a wide temperature range; a signal linearity of less than  $\pm 0.5$  percent; the practical utilization of an unregulated power source—a variation of power supply voltage of 10 percent will produce less than a 0.05 percent frequency change. The unit has a volume of 2.5 cu in. and weighs less than 2.5 oz.

CIRCLE 442 ON READER SERVICE CARD



### 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.

CIRCLE 443 ON READER SERVICE CARD

### Oscilloscope

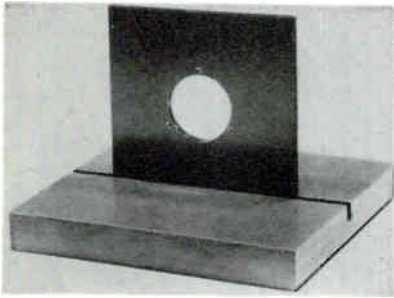
#### MILITARIZED

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 transformation 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.

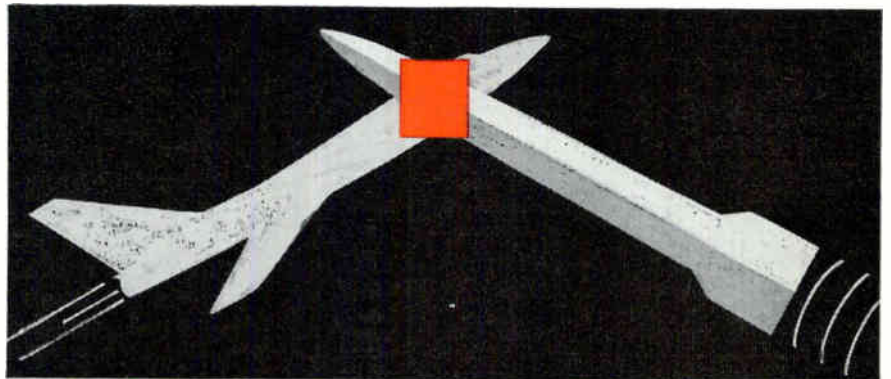
**CIRCLE 445 ON READER SERVICE CARD**



**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

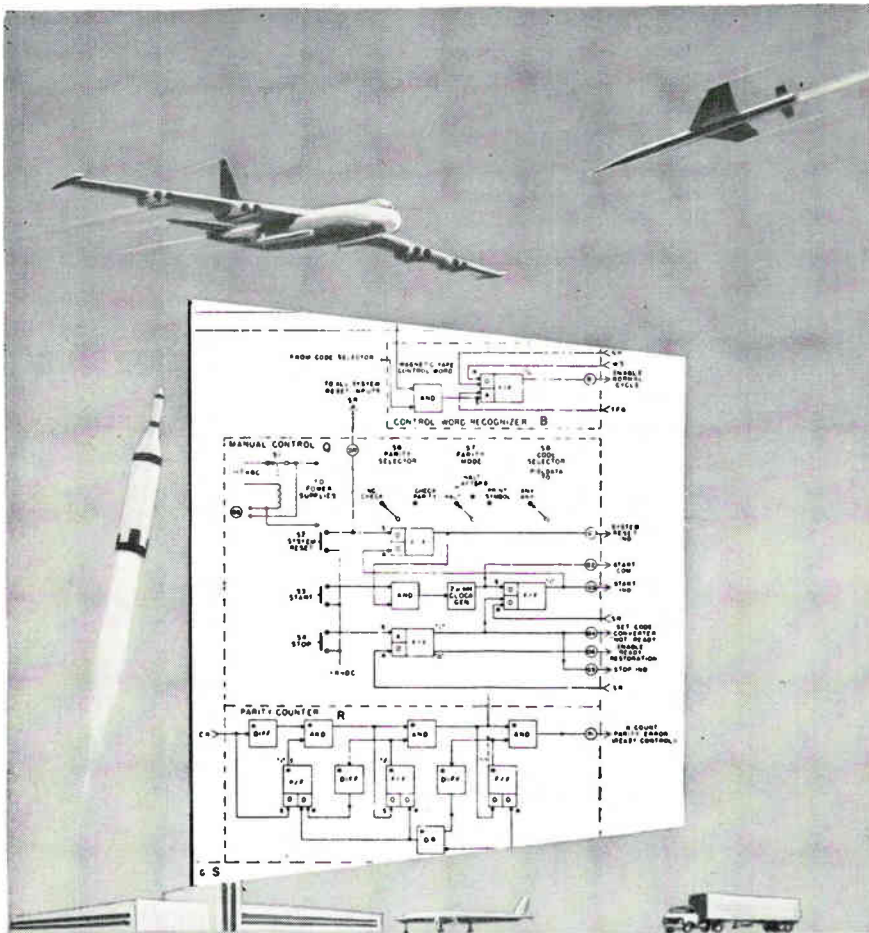


Westinghouse packages silent, lightweight, static transformer-rectifier units now in use on Snark and Sergeant missiles, Lockheed Electra and U.S.A.F. C-130 aircraft. The 200 ampere regulated d-c power supply shown at right is used on the Lockheed Electra. Size: 0.4 cu. ft. Weight: 19 lbs. Regulation is never more than  $\pm .8$  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.

J-92505

## Westinghouse





## The Application of DATA PROCESSING TECHNIQUES

••• in tracking, timing, guidance and test systems is a familiar problem to Analex<sup>®</sup> 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 MIL 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.

ANELEX

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 "inching" 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**



## H-V Test Sets

### CONSOLE TYPE

ASSOCIATED RESEARCH, INC., 3777 W. Belmont Ave., Chicago 18, Ill., has introduced h-v test sets in console type cabinets, providing a-c potentials to 150 Kv for tests of components, assemblies, cables and insulating materials, films and oils. Models are available with maximum outputs of 30 Kv, 50 Kv, and 75 Kv, with ratings of 1, 2 and 5 Kva, as well as up to 150 Kv.

**CIRCLE 447 ON READER SERVICE CARD**

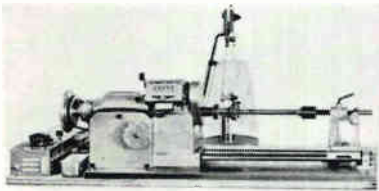
## Ceramic Capacitors

### SUBMINIATURE

MUCON CORP., 9 St. Francis St., Newark, N. J., announces subminiature ceramic capacitors made with Low-Var (low capacitance variation) ceramic. The capacitance remains within +4 percent and -8 percent of the capacitance at 25 C over the whole temperature range

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  $\frac{1}{4}$  in. sq by 0.090 in. thick to  $\frac{17}{32}$  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 tail-stock.

**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



**E**XCELLENT 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.

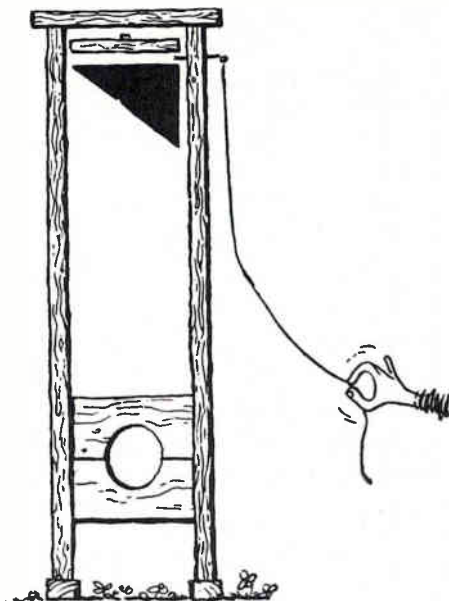
Engineering programs in progress at Microwave Associates are directed towards development of this tube as a voltage-tunable magnetron within the same form-factor. Your inquiries are welcomed on these and other magnetrons.

*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



## SIGMA

### CAN NOW TAKE CARE OF COMPETITION IN ON-OFF DEVICES

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 mw for operation. (How's that for being wrong two out of two?)



Series 33 relay

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  $-65^{\circ}\text{C}$ . to  $+125^{\circ}\text{C}$ . 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

# SIGMA

SIGMA INSTRUMENTS, INC.  
62 Pearl St., So. Braintree 85, Mass.

An Affiliate of The Fisher-Pierce Co. (since 1939)

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 demodulation, 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 Gc. Model 5-542, which uses a p-m focused twt, provides high gain and flat response over the entire 4 Gc range at one setting of the front panel controls. Some key specifications are: saturated power output, 1 w 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

TRANSITRON ELECTRONIC CORP., 168 Albion St., Wakefield, Mass., announces a series of four intermediate power diffused mesa transistors in the convenient  $\frac{1}{8}$  in. stud-mounted hex package. Characteris-



# HIGH POWER IN SMALL PACKAGES

**Yuba-Dalmotor Division is modern,  
diversified and flexible—  
from design through production**



Constant-Speed Motor/SC-23

Speed-Regulated Motor/SC-5



Motor Generator/MG-146

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.*



*specialists in electronic and  
electromechanical equipment*

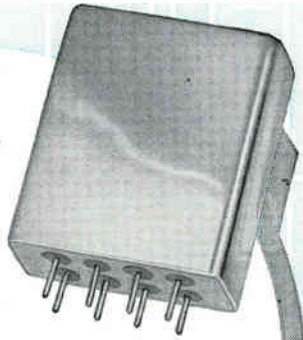
**YUBA-DALMOTOR DIVISION**  
1375 El Camino Real, Santa Clara, California  
**YUBA CONSOLIDATED INDUSTRIES, INC.**

Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York  
Philadelphia • Pittsburgh • San Francisco • Seattle

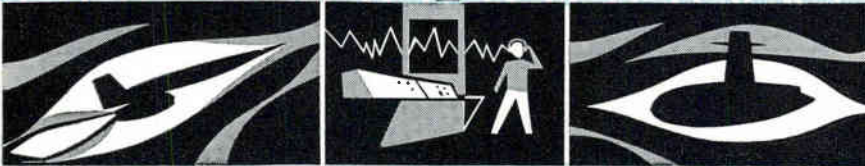
# new!

## 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. Permitting contact loads from dry circuit to 10 amps, the crystal can 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.



ACTUAL SIZE



### SPECIFICATIONS

Vibration: 30 g, 10-2000 cycles. Shock: 50 g, 11 millisecond. Diel. Str.: 1250 V. Insul. Res.: 10,000 M $\Omega$ . Life: 100,000 operations min. @125 C to Mil R 5757C. Temp. Range: -65°C to +125°C to Mil R 5757C. Duty: Continuous. Contact Rating: BR-9X: 10 amp resistive, 28 V DC or 110 V AC. BR-9Y: Dry circuit to 5 amps. Derate 50% for inductive loads. Overload Rating: 25 amps min. for BR-9X. Contact Arrangement: DPDT. Max. Coil Dissipation: 3 watts. Min. Pull-In Power: BR-9X - 100 mw, 2 coil pulse operation (15 millisecond. pulse). Operating Characteristics: Refer to BR-7Z coil resistance and operating characteristics, Bulletin BR-592. Operate Time: 10 millisecond. max.

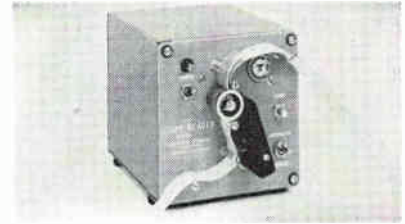
Other Babcock Relays include BR-1SZ 5 mw Relays, BR-7 ten amp Relays and BR-8 subminiature Relays.

## 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**

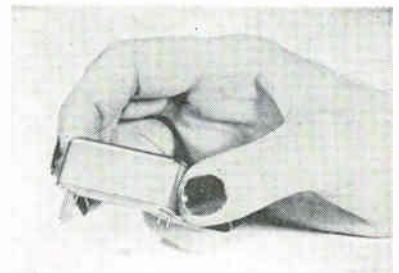


## Tape Reader

### 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**



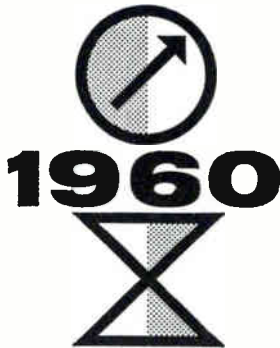
## Chopper Package

### FOR PRINTED BOARD USE

JAMES ELECTRONICS INC., 4050 N. Rockwell St., Chicago 18, Ill., introduces a new hermetically sealed miniature chopper package for

INTERNATIONAL CONGRESS AND EXHIBITION FOR  
INSTRUMENTATION AND AUTOMATION

# INTERKAMA



DUESSELDORF · 19 — 26 OCTOBER 1960

Nordwestdeutsche Ausstellungs-Gesellschaft mbH. (Nowea)  
Düsseldorf, Messengelände · Telex: 0858 4853 Nowea Dssd.

For Information:

German American Chamber of Commerce  
666 Fifth Avenue New York 19, N. Y.  
CIRCLE 311 ON READER SERVICE CARD



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.

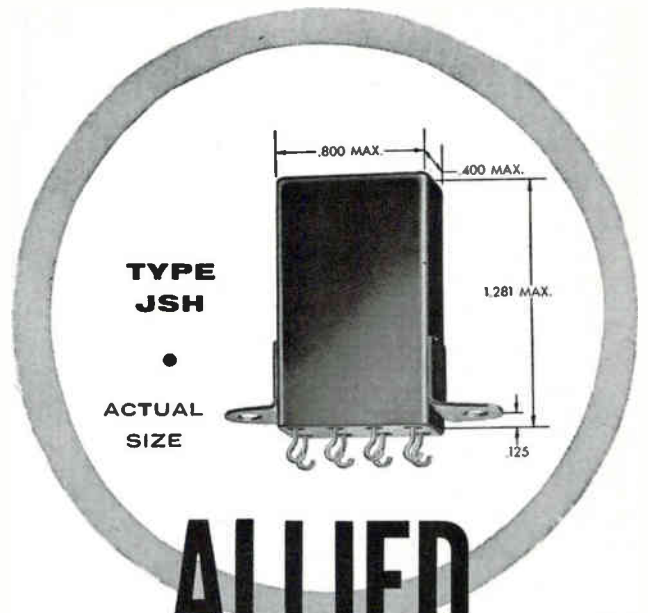
*electronics* tells you where and when "Meetings Ahead" ... gives you the highlights later on.

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

August 12, 1960



# ALLIED CONTROL'S NEW

**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** 

ALLIED CONTROL COMPANY, INC.

2 EAST END AVENUE, NEW YORK 21, N. Y.

AL206

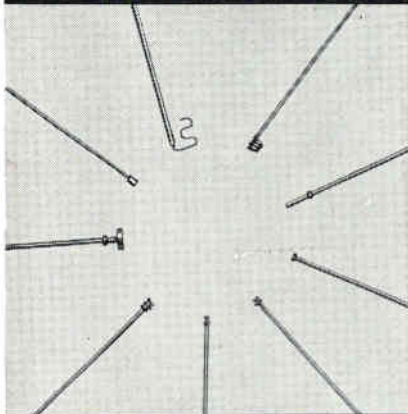
CIRCLE 225 ON READER SERVICE CARD

225

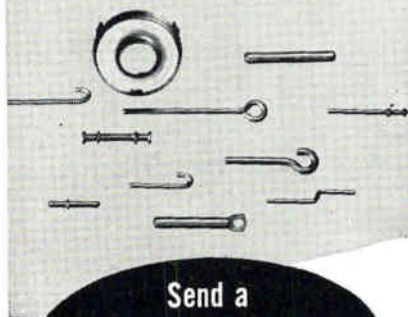
Let us show you how our precision wire forms CUT COSTS!



**TERMINAL LEADS FOR RESISTORS, DIODES, TRANSISTORS, CAPACITORS, ETC.**



**FOR THE HERMETIC SEAL INDUSTRY**



Send a sample or blue print for estimates.

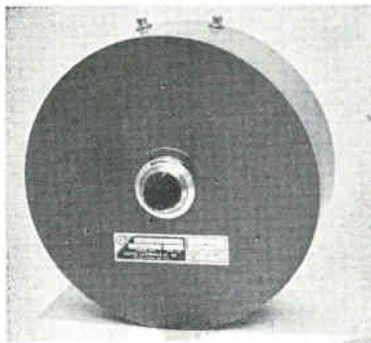
When Art Wire tackles the job, big gains in precision and uniformity are possible on small components . . . resulting in big savings in time and production costs. In addition, Art Wire's modern production methods produce a wide variety of components more economically.

Art Wire specializes in wire forms designed for today's automatic production lines . . . manufactured to assure the economy of an uninterrupted work flow.

**ART WIRE AND STAMPING CO.**  
18 Boyden Place, Newark 2, N. J.

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  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . 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  $15\ \mu\text{V}$  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  $\mu\text{sec}$ . 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

# TAURUS TERMINALS OF TEFLON\*

We are specialists in manufacturing STANDOFF & FEEDTHRU TERMINALS insulated with Teflon\*. Simple terminal to install by forcing into undersize chassis hole.

Taurus Terminals are accepted and approved by major users. Taurus is a completely integrated, experienced and quality minded manufacturer of terminals. \*REG. T.M. OF E. I. DUPONT

### TAURUS PUNCHED CARD SENSORS

Read Entire Punched Card Statically



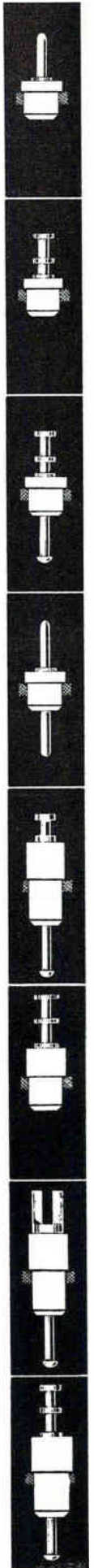
**FOR  
SIMPLE SWITCHING USING  
STANDARD PUNCHED CARDS**

The Sensor statically reads entire standard I.B.M. or Remington Rand punched cards. Each hole position has a corresponding closed switch, and each unpunched hole position has a corresponding open switch when the Sensor is actuated.

Used for automatic test equipment and other automatic devices.



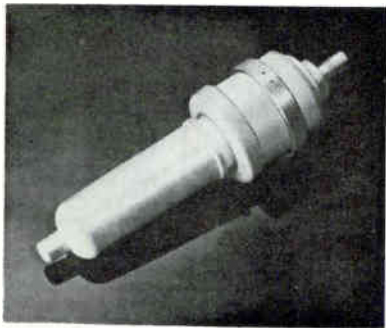
**TAURUS  
CORPORATION**  
8 Coryell Street  
Lambertville, New Jersey





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 non-flickering trace on any oscilloscope or slow enough for mechanical recording devices. Model 682 A maintains output flat to within  $\pm 1$  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 twt 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.



MODEL 751-C-4

#### POWER RATINGS AVAILABLE:

| SINGLE PHASE |                   | TWO PHASE |                    | THREE PHASE |                    |
|--------------|-------------------|-----------|--------------------|-------------|--------------------|
| MODEL NO.    | POWER             | MODEL NO. | POWER              | MODEL NO.   | POWER              |
| 21           | 20 VOLT AMPERES   | 42        | 40 VOLT AMPERES    | 63          | 60 VOLT AMPERES    |
| 41           | 40 VOLT AMPERES   | 82        | 80 VOLT AMPERES    | 123         | 120 VOLT AMPERES   |
| 81           | 80 VOLT AMPERES   | 162       | 160 VOLT AMPERES   | 253         | 250 VOLT AMPERES   |
| 161          | 160 VOLT AMPERES  | 502       | 500 VOLT AMPERES   | 503         | 500 VOLT AMPERES   |
| 251          | 250 VOLT AMPERES  | 1002      | 1000 VOLT AMPERES  | 753         | 750 VOLT AMPERES   |
| 501          | 500 VOLT AMPERES  | 2002      | 2000 VOLT AMPERES  | 1003        | 1000 VOLT AMPERES  |
| 751          | 750 VOLT AMPERES  | 4002      | 4000 VOLT AMPERES  | 1503        | 1500 VOLT AMPERES  |
| 1001         | 1000 VOLT AMPERES | 6002      | 6000 VOLT AMPERES  | 2003        | 2000 VOLT AMPERES  |
| 1501         | 1500 VOLT AMPERES | 10002     | 10000 VOLT AMPERES | 3003        | 3000 VOLT AMPERES  |
| 2001         | 2000 VOLT AMPERES |           |                    | 6003        | 6000 VOLT AMPERES  |
| 3001         | 3000 VOLT AMPERES |           |                    | 9003        | 9000 VOLT AMPERES  |
| 5001         | 5000 VOLT AMPERES |           |                    | 15003       | 15000 VOLT AMPERES |

#### OUTPUT FREQUENCIES AVAILABLE:

| MODEL LETTER | FREQUENCY CYCLES PER SECOND | FREQUENCY ACCURACY |   |   |   |   |   | MODEL LETTER | FREQUENCY CYCLES PER SECOND   | FREQUENCY ACCURACY |   |   |   |   |   |
|--------------|-----------------------------|--------------------|---|---|---|---|---|--------------|-------------------------------|--------------------|---|---|---|---|---|
|              |                             | 1                  | 2 | 3 | 4 | 5 | 6 |              |                               | 1                  | 2 | 3 | 4 | 5 | 6 |
| A            | 60 FIXED                    | x                  | x | x | x | x | x | G            | 50-1350 VARIABLE              | x                  |   |   |   |   |   |
| B            | 50-75 VARIABLE              | x                  | x |   |   |   |   | J            | 55-65 VARIABLE                | x                  | x | x |   |   |   |
| C            | 400 FIXED                   | x                  | x | x | x | x | x | K            | 300-2000 VARIABLE             | x                  |   |   |   |   |   |
| D            | 350-450 VARIABLE            | x                  | x | x |   |   |   | L            | 300-3000 VARIABLE             | x                  |   |   |   |   |   |
| E            | 300-500 VARIABLE            | x                  | x |   |   |   |   | M            | 20-2000 VARIABLE              | x                  |   |   |   |   |   |
| F            | 150-1350 VARIABLE           | x                  |   |   |   |   |   | SF/SV        | ANY SPECIAL FIXED OR VARIABLE |                    |   |   |   |   |   |

Frequency Accuracy Code: 1=0.5%; 2=0.2%; 3=0.1%; 4=0.05%; 5=0.01%; 6=0.001%; 7=0.0001%; 8=0.00001%.

## BEHLMAN

ENGINEERING COMPANY

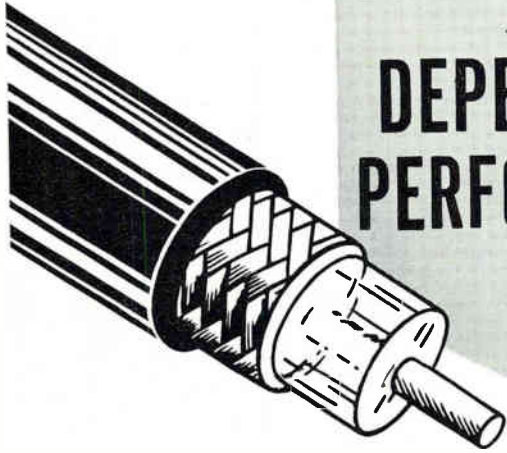
2911 Winona Avenue Burbank, California



# 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:*

| Army-Navy Type No. | Dia. of Dielectric In. | Nom. IMP. OHMS | Attenuation DB/100 ft. 400 Mc 3000 |      | Shielding Braid | Nom. Overall Dia. In. |
|--------------------|------------------------|----------------|------------------------------------|------|-----------------|-----------------------|
| RG-8A/U            | .285"                  | 52             | 6                                  | 19   | Single Copper   | .405                  |
| RG-9B/U            | .280"                  | 50             | 6.1                                | 21.8 | Double Copper   | .420                  |
| RG-11A/U           | .285"                  | 75             | 5.2                                | 18.5 | Single Copper   | .405                  |
| RG-13A/U           | .280"                  | 75             | 5.7                                |      | Double Copper   | .420                  |
| RG-17A/U           | .680"                  | 52             | 2.8                                | 11   | Single Copper   | .870                  |
| RG-59A/U           | .146"                  | 75             | 9                                  | 30   | Single Copper   | .242                  |
| RG-74A/U           | .370"                  | 50             | 4.3                                | 14   | Double Copper   | .615                  |



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**

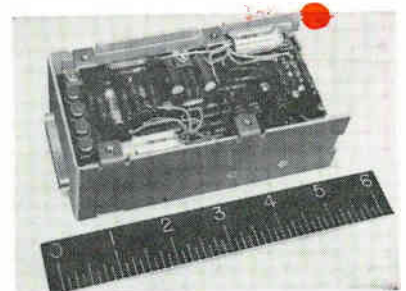
Manufactured by  
SUPERIOR CABLE CORPORATION, Hickory, North Carolina

4424

228 CIRCLE 228 ON READER SERVICE CARD

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 side-band 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 \$1,100 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  $\pm 2.5$  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 1¾ 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 1¾ in. high reliability precision

electronics

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  $\pm 0.25$  deg and precision machined metal housings. Environmental specifications include 1,000 megohms 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.

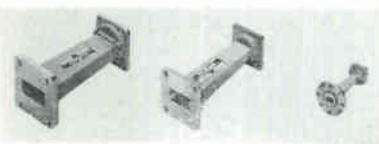
CIRCLE 462 ON READER SERVICE CARD



### 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

DEMORNAY-BONARDI, 780 Arroyo Parkway, Pasadena, Calif., announces a complete line of tapered

August 12, 1960

## NEW "SILDISC" 500 mW SILICON DIODE FOR PRINTED CIRCUITS

Only 3/16" dia. x 1/16" thick

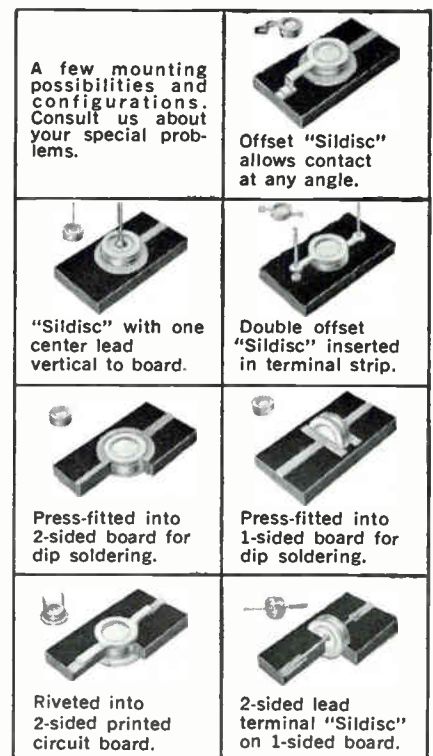


New double-cup design saves space, dissipates heat more efficiently. Plug it in . . . clip it in . . . solder it in or pressfit. Can be mounted many ways.

| LOW LEAKAGE "SILDISC" DIODES |     |                                    |                                     |                                                 |  |
|------------------------------|-----|------------------------------------|-------------------------------------|-------------------------------------------------|--|
| CC Part Number               | PIV | Reverse Dc Current at Rated PIV mA | Max. Rectified Dc Output Current mA | Forward Dc Volt. Drop at Rated Dc Current Volts |  |
| CC.5- 15                     | 15  | .010                               | 500                                 | 1                                               |  |
| CC.5- 30                     | 30  | .010                               | 500                                 | 1                                               |  |
| CC.5- 50                     | 50  | .010                               | 500                                 | 1                                               |  |
| CC.5- 75                     | 75  | .015                               | 500                                 | 1                                               |  |
| CC.5-100                     | 100 | .020                               | 500                                 | 1                                               |  |
| CC.5-150                     | 150 | .020                               | 500                                 | 1                                               |  |
| CC.5-200                     | 200 | .020                               | 500                                 | 1                                               |  |
| CC.5-250                     | 250 | .025                               | 500                                 | 1                                               |  |
| CC.5-300                     | 300 | .025                               | 500                                 | 1                                               |  |
| CC.5-500                     | 500 | .025                               | 500                                 | 1                                               |  |

| DOUBLE ANODE<br>TWIN ZENER "SILDISCS" |                     |                   |            |                   |            |
|---------------------------------------|---------------------|-------------------|------------|-------------------|------------|
| CC Part Number                        | ZENER VOLTAGE RANGE |                   |            | TYPICAL IMPEDANCE |            |
|                                       | $E_z$ (Min) Volts   | $E_z$ (Max) Volts | @ $I_z$ mA | $Z_z$ Ohms        | @ $I_z$ mA |
| CC.5D-1.5                             | 1.35                | 1.65              | 50         | 10                | 50         |
| CC.5D-1.8                             | 1.63                | 1.98              | 50         | 10                | 50         |
| CC.5D-2.2                             | 1.97                | 2.42              | 50         | 10                | 50         |
| CC.5D-2.7                             | 2.42                | 2.96              | 50         | 20                | 50         |
| CC.5D-3.3                             | 2.96                | 3.62              | 30         | 20                | 30         |
| CC.5D-3.9                             | 3.51                | 4.28              | 30         | 20                | 30         |
| CC.5D-4.7                             | 4.23                | 5.16              | 30         | 20                | 30         |
| CC.5D-5.6                             | 5.04                | 6.15              | 20         | 20                | 20         |
| CC.5D-6.8                             | 6.12                | 7.46              | 20         | 20                | 20         |
| CC.5D-8.2                             | 7.38                | 9.02              | 10         | 15                | 10         |
| CC.5D-10                              | 9.00                | 11.1              | 10         | 15                | 10         |
| CC.5D-12                              | 11.00               | 13.5              | 10         | 15                | 10         |
| CC.5D-15                              | 13.4                | 16.5              | 10         | 25                | 10         |
| CC.5D-18                              | 16.3                | 19.8              | 10         | 35                | 10         |
| CC.5D-22                              | 19.7                | 24.2              | 3          | 50                | 3          |
| CC.5D-27                              | 24.1                | 29.6              | 3          | 60                | 3          |
| CC.5D-33                              | 29.5                | 36.2              | 3          | 80                | 3          |



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.



Semi-Conductor Component Specialists

**CONTROLS COMPANY OF AMERICA**

**ELECTRON DIVISION**

811 W. Broadway, P.O. Box 937, Tempe, Arizona

CIRCLE 231 ON READER SERVICE CARD

231

for **CONTINUOUS**  
**RELIABILITY....**

**INSTALL Hoyt**  
**PANEL METERS**



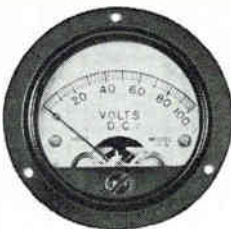
**NEW!**  
Model 1060  
Transparent  
Polystyrene

Quality meters on the panel indicate quality throughout—and HOYT Panel Meters are quality in appearance and function . . . the complete Line of matching AC and DC Meters for original equipment and replacement applications. Get accuracy, readability, and reliability; plus economy. Specify HOYT Electrical Instruments — compatible components for production, research, and test requirements.



Model 647  
Black Bakelite

Moving coil, rectifier, and repulsion types available promptly in a wide assortment of sizes, ranges, cases, shapes, and colors; some with parallax-free mirror scales — all with standard mounting dimensions. Or, custom designed to the most exacting specifications.



Model 17/3  
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Send for latest fully illustrated brochure with descriptions, engineering data, and moderate prices.



Write Export Manager regarding world-wide availability for Electronic, Industrial and Automotive applications.

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SINCE 1904

**ELECTRICAL**  
**INSTRUMENTS**

**BURTON-ROGERS COMPANY**

Sales Division—Dept. E

42 Carleton St., Cambridge 42, Mass., U.S.A.

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-018 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**



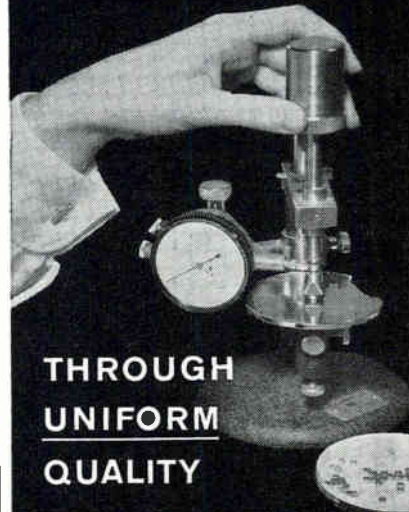
## Silicon Chopper

### 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-

*Bird*  
**JEWEL BEARINGS**

**CUT**  
**YOUR**  
**COSTS**



**THROUGH**  
**UNIFORM**  
**QUALITY**

Exacting quality control standards employed by Bird are your guarantee that every Bird Sapphire or Glass Jewel Bearing, or Complete Jewel Assembly or Cushion Jewel Assembly, is as specified. There's never a chance of inconsistency in dimensions, chemical and physical properties.

As an added benefit, Bird Complete Assemblies cut your manufacturing costs because they reach you ready for immediate installation . . . eliminating all problems with expensive rejects and breakage. Our engineering staff would be pleased to work with you on your special jewel bearing needs. Write for our free catalog with complete details on properties and uses of jewel bearings.

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serving industry with fine jewels since 1913

Illustration shows concentricity check of jewel assembly, just one of several important quality control steps.

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,**

ENGINEERING EMPLOYMENT MANAGER

**Bendix-Pacific Division**

NORTH HOLLYWOOD, CALIFORNIA



## WHAT'S **BEST** IN HIGH VACUUM

## MEASUREMENT?

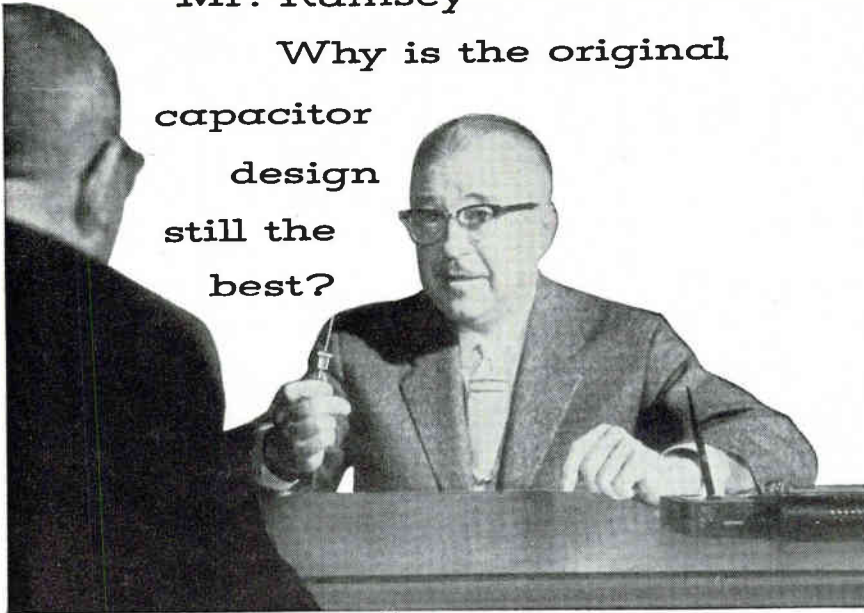
Do you know the specific advantages and disadvantages of 11 different vacuum gages? Improved electronic gage designs are extending measuring range to 10–14 mm Hg. Measurement and control are keys to the success of many production and test applications — **electronics** has the story! (See issue of October 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...**

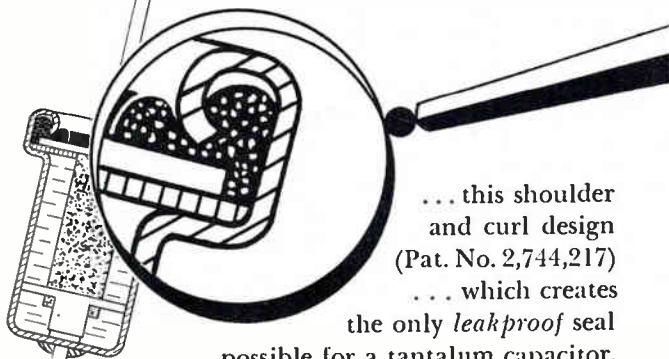
# **electronics**

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.

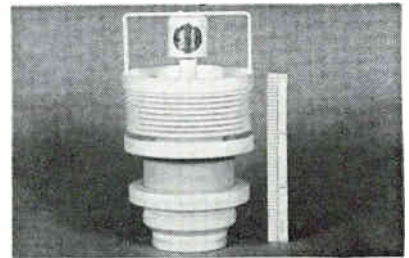


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WESCON BOOTHS  
2106-2107

WHERE RELIABILITY DICTATES STANDARDS

ing or chopping of voltages can be accomplished over an extremely wide dynamic range which extends down to a fraction of a millivolt and up to  $\pm 150$  v. It is an inertialess device that can be driven from 270 cps to 30 Kc. Applications include high level voltage measurements, power supply stabilization, d-c amplifier stabilization, high speed servomechanism, high voltage transducer measurements, high level switching and many other uses.

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### 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  $\mu$ sec. 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.

CIRCLE 467 ON READER SERVICE CARD



### 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 shippable equipment. Available voltages: 1 to 15 v d-c

# WATER

ALMOST TOO PURE  
TO DRINK...

and what  
it means to the  
**RELIABILITY**  
of a  
silicon rectifier

Water, after passing through a specially-designed water purifying system in the new Fansteel rectifier plant, is almost too pure for human consumption. Minerals and other "impurities" that the human body needs — and can most conveniently get from water — have been removed. Electrical resistivity of this water — true measure of its purity — is a fantastic 18,000,000 ohm-centimeters.

Here is water that is softened, de-ionized, de-mineralized . . . and still isn't good enough for Fansteel rectifiers. So it is passed through sub-micron filters to remove all matter coarser than 0.5 micron, organic or inorganic. (Never once, throughout its purification process, is the water permitted to contact air.) Finally, at the last second, the water is "filter-polished" to remove any impurity which might still remain.

Now the water is ready for use — in the critical chemical cleansing process of Fansteel silicon rectifier junctions. Thorough washing of the silicon rectifier junctions in this ultra-pure water results in contaminant-free junctions . . . and another assurance of complete Fansteel silicon rectifier reliability.

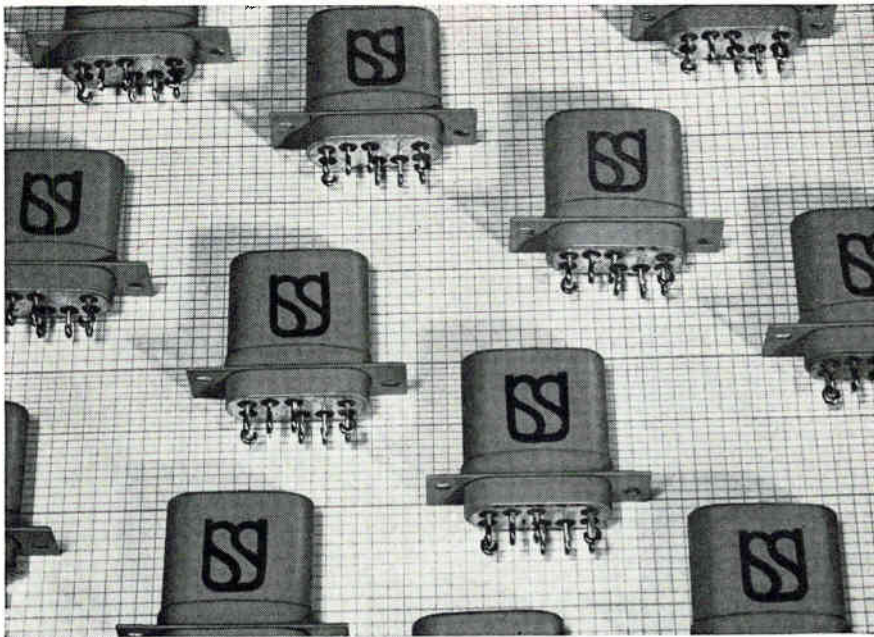
Look at any other phase of our manufacturing operations — large or small — and you'll see like examples of uncompromising thoroughness and care. We can't afford to take any short-cuts — *not when reliability is at stake.*

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



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WESCON BOOTHS  
2106-2107

WHERE RELIABILITY DICTATES STANDARDS



## 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  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  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:  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

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, 10½ in. high and 17¾ in. deep, adaptable for relay rack mounting. Operation up to 50 C ambient.

**CIRCLE 470 ON READER SERVICE CARD**

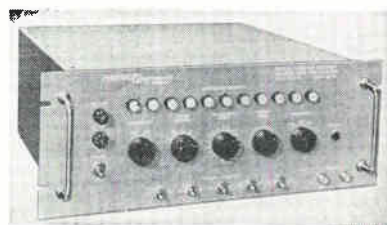


## D-C Voltage Monitor

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**

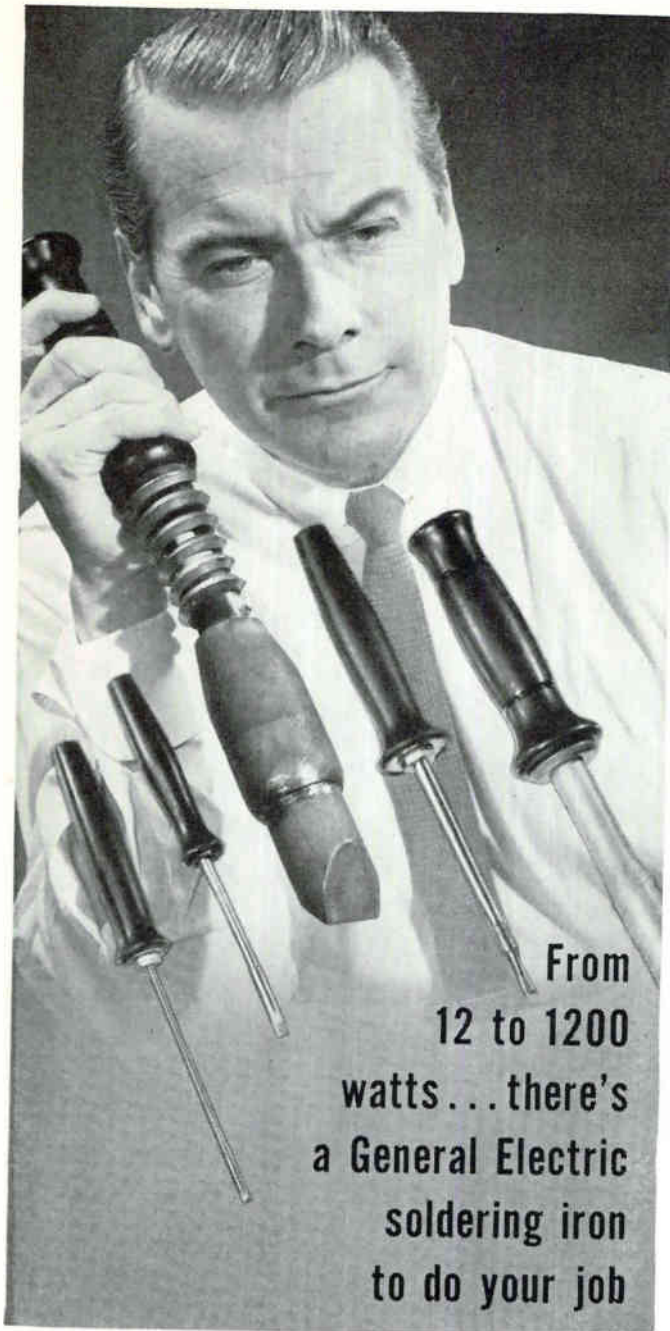


## Subcarrier Calibrator

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**

CIRCLE 315 ON READER SERVICE CARD

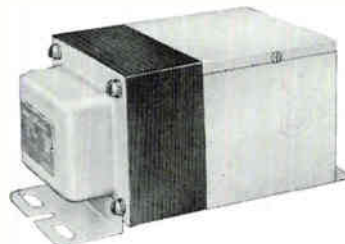
August 12, 1960

**WHICH CONSTANT VOLTAGE  
STABILIZER  
MEETS YOUR NEED?**



This compact stabilizer design occupies a minimum of space and is especially adaptable as a component in electronic devices where output voltages must be maintained  $\pm 1\%$  of normal. Available in ratings of 15, 25, 50 VA.

Input voltage: 95/130  
Output voltage: 120; 6.3



For applications requiring steady-state voltage for laboratory use or electronic circuitry this heavy duty design is available in the following stock ratings and voltage ranges.

Capacities: 100; 200; 300; 500 VA  
Input voltage: 95/130; 190/260; 190/260  
Output voltage: 120 120 240

This unit has been designed to provide instantaneous response to voltage fluctuation in large loads. Voltage output regulation between no load and full load is constant regardless of input voltage. Current limiting protection under overload conditions.

Available in ratings of  
1000 and 2000 VA  
Input voltage:  
95/130; 190/260; 190/260  
Output voltage:  
120; 120; 240



**ACME ELECTRIC CORPORATION**

318 Water St. • Cuba, N. Y.

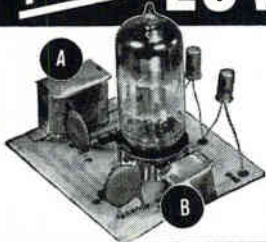
In Canada: Acme Electric Corp. Ltd. • 50 Northline Rd. • Toronto, Ont.

SA 3420/1873



CIRCLE 237 ON READER SERVICE CARD 237

# MINIATURIZATION PLUS LOWER COST



## Thin Versatile Co-Netic and Netic Magnetic Shielding Foils

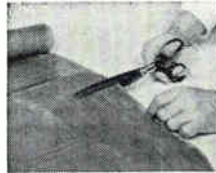
Permit positioning foil-wrapped components A & B closely, minimizing interaction due to magnetic fields... making possible compact and less costly systems.

How thin Co-Netic and Netic foils lower your magnetic shielding costs:

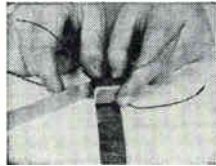
- 1) Weight reduction. Less shielding material is used because foils (a) are only .004" thick and (b) cut and contour easily.
- 2) Odd shaped and hard-to-get-at components are readily shielded, saving valuable time, minimizing tooling costs.

These foils are non-shock sensitive, non-retentive, require no periodic annealing. When grounded, they effectively shield electrostatic and magnetic fields over a wide range of intensities. Both foils available from stock in any desired length in various widths.

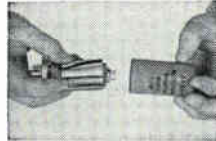
Co-Netic and Netic foils are successfully solving many types of electronic circuitry magnetic shielding problems for commercial, military and laboratory applications. These foils can be your short cut in solving magnetic problems.



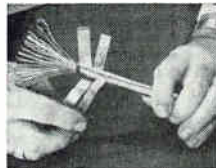
Cuts readily to any shape with ordinary scissors.



Wraps easily.



Inserts readily to convert existing non-shielding enclosures.



Shielding cables reduces magnetic radiation or pickup.



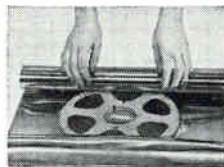
Wrapping tubes prevents outside magnetic interference.

# 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.

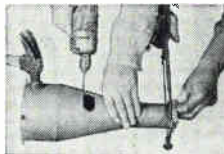


Thin pliable foil wraps easily around magnetic tape, maintaining original recorded fidelity.



Rigid Netic (.014" and up in thickness) Shielded Rooms and Enclosures for safe, distortion-free storage of large quantities of recorded magnetic tapes.

Composite photo demonstrating that magnetic shielding qualities of Rigid Netic Alloy Material are not significantly affected by vibration, shock (including dropping or bumping) etc. Netic is non-retentive, requires no periodic annealing.



Write for further details today.

## MAGNETIC SHIELD DIVISION PERFECTION MICA CO.

1322 No. Elston Avenue, Chicago 22, Illinois

ORIGINATORS OF PERMANENTLY EFFECTIVE NETIC CO-NETIC MAGNETIC SHIELDING

f-m/f-m channels, a source for multiple frequency references, and checks of VCO deviation linearity, are all provided in the model TMC-411 transistorized subcarrier 11-point calibrator. With 0.01 percent long term accuracy, 11 equally spaced frequencies are furnished within the  $\pm 7\frac{1}{2}$  percent limits for the 18 standard subcarrier channels, and within the  $\pm 15$  percent limits for the five upper channels (A-E). Individual channel outputs are also furnished. Distortion components are at least 40 db down. Discriminator linearity measurements are speeded by automatic 3- or 11-point sequencing. Dwell periods of  $\frac{1}{3}$  to 4 sec per deviation may be selected. In addition, manual operation is provided for spot checking deviations in any or all channels.

CIRCLE 472 ON READER SERVICE CARD

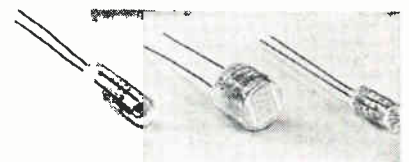


## Crystal Filters

### 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  $\frac{1}{2}$  in. by  $1\frac{1}{4}$  in. by 2 in.

CIRCLE 473 ON READER SERVICE CARD



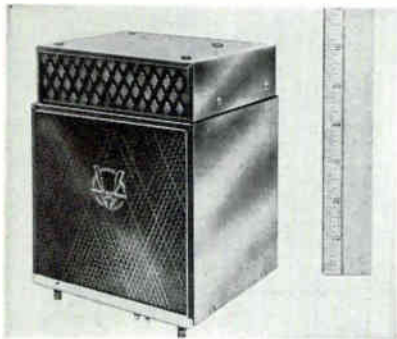
## Photoconductive Cells

### LOW RESISTANCE

CLAIREX CORP., 19 W 26th St., New York 10, N. Y. Type L low resist-

ance series of photoconductive cells are hermetically sealed in glass. Particularly useful in transistor and other low voltage applications, the units are rated at 60 v maximum with a resistance as low as 40 ohms at 100 foot candles. Standard line consists of seven types, five of the cadmium selenide variety and two of cadmium sulphide. They provide a choice of resistance, speed and spectral response to suit most applications. They also provide a power dissipation range to  $\frac{1}{2}$  w, continuous, and high ratios of light to dark current even at low light levels. Units are available in the three package configurations of the 400, 500 and 600 series, ranging in diameter from 0.25 to 0.5 in. and in length from 0.5 to 1.0 in. All design parameters are stable and closely controlled.

**CIRCLE 474 ON READER SERVICE CARD**

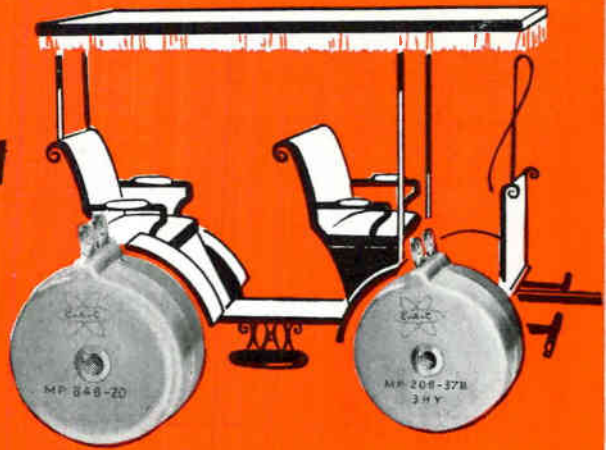


## Power Supply

### SEPARABLE REGULATORS

VICTORY ELECTRONICS, INC., 50 Bond St., Westbury, N. Y., has developed a power supply, available in various capacities and models, in which the voltage regulating elements are completely separate from the power unit proper . . . and, in some instances, may be absent altogether. If 1 percent regulation is satisfactory the purchaser need invest in no external regulator at all. The unit operates without one. If, at the time of purchase, or subsequently, he requires regulation within  $\pm 0.25$  percent, he purchases a regulator section from the company that will hold the output to just that. Also available is a regulator that will hold output within  $\pm 0.05$  percent. One advantage, besides space-saving, is that if something goes wrong with the regu-

## Hitch Your Breadboard to this Wagon!



### NEW at C-A-C "Poker Chips"

Thin shaped, easily stacked, plastic packaged, saturable reactors, pulse transformers, DC to DC converters and 400 cycle power transformers. Can be sub-miniaturized. Terminals to meet requirements. Mil Specs. Fast delivery. Send your specifications.

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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.

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**SPECIAL CORE TYPES** in a variety of permeabilities and sizes, including temperature stabilized. Many are carried in stock.



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**COMMUNICATION ACCESSORIES COMPANY**

Job opportunities at C-A-C for network design engineers. Write personnel director.

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## 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

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**NEW...COMPACT...  
TRANSMISSION & DELAY  
MEASURING SET  
TYPE 453-A**



**FEATURES:**

- ✓ Measures Attenuation and Relative Delay Characteristics of Transmission Systems with Impedances of 600 ohms
- ✓ 500 cps to 50 kc Carrier Frequency Range
- ✓ Accuracy =  $\pm 5$  microseconds

**TYPE 453-A MEASURES DELAY**

... by comparing the time relationship between the transmitted and received signals. The transmitter generates an amplitude modulated signal consisting of a variable carrier modulated at a constant 62.5 cycle rate. The receiver measures the change in relative phase of the 62.5 cycle envelope of the transmitted signal with respect to a common reference derived from the source which generates the 62.5 cycle modulation. Provisions are also made to measure the levels of the transmitted and received signals.

**SPECIFICATIONS:**

**Carrier Frequency:** Adjustable in two ranges from 500 cps to 40 kc.

**Modulation Frequency:** 62.5 cps derived through frequency dividing circuits from a tuning fork controlled oscillator.

**Transmitter Output:** Two output levels 0 dbm and -4 dbm, floating and balanced. Output impedance 600 ohms  $\pm 30$  ohms over range 500 cps to 50 kc. Frequency characteristics of output signal flat to  $\pm .5$  db.

**Receiver Input:** Balanced and floating with an input impedance of 600 ohms  $\pm 20$  ohms from 500 cps to 50 kc.

**Delay Measurements:** Indicated on a relative basis. Always read on the 0 to 0.2 M.S. full scale range. Coarse and Fine Delay switches and Fine Phase Control for precise adjustments.

**Amplitude to Phase Conversion:** With 10 db change in Receiver Input amplitude, output delay indicator will not change more than  $\pm 5$  microseconds.

**Power:** 117 volts, 60 cps, single phase, 60 watts.

**Dimensions of Cabinet:** 22" long, 15" deep, 14" high.

**Dimensions for Rack Mounting:** 19" long, 14" deep, 13 1/2" high.

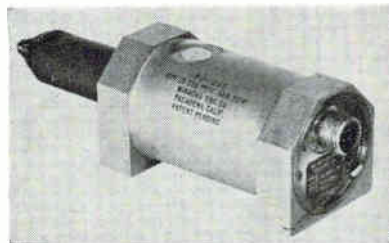


For complete details write for catalog

**ACTON LABORATORIES, INC.**  
subsidiary of  
**TECHNOLOGY INSTRUMENT CORP.**  
517 Main St. • Acton, Mass.  
COlonial 3-7756

lator, the basic power supply is not "out". Power supply models are available in 6.3 v, 12 v, and 28 v units; regulator units may be purchased and operated separately without purchasing a power supply.

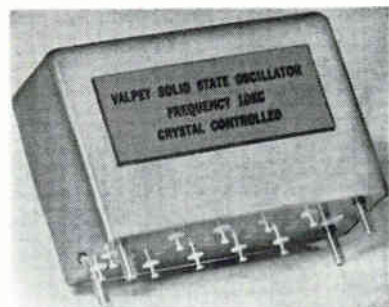
**CIRCLE 475 ON READER SERVICE CARD**



**Pressure Transducer  
EXPANDED-SCALE**

WIANCKO 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.

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**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 Mc, these oscillators are available with stabilities from

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DUTY 2 & 3  
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FOR  
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Nameplates  
Fine Routing Work  
Profiling Small  
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Making Small Dies  
and Molds

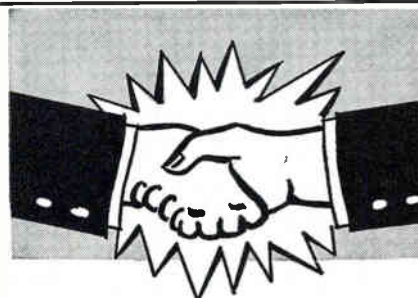


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2-75  
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LUdlow 9-3360

# Headquarters for INSULATION TESTING



## 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, automatic test cycling and provisions to meet every application.

### 10 kv Insulation Testing . . . Portable HYPOT® Jr.

Insulation testing of a-c potentials with separate indication of leakage current and insulation breakdown. Optional features including audible "squawker" 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 4½" 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 4½" 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, condensers, 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 5 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 . . . yet speed and simplified operation meet needs for production and quality control applications. Transparent test cage with safety interlocks is optional as well as automatic rate of rise control. Interchangeable fixtures available for varnishes, porcelain, oils, solid filling compounds, paper, tape, acetate sheets, films, tubing and cloth. Prices start at \$1175.00. Write for bulletin describing the Model 4501 HYPOT® Materials Tester.



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Write today!

Write today for new "Manual on Insulation Testing" describing the complete range of HYPOT® Test Sets and VIBROTEST® Resistance Measuring Instruments.

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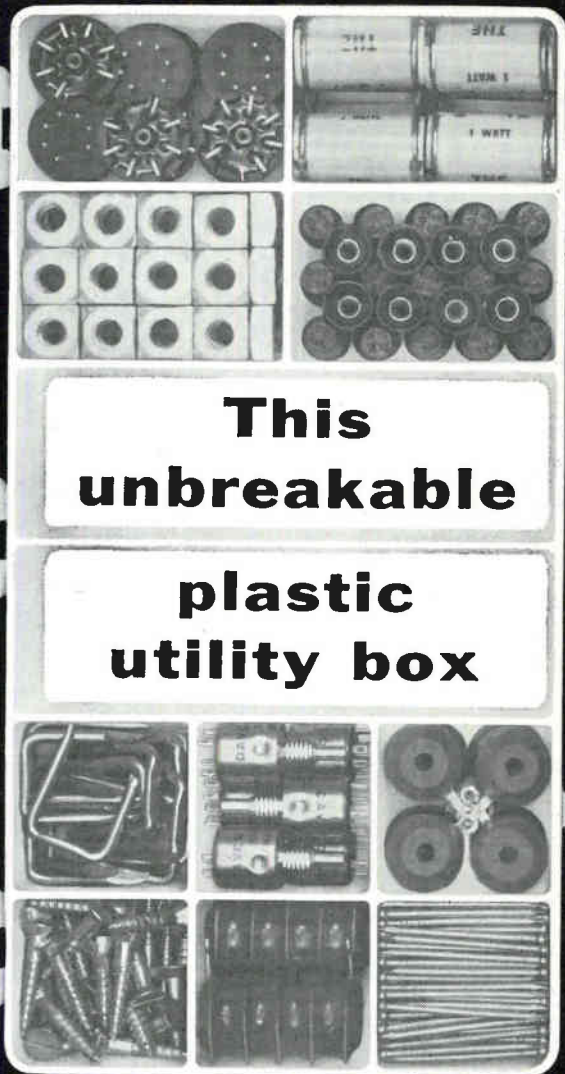
**ASSOCIATED RESEARCH, Incorporated**  
"Electrical Testing Instruments Since 1936"

3781 W. Belmont Avenue

Chicago 18, Illinois

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August 12, 1960



**This  
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In 17 sizes and compartment variations plus wide range of colors. Transparent plastic utility boxes also available in 24 sizes and compartment variations.

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# THE Systems Concept

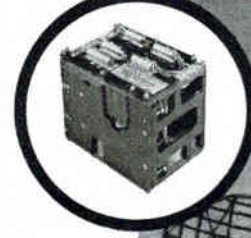
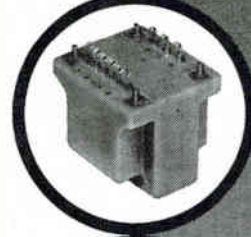
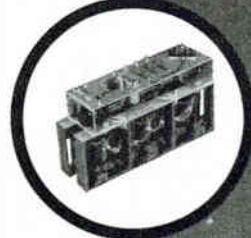
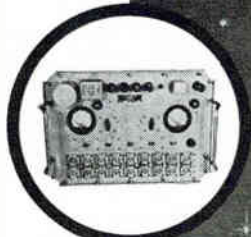
## IN THE DESIGN OF HIGH RELIABILITY ELECTRO-MAGNETIC PRODUCTS

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.

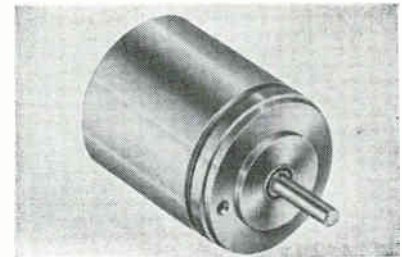
Wheeler's team of exceptionally well-qualified engineers will skillfully interpret and develop your specifications, and will translate your special needs into efficient production methods constantly keeping in mind the vital part each component will play in the system.

All of these skills, plus the constant test and inspection procedures used at Wheeler, assure you of the highest reliability components and products.



$\pm 0.1$  percent to  $\pm 0.001$  percent as standard. Custom units with stabilities to  $\pm 5$  parts in  $10^6$  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., 4530 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.

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### Attenuator

**CONTINUOUSLY VARIABLE**

ANTENNA & RADOME RESEARCH ASSOCIATES, 27 Bond St., Westbury, N. Y., has introduced a miniature S-band continuously variable at-

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CORP

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2WH60

# 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.



*Sponsored as a public service  
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# NEW FOAM PLANT



Here are the advantages you can expect when you specify MIDWEST FOAM —

- ALL TYPES OF Polyether or Polyester FOAMS
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**NO ORDER TOO SMALL OR TOO LARGE**

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## MIDWEST FOAM PRODUCTS COMPANY

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### RESISTANCE

### GB COMPONENTS, INC.

14621 ARMINTA STREET • VAN NUYS, CALIFORNIA

### Announces

*the availability of complete sets of Standard Resistances available at moderate prices. These are intended to be used as working sets of high precision resistance standards in any area where it is necessary to make critical precision measurements.*

▼ Each set consists of eight individual encapsulated resistors, attractively boxed. The first set RS-1 consists of unity in each decade from 1/10 ohm to 1 meg ohm, inclusive, made up of the values of 0.1 ohms, 1.0 ohms, 10.0 ohms, 100.0 ohms, 1.0K, 10.0K, 100.0K, 1 Meg ohm. **\$60.80**

▼ Set No. RS-2 includes the values of 0.2 ohms, 2.0 ohms, 20.0 ohms, 200.0 ohms, 2.0K, 20.0K, 200.0K and 2 Meg ohms **\$78.30**

▼ Set No. RS-4 consists of 0.4 ohms, 4.0 ohms, 40.0 ohms, 400.0 ohms, 4.0K, 40.0K, 400.0K and 4 Meg ohms. **\$112.10**

▼ Set No. RS-7 consists of the values of 0.7 ohms, 7.0 ohms, 70.0 ohms, 700.00 ohms, 7.0K, 70.0K, 700.0K and 7 Meg ohms **\$162.30**

It is intended that with all four sets any value in any given decade can be checked with no more than two resistances in series producing the ability to make critical, precise resistance checks with a minimum of possibility for error.

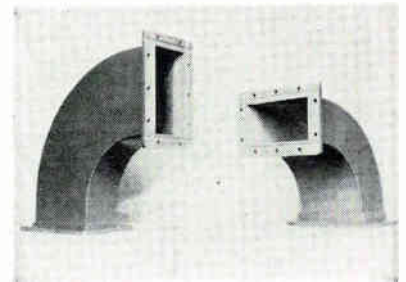
Circuit Boards are available at a nominal price for making series and parallel resistance measurements with a minimum contact resistance.

## STANDARDS

244 CIRCLE 244 ON READER SERVICE CARD

tenuator with an insertion loss of less than 0.5 db. Unit is 3 in. in diameter by 1½ in. high and weighs about 14 oz. Designed primarily for airborne applications, it features a simple locking device and a dial plate calibrated in degrees for easy resettability. Design is of the Pi Line Vamp type with full attenuation achieved in less than 180 deg of revolution. Vswr for bandwidths of 15 percent or less is 1.3 maximum on the input end. Total attenuation available is 20 db minimum at about 3,000 Mc. Connectors are type N male. Average power capacity is 10 w. Peak power is 5 Kw.

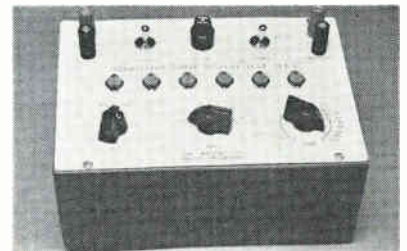
CIRCLE 479 ON READER SERVICE CARD



### 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 multimewatt 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



**THERE'S A  
BETTER  
WAY...**



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  
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*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 *npn* 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 95 to 130 v and an output of 115 v. This unit has a line regulation of  $\pm 1\frac{1}{2}$  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  
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to DC  
amplifier  
devotees**



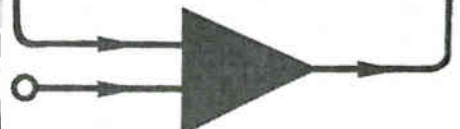
**WIDELY  
RECOGNIZED ...  
WIDELY ACCEPTED ...  
K2 OCTAL PLUG-INS  
FROM PHILBRICK**

**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\***

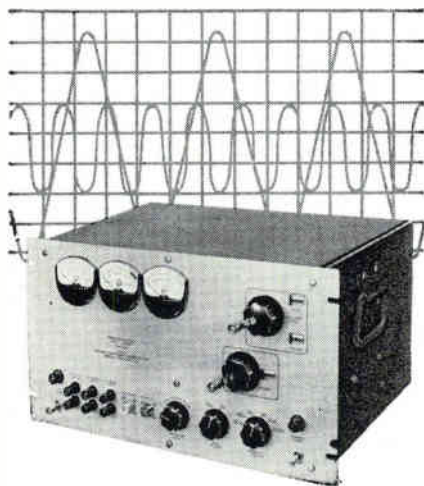
- \* Military equivalents available
- \* OEM's: write wire or phone for quantity prices
- \* 24 page Applications Manual available on request



**GEORGE A.  
PHILBRICK  
RESEARCHES, INC.**

285 Columbus Avenue, Boston 16, Mass.  
Commonwealth 6-5375  
EXPORT OFFICE: 135 Liberty St., New York 6, N.Y.,  
Tel. WOrth 4-3311, Cable TERMRADIO

## WIDE RANGE POWER OSCILLATOR



**a reliable  
signal source  
for microwave  
measurement**

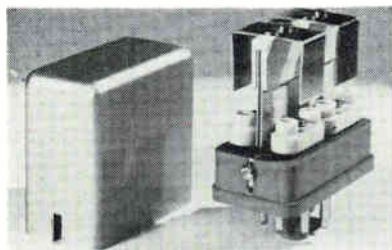
The AIL Type 124C Power Oscillator is applicable as a signal source over the wide range of 200 to 2500 Mc. Its range, power and stability make it an essential element of microwave component test systems. It is often used in measurements relating to antenna design. Facilities for both internal and external modulation are provided. Relative power output is indicated directly on panel meter.

Detailed literature is available on request.



instrument is very suitable for automatic plotting of transfer characteristics of a control system with a conventional X-Y recorder. By turning the dial of the instrument, continuous plotting of Nyquist diagram can be achieved over a wide range from 0.3 cps to 3 Kc in type 308A and 30 cps to 300 Kc in type 308B. Both the in-phase and the quadrature components of an unknown signal, either a-c or d-c (servo frequency or modulated carrier) are indicated simultaneously by two panel meters of type 308 directly in volts rms. Since both meters have center zero, the components can be easily identified as in-phase, out of phase, lead or lag.

**CIRCLE 483 ON READER SERVICE CARD**



### 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 1½ 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 -35 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 484 ON READER SERVICE CARD**

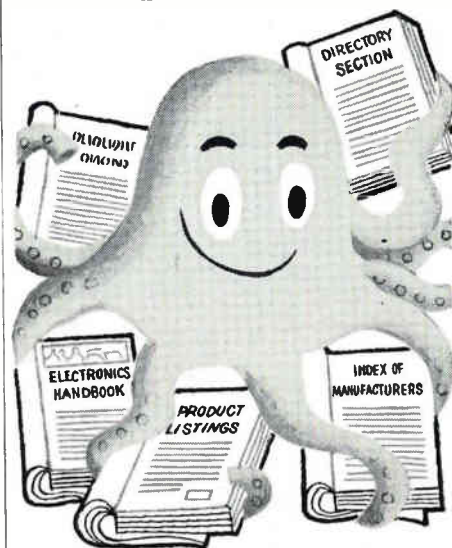


### Capacitors

#### METALLIZED MYLAR

ELECTRON PRODUCTS, 430 N. Halstead St., Pasadena, Calif., an-

# Get the facts together quickly



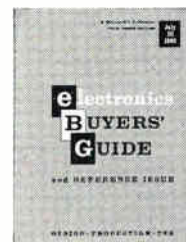
Buying is easier when you've got all the facts in *one* place.

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.

That's why the GUIDE will put you in the *strongest* position to make the best buying choice for yourself and your company.

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NEED  
IN  
THE



**electronics  
BUYERS' GUIDE**

# 3 steps to using the BUYERS' GUIDE



## locate products

In product listings



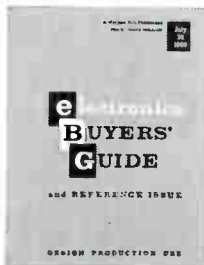
## find product specifications

In the advertising pages



## buy products

From local office in manufacturers' listings

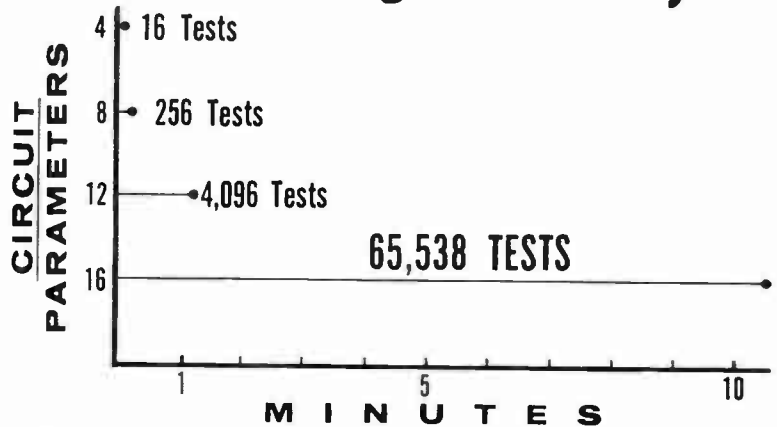


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THE

# electronics BUYERS' GUIDE

August 12, 1960

# HOW FAST CAN YOU TEST Circuit Design Reliability?



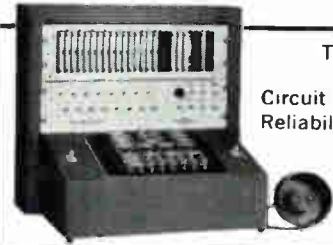
Yes, you can test all combinations of high and low values of as many as 16 circuit parameters in less than 11 minutes!

Write today for informative 8-page Brochure.



**AIRBORNE  
INSTRUMENTS  
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DEER PARK, LONG ISLAND, NEW YORK  
A DIVISION  
OF CUTLER-HAMMER, INC.

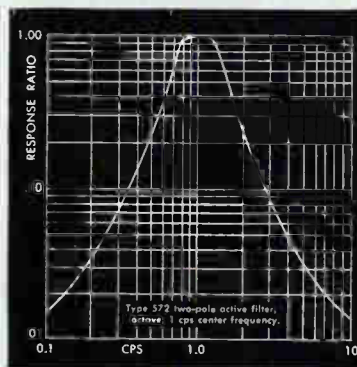


TYPE  
90  
Circuit Design  
Reliability Tester

PRICE:  
\$3600.

CIRCLE 324 ON READER SERVICE CARD

# ULTRA-LOW-FREQUENCY BAND PASS



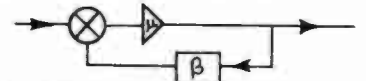
All filters and networks hermetically sealed with special encapsulations available.  
Plug in or stud mounted  
Individual problems promptly considered by our complete engineering facilities  
Prompt delivery — Moderate prices



PLANT AT 5500 BALCONES TRAIL

WHITE  
INSTRUMENT LABORATORIES  
INCORPORATED  
BOX 9006 AUSTIN 17, TEXAS

## 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.

Twin-T Networks for harmonic rejection, low-pass filtering, feedback circuits. Null frequencies .02 cps to 50 kc, wide range of impedance levels. Bulletin 500.

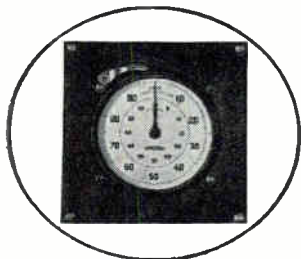
Toroidal Wave Filters, LC filters with stable toroidal inductors. Low, high, band-pass models available over wide impedance and frequency ranges. Ask for LC Bulletins.

Network Notes contain articles on use, performance, and problems of networks and filters.

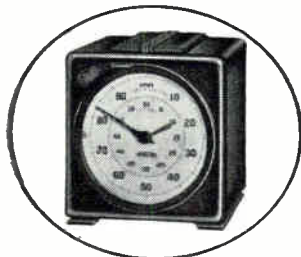
CIRCLE 247 ON READER SERVICE CARD



# ...When there's NO SUBSTITUTE for PRECISION TIMING



PANEL MOUNTED



PORTABLE



Request  
Catalog  
No. 198

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.

| Model   | Scale Divisions | Totalizes | Accuracy    |
|---------|-----------------|-----------|-------------|
| S-100   | 1/5 sec.        | 6000 sec. | ±.1 sec.    |
| S-60    | 1/5 sec.        | 60 min.   | ±.1 sec.    |
| SM-60   | 1/100 min.      | 60 min.   | ±.002 min.  |
| S-10    | 1/10 sec.       | 1000 sec. | ±.02 sec.   |
| S-6     | 1/1000 min.     | 10 min.   | ±.0002 min. |
| S-1     | 1/100 sec.      | 60 sec.   | ±.01 sec.   |
| MST     | 1/1000 sec.     | .360 sec. | ±.001 sec.  |
| MST-500 | 1/1000 sec.     | 30 sec.   | ±.002 sec.  |

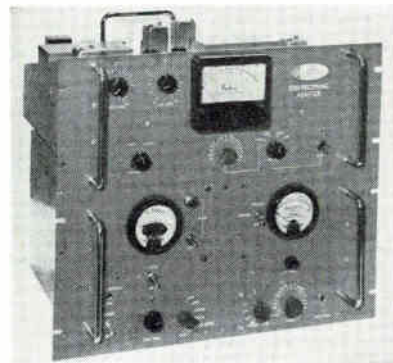
## THE STANDARD ELECTRIC TIME COMPANY

89 LOGAN STREET, SPRINGFIELD, MASSACHUSETTS

CIRCLE 325 ON READER SERVICE CARD

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  $\mu$ f 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  $\times$   $\mu$ f 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  $\pm 20$  percent . . . 10, 5, 3, 2 and 1 percent tolerances are available. The 0.001 to 0.033  $\mu$ f 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  $\pm 2$  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

*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

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Paine, Webber, Jackson & Curtis    Smith, Barney & Co.    White, Weld & Co.  
Incorporated    Incorporated

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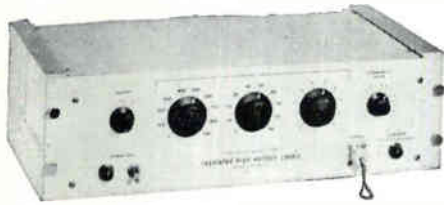
W. E. Hutton & Co.    R. W. Pressprich & Co.    Model, Roland & Stone

Spencer Trask & Co.    Tucker, Anthony & R. L. Day

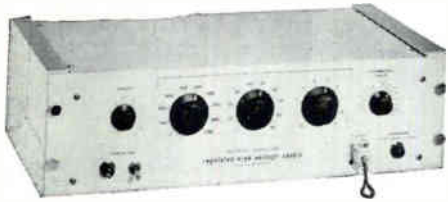
H. C. Wainwright & Co.    G. H. Walker & Co.    Spencer, Swain & Co. Inc.

July 25, 1960.

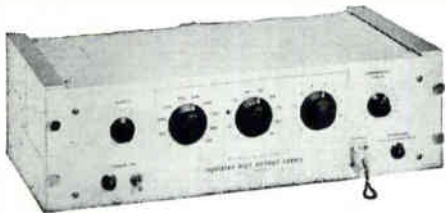
# dial any output



# 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  $\pm 0.02\%$  per day.
- Protective relays disconnect output at 12 milliamperes.
- Price: \$325.00.

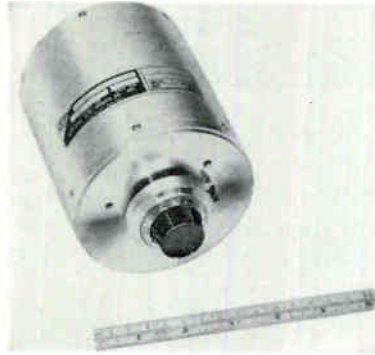
Send for details about the Model 240 Supply.



**CIRCLE 326 ON READER SERVICE CARD**  
August 12, 1960

is within  $\pm 2$  db from 150 to 6,000 cps.

**CIRCLE 486 ON READER SERVICE CARD**



## Variable Delay Line MAGNETOSTRICTIVE

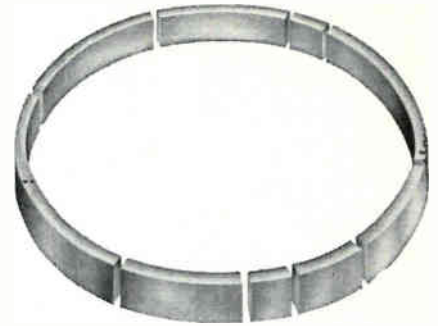
CONTROL ELECTRONICS CO., INC., 10 Stepar Place, Huntington Station, L. I., N. Y., has a variable magnetostrictive delay line that offers precise calibration and features a continuous range of delays from 3 to 500  $\mu$ sec. Unit is used for delay trigger in radar systems. Model VM-1030 features a 10-turn dial, giving the maximum delay of 500  $\mu$ sec to within an accuracy of  $\pm 0.5$   $\mu$ sec. Dial is turn indicating type calibrated into 100 divisions per turn  $\times 10$  turns or 1,000 divisions. The VM-1030 has an optimum pulse input of 1  $\mu$ sec and can be supplied with an impedance range running from 50 ohms to 4 K ohms. Insertion loss at the end of the range is 56 db and maximum number of pulses per sec is 300 Kc.

**CIRCLE 487 ON READER SERVICE CARD**



## Servo Amplifier TRANSISTORIZED

GENERAL KINETICS DIVISION of Hyda-Electric, Inc., 3151 Kenwood St., Burbank, Calif. Model SD132 is specifically designed for use in electrohydraulic servo systems but



## 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.

The Gamewell SG-270 Switch is available with diameters of  $\frac{5}{8}$ ",  $1\frac{1}{4}$ ",  $1\frac{3}{8}$ ", 2", 3" and 5" in various mounting styles.



**BLISS**  
**Gamewell**  
**PRECISION POTENTIOMETERS**  
"INTEGRALS OF  
HIGH PERFORMANCE"

**CIRCLE 249 ON READER SERVICE CARD** 249



tantalum wet slug, porous anode



tantalum foil, silver encased, non-polar



tantalum foil, silver encased, polar



aluminum foil, plastic encased, axial lead



aluminum foil, plastic encased, single end

# iei SPECIALISTS

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Fast, personalized service to assist you in adapting standard capacitors for your special requirements, or in developing entirely new capacitors for your individual needs.

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AN **sps** COMPANY

where reliability replaces probability

is also useful in magnetic clutch and motor circuitry. Completely transistorized, this etched circuitry unit is capable of furnishing 20 ma differential current into 1,000 ohms/coil push-pull coils of valves. Any carrier frequency from 60 cps to 10 Kc may be used. Time lag introduced by the unit is negligible. Internal pickup is exceptionally low. Units are available for airborne as well as ground-based use. Gain stability is 1 db at full gain over the temperature range from -55 C to +71 C.

CIRCLE 488 ON READER SERVICE CARD

## 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  $\mu$ sec. 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, templets, 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.

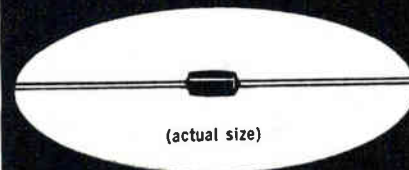
CIRCLE 490 ON READER SERVICE CARD

# 700,000

## OHMS

# 0.25%

## TOLERANCE



(actual size)

# CINEMA MICROMINIATURE PRECISION WIRE-WOUND RESISTORS

Space at an absolute premium? Take advantage of Cinema's extremely compact design in precision wire-wound resistors to miniaturize your electronic assemblies. Featuring rugged construction, Type CE200 resistors utilize unique winding techniques and are encapsulated in a superior epoxy formulation for complete protection against environmental conditions. Units are aged for long-term stability and high reliability. Performance characteristics per MIL-R-93B and MIL-R-9444. Standard temperature coefficients are  $\pm 20$  ppm, with finer coefficients on special order. The CE200 resistors are available in the following sizes and ratings:

| TYPE   | WATTAGE RATING | DIA. | LENGTH | MAX. RESISTANCE |
|--------|----------------|------|--------|-----------------|
| CE241E | .05            | 1/8" | 1/4"   | 450K            |
| CE242E | .1             | 1/8" | 3/8"   | 700K            |
| CE243E | .25            | 3/8" | 3/8"   | 1.8 Meg.        |
| CE244E | .25            | 1/4" | 3/8"   | 2.5 Meg.        |

For printed-wiring applications CE400 Series Units are available. Write today for complete technical details to...

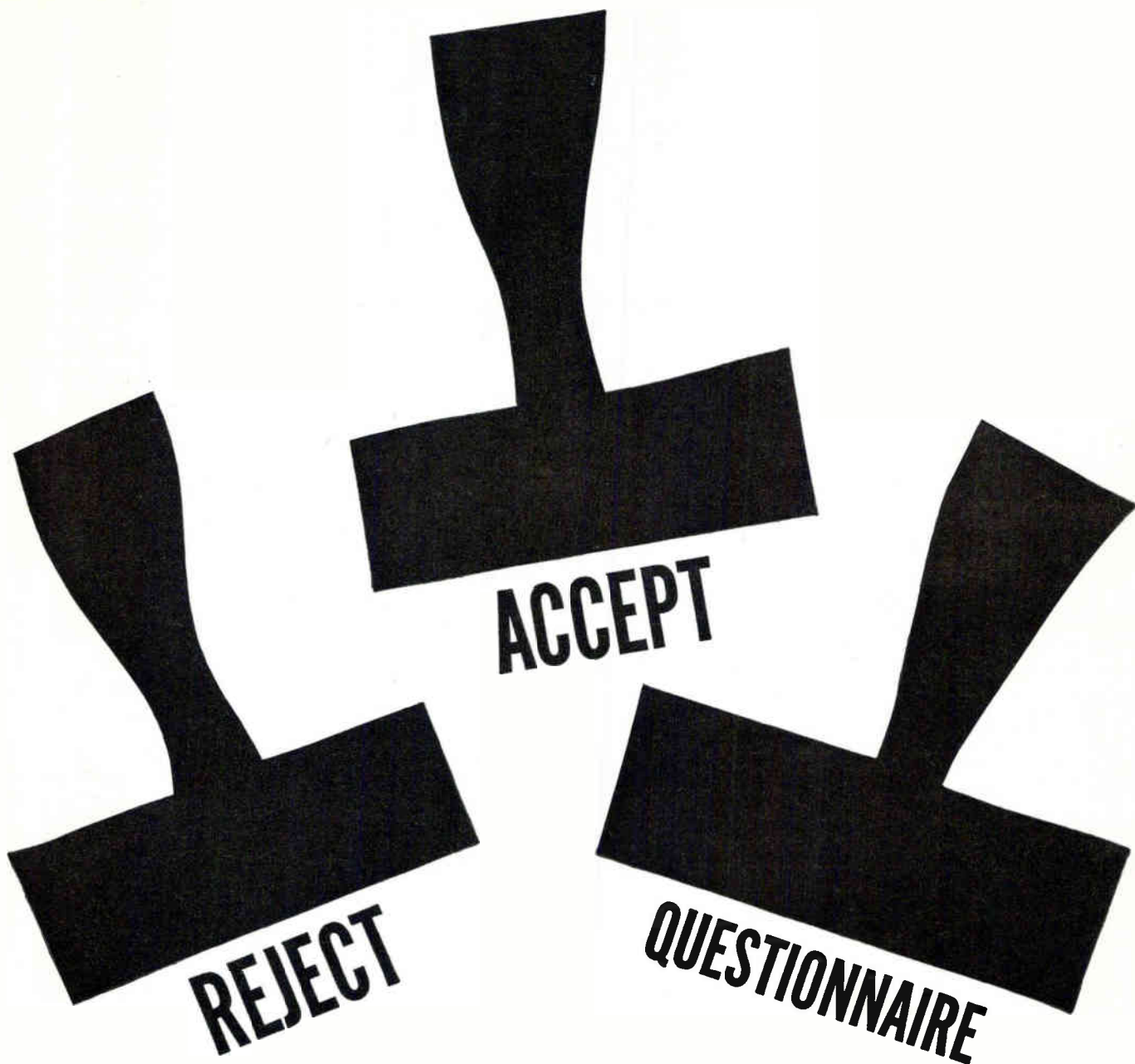


# CINEMA ENGINEERING

DIVISION AEROVOX CORPORATION  
1100 Chestnut, Burbank, California

WESCON Booth 2805

CIRCLE 327 ON READER SERVICE CARD  
electronics



## THREE TOOLS FOR QUALITY CIRCULATION

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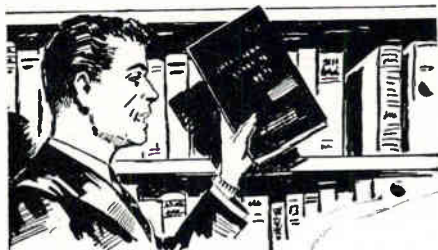
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### 7 SELF-SATURATING MAGNETIC AMPLIFIERS

Just Published. A practical guide covering basic theory, operating principles, design techniques and applications of magnetic amplifiers employing self-saturation. By G. Lynn, T. Pula, J. Ringelman, and F. Timmel, Air Arm Div. Westinghouse Elec. Corp. 232 pp., 152 illus., \$8.00

### 8 INFRARED RADIATION

Just Published. Explains exactly what infrared radiation is and what it does. Analyzes a typical infrared system and discusses the components of such a system, the laws of physics by which it operates, and the materials involved. By H. Hackforth, Northronics, Div. of Northrop Aircraft, 280 pp., 172 illus., \$10.00

### 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 how typical design problems are solved. By G. Thaler, U. S. Naval Postgraduate School; and R. Brown, Electronics Div., General Motors Corp. 2nd. Ed., 640 pp., 472 diagrams, charts, tables, \$14.50

### 10 TWO-WAY RADIO

A complete guide to two-way radio—from a description of a typical radio system and its many uses in business and industry, to technical information on transmitters and receivers, circuit details, selective calling methods, installation, trouble-shooting, and repair. By A. Lytel, Avco Mfg. Co., Crosley Div. 281 pp., 283 illus., \$9.50

### 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. La Londe, Jr., Newark Coll. of Eng. 2nd Ed., 615 pp., 273 illus., \$7.50

### 12 FUNDAMENTALS OF SIGNAL THEORY

Just Published. Explains important mathematical techniques useful in understanding excitation and response of linear systems. Coverage ranges from complex algebra—through pole-zero and operational methods—to Fourier integrals, spectrum concepts, and optimum systems for separating signals from interference. By J. Stewart, Univ. of Arizona. 368 pp., 129 illus., \$9.00

## 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 815-1853013 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

**HOO-K-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

### 1 ULTRASONICS

Just Published—Second Edition. Covers the design, repair, and construction of ultrasonic equipment. Includes special experimental results of many details of equipment, plus advances in cleaning, degreasing, soldering, plating, and other operations. By B. Carlin, formerly Product Research Supv. Sperry Products. 2nd Ed., 320 pp., 263 illus., \$11.50

### 2 FIXED AND VARIABLE CAPACITORS

Gives a wealth of working information on fixed and variable capacitors—details of design and construction, application in modern electronic equipment, experimental types of capacitors, and more. By G. W. A. Dummer, Royal Radar Establishment; and Harold M. Nordenberg, Bureau of Ships. 281 pp., 164 illus., \$10.00

### 3 DIGITAL COMPUTER AND CONTROL ENGINEERING

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## the Week

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CIRCLE 564 ON READER SERVICE CARD

**CONTROLLED RECTIFIER**  
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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** Composite Industrial Metals, Inc., 235 Georgia Ave., Providence 5, R. I. A new catalog introduces C-I-M's facilities, describes their ability to serve and contains precious and non-precious metal solder selection tables and base metal selection tables.

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.

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Both time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. Time-correlate data to within  $\pm 1$  millisecond at a cost of only \$7,650 for the ZA-810, \$7,050 for the ZA-802. Frequency Stability: 3 parts in  $10^8$  per day.

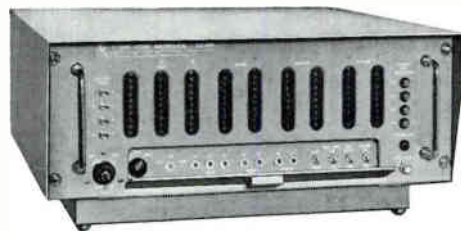
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MODEL ZA-803 BCD OUTPUT (20-BIT)



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MODEL ZA-810 36-BIT 100 PPS CODE

ALSO MODEL ZA-810-M1  
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## Moore\*: At Wescon, a numismatist

CHAIRMAN of the executive committee for 1960 Wescon is methodical Hugh P. Moore, board chairman of Lercos 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 Aerovox. In 1955 he bought controlling interest in Lercos, 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.

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.

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\* Left, with Walter E. Peterson, chairman of 1960 Wescon's board.

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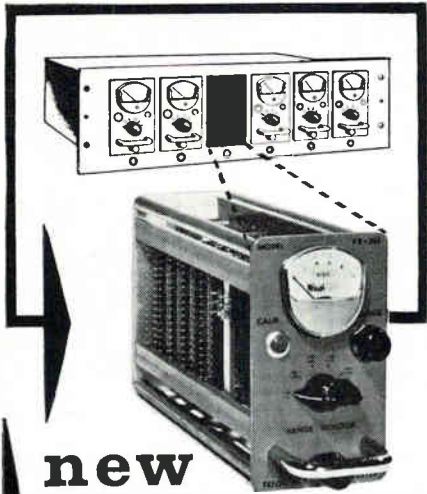
| MODEL | VOLTAGE      | CURRENT | REGULATION |        | STABILITY PER HOUR | MAX. RIPPLE RMS | RESOLUTION | PRICE     |
|-------|--------------|---------|------------|--------|--------------------|-----------------|------------|-----------|
|       |              |         | LINE       | LOAD   |                    |                 |            |           |
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| 405   | 600-3100V    | 0-15 ma | 0.01%      | 0.005% | 0.005%             | 5mv             | 10mv       | \$595.00  |
| 408A  | 500-6010V    | 0-20 ma | 0.01%      | 0.01%  | 0.005%             | 5mv             | 10mv       | \$695.00  |
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All prices quoted, F.O.B., Factory, Seattle. Prices and technical data subject to change without notice.

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### Frequency-to-D.C. Converter

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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 oscillographs, 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  $\pm 0.1\%$  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          | $\pm 0.1\%$ full scale peak to peak maximum |
| Pulse Output    | 10 milliamp into 250 ohms                   |
| D.C. Output     | 0 to 5 volts d.c.                           |

Request Bulletin 112 for complete specifications.

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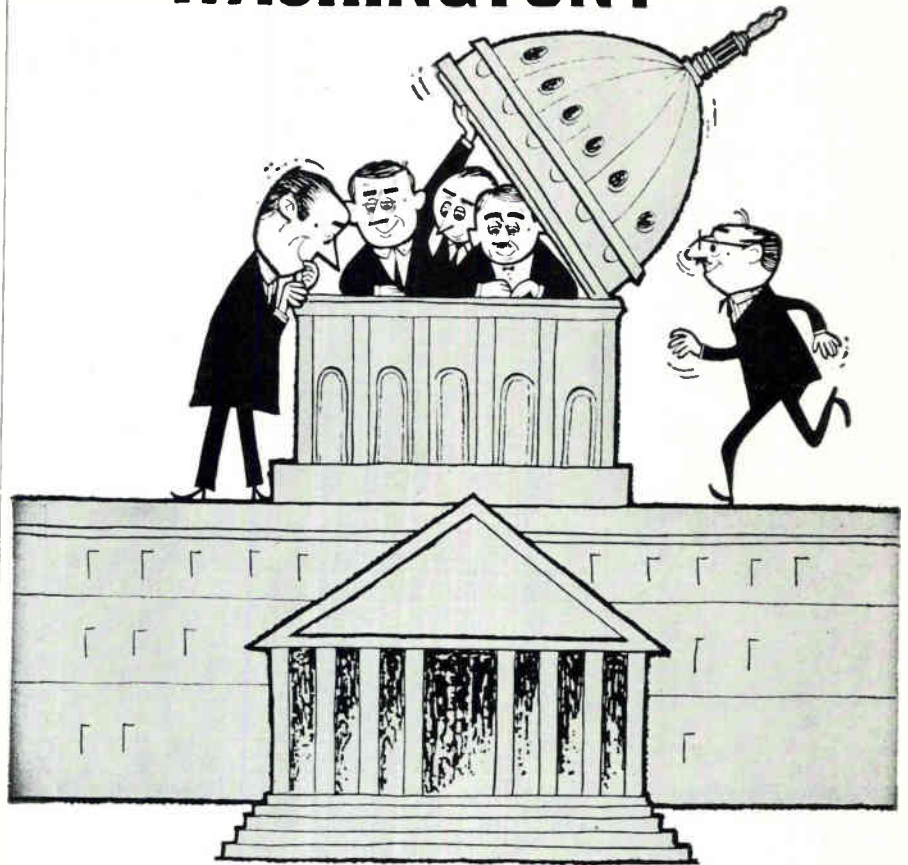
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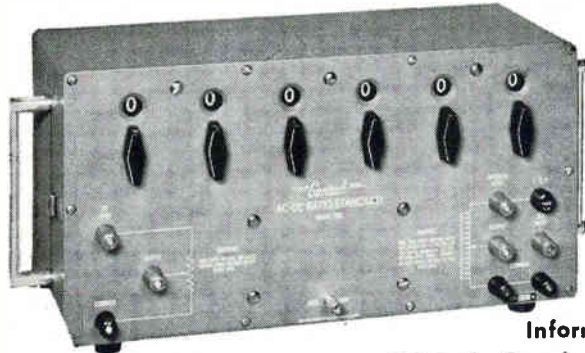
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| Linearity:  | 1 part per million (0.0001%) | 10 parts per million (0.001%) |
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Information on AC Ratio Standards in the GERTSCH RATIO STANDARDS SERIES, Models 1000, 1003 and 1004, is also available.

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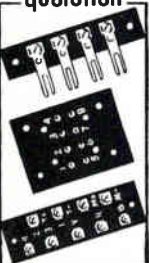
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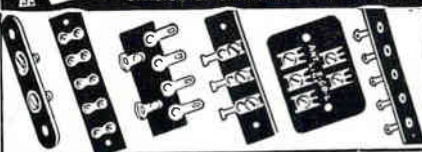
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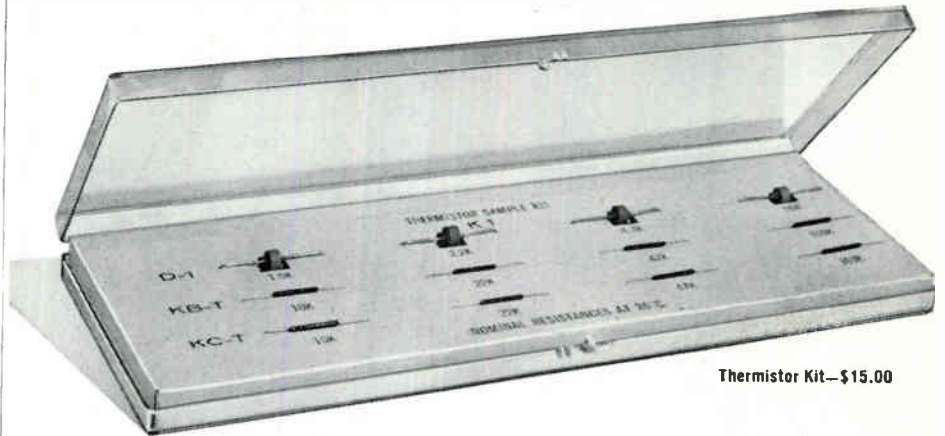
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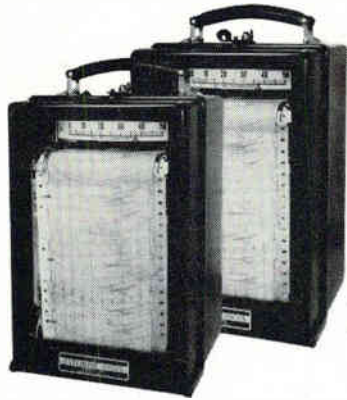
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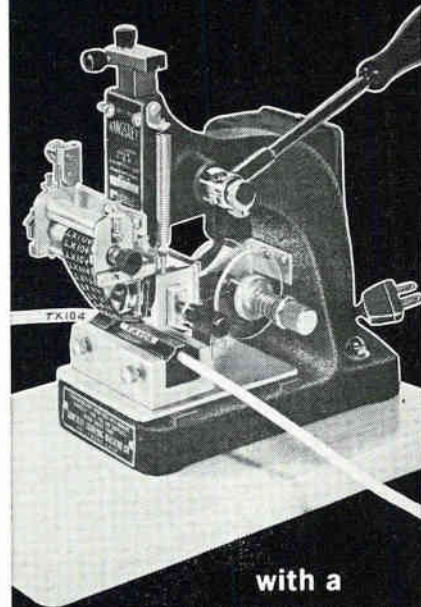
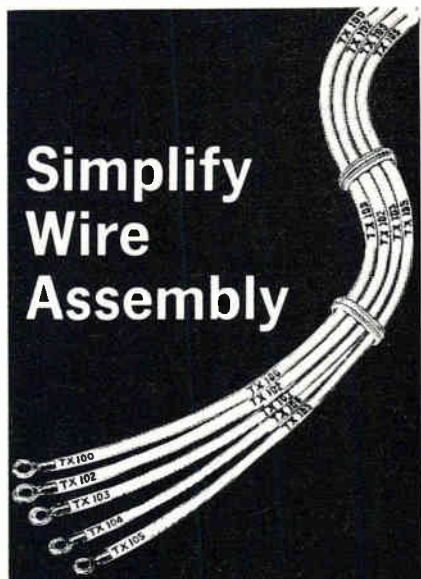
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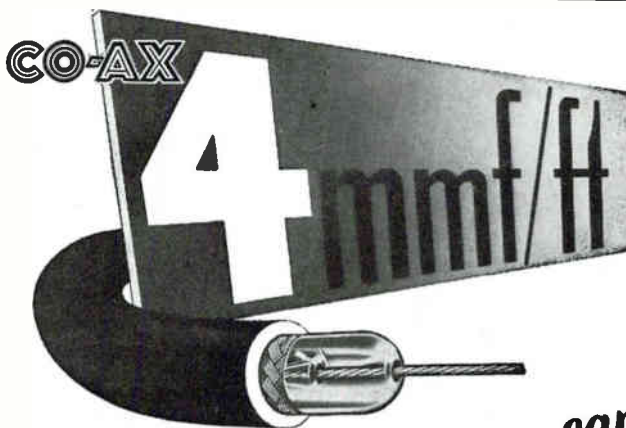
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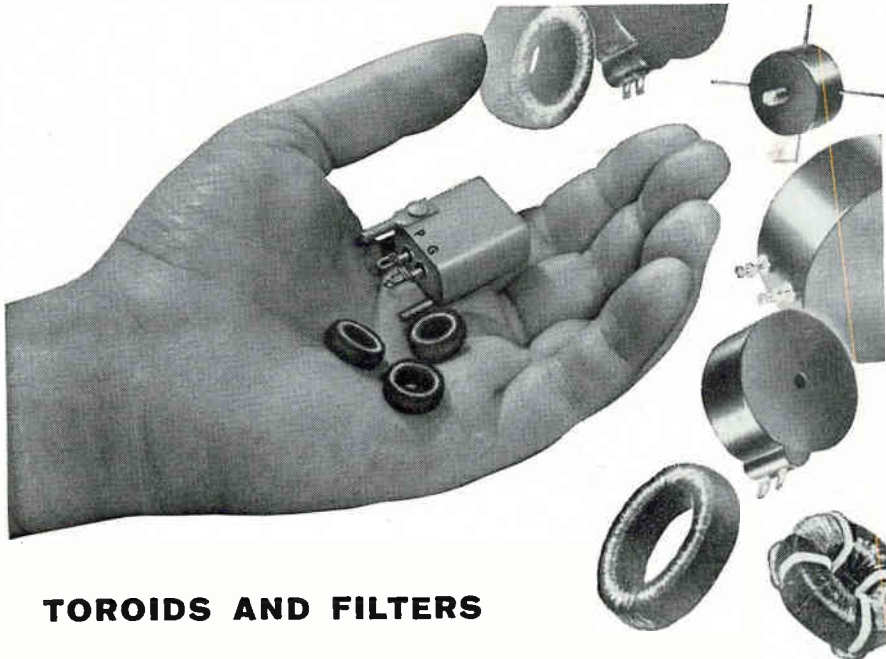
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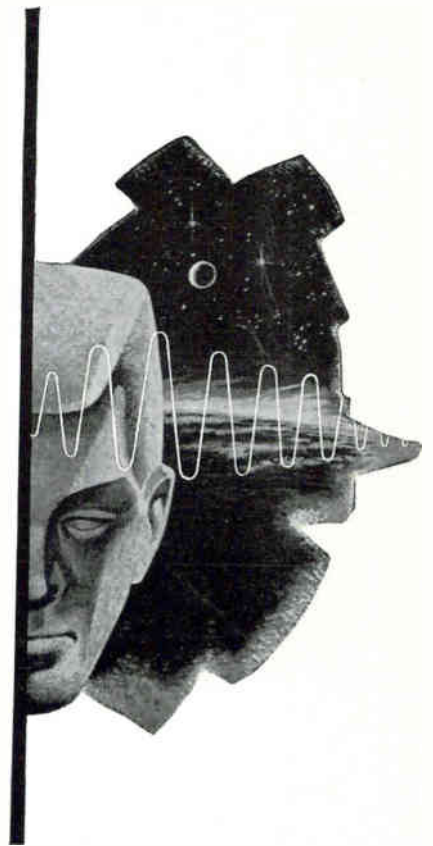
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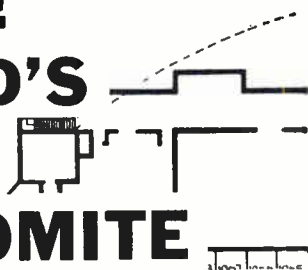
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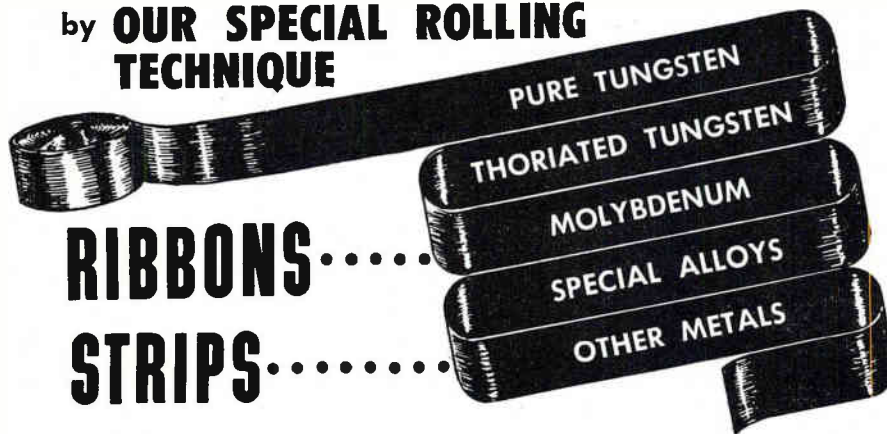
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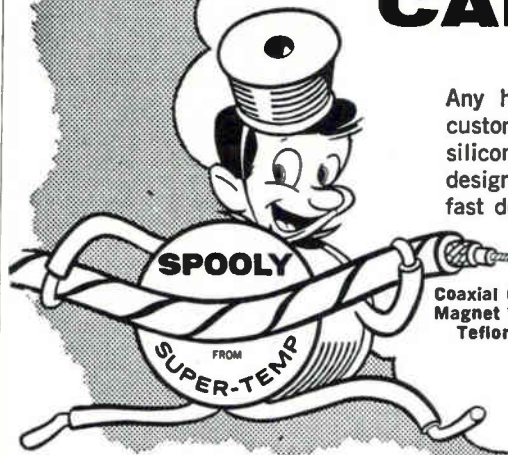
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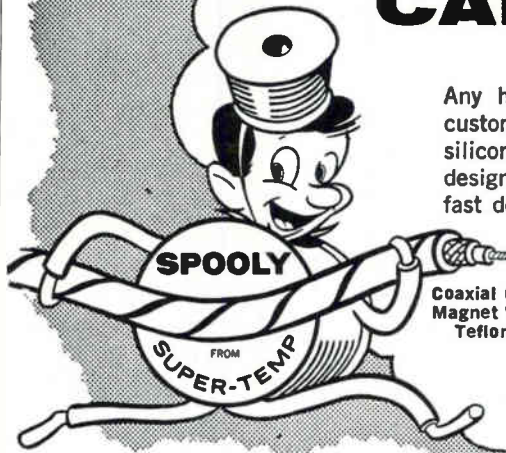
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Require degree plus at least 5 years' experience performing mathematical formulation and analysis of complex weapon systems problems. Experience with electronic data processing equipment is desirable.

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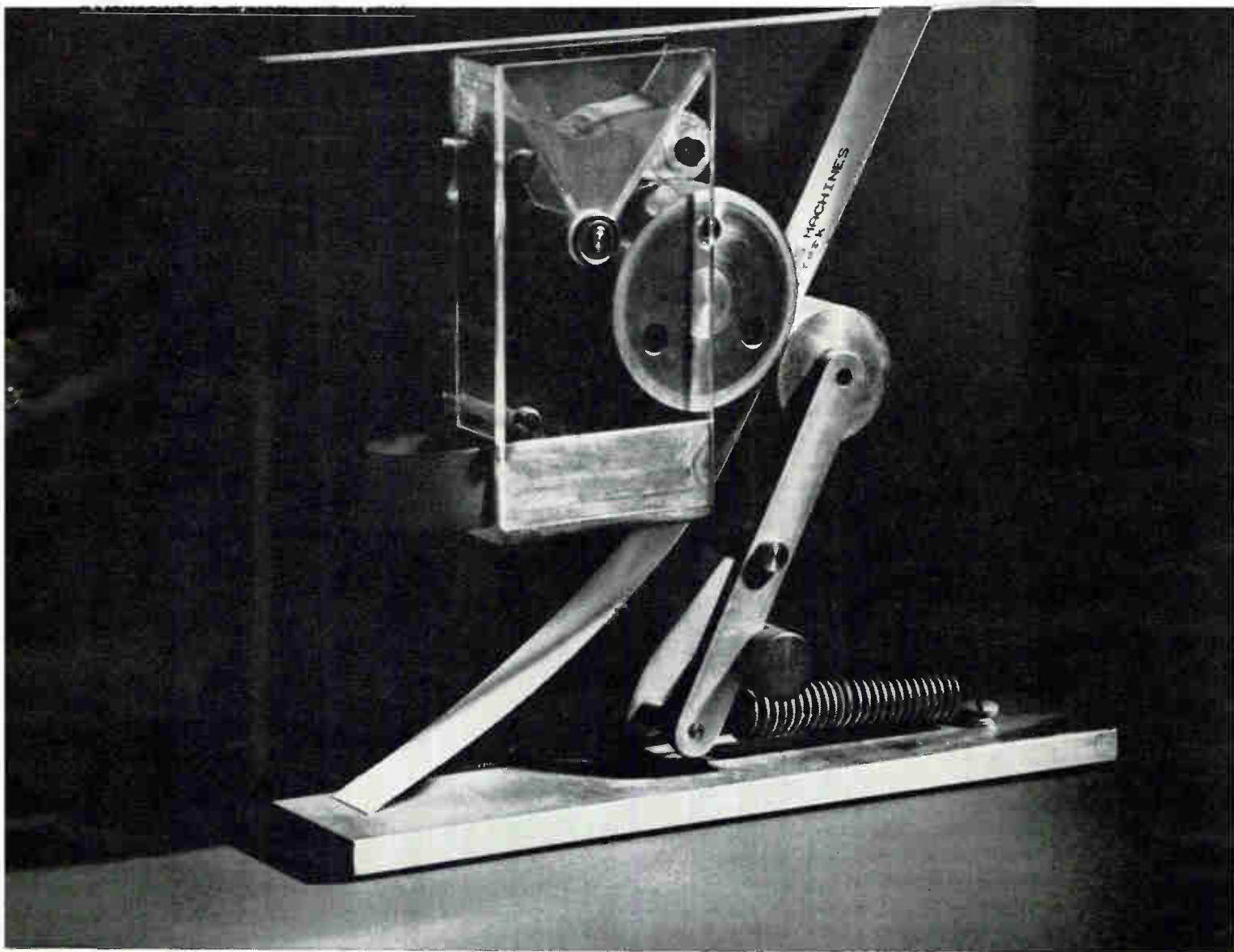
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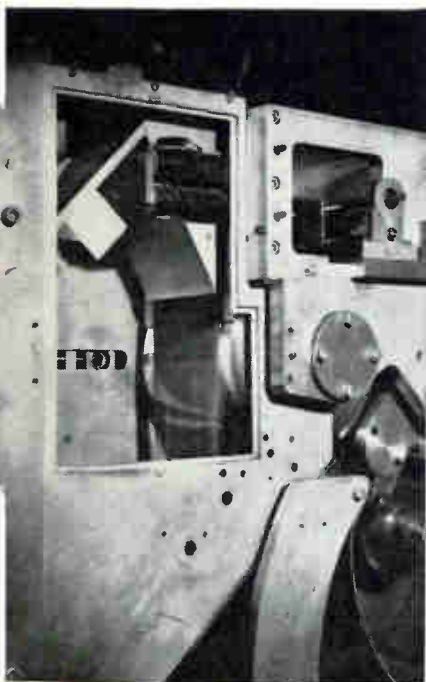
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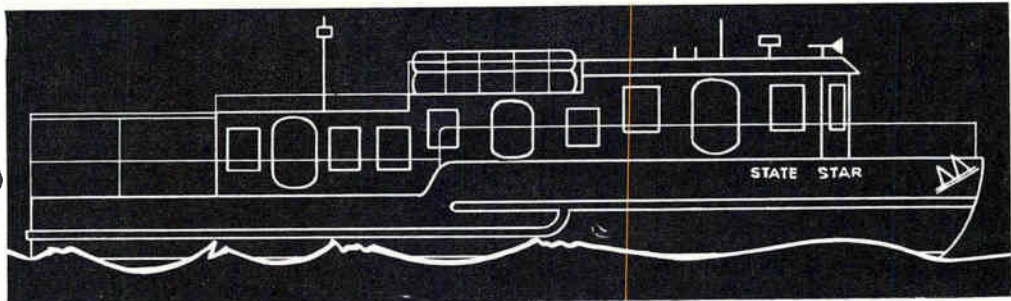
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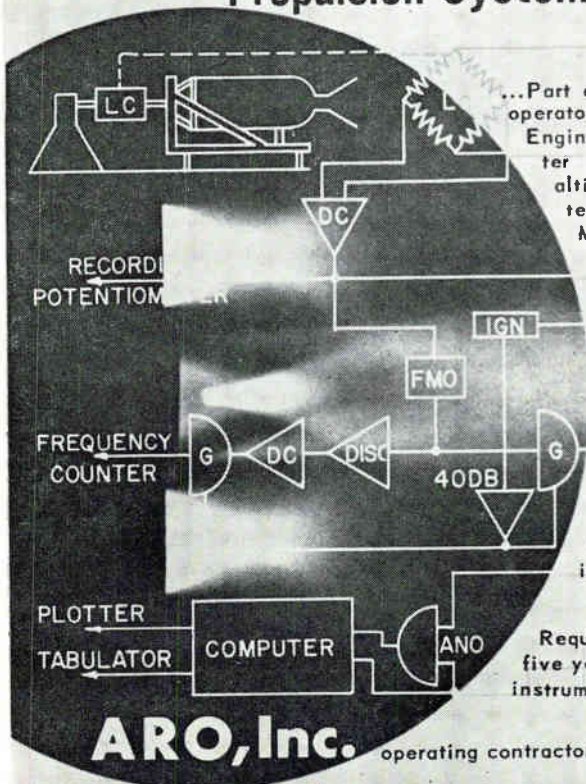
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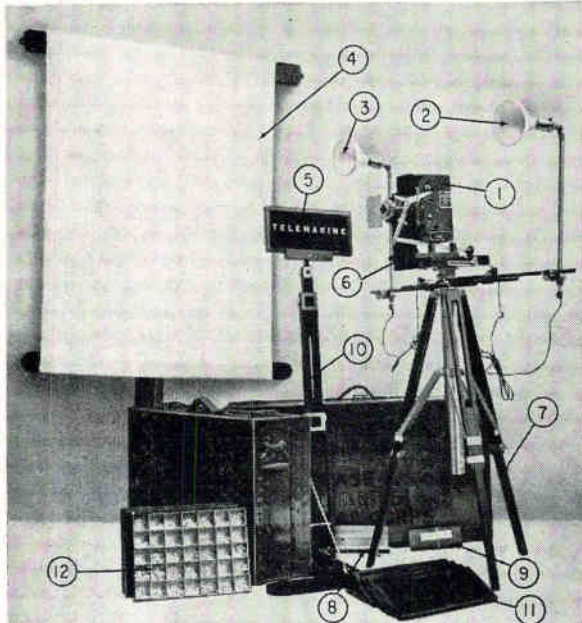
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| TS270B                                             | Echo Box                                                        | 225.00                                                                                         |
| TS403                                              | S Band Signal Generator                                         | 1,250.00                                                                                       |
| TS419                                              | L Band Signal Generator                                         | 895.00                                                                                         |
| TS445                                              | L Band Echo Box                                                 | 295.00                                                                                         |
| TS577                                              | Telephone Test Set                                              | 295.00                                                                                         |
| TS666                                              | Calibrator                                                      | 125.00                                                                                         |
| EPUT554                                            | Berkeley Instruments Frequency Meter                            | 395.00                                                                                         |
| RCA M1-7519E                                       | Distortion & Noise Analyzer                                     | 150.00                                                                                         |
| UPM 7, 10, 11, 11A, URM 12, 23, 25, 26, UPM 30, 33 | Radar Test Sets                                                 | Prices on Request                                                                              |
| Tektronix                                          | Oscilloscope measurement signal generator Model 80              | 450.00                                                                                         |
|                                                    | Model 84                                                        | 750.00                                                                                         |
|                                                    | Model 905                                                       | 895.00                                                                                         |
| General Radio                                      | Signal Generator 905                                            | 895.00                                                                                         |
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|                                                    | 32/100                                                          | 195.00                                                                                         |
| Dummy Load                                         | Jones 634H                                                      | 150.00                                                                                         |
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| APR5                    | 180.00        | APS10              | 695.00        |
| APR5A                   | 180.00        | APS23 (trans)      | 195.00        |
| APR10                   | 180.00        | APS32 K band radar | 875.00        |
| APT2                    | 75.00         | APS31 PARTS        |               |

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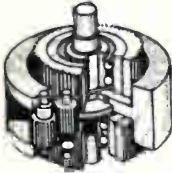
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1:1 reverse ratio, 60 teeth on large gear; 1/4" shaft. Size: 3" long with 1-15/16" dia. Stock no. A6-104.....each \$3.95

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1:1 reverse ratio on both. Size: 3 1/4" long x 1-7/16" dia. Shaft size: 1/8" and 5/32". Stock no. A6-107.....each \$7.50

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Part #673073, Motor 115 volts, 3 phase, 400 cycle, 8 watts, 20,000 RPM. 3-minute runup, synchro pickoffs, roll 360°, pitch 85°. Synchro excitation 26 volts, 400 cycle, 150 m.a. Vertical accuracy ±1/2". Weight 3 1/2 lbs. Approx. dim. 5 3/4" L., 4 1/2" W., 4 1/2" H. Price \$35.00

### MINNEAPOLIS-HONEYWELL RATE GYRO (Control Flight)

Part no. JG7005A, 115 volts A.C., 400 cycle, single phase potentiometer take off resistance 530 ohms. Speed 21,000 r.p.m. Angular momentum 2 1/2 million, CM²/sec. Weight 2 lbs. Dimensions 4-7/32 x 3-29/32 x 3-31/64. Price \$22.50

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No. 145 Forward & Reverse 2 1/4-0-2 1/4. Input shaft spline gear 12 teeth 9/32" dia. 3/8" long. Output shaft 15/64" dia. x 15/32" long. Control shaft 11/32" x 3/8" long. Cast aluminum construction. Approx. size 3" x 3" x 2 3/4". \$17.50

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(approx. size overall 3 3/4" x 1 1/4" dia.):  
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Model =A-12  
120/208 volts, 400 cycle, 1 or 3 phase, 1 kva, pf 0.8, rpm 8,000. Approx. dim. 6" x 5 1/2". Internal spline drive. Price \$100.00

### 400 CYCLE 1/3 PHASE GENERATOR

115 VAC. 3 KVA. Mfg. Bogue Elect. Mod. 2800S. External excitation 107 VDC. 1.1 amp. 3450 rpm. 1" shaft. \$200.00

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115 volts, 400 cycles, single phase, 35 watts. Pitch and roll potentiometer pickoffs 890 ohms, 40 volts max. AC or DC. Speed 20,000 rpm, angular momentum 12,500,000 gm-cm 2/sec. Erection system 27 VAC, 400 cycles, time 5 min. to 1/2". Weight 5.5 lbs. Price \$35.00 each

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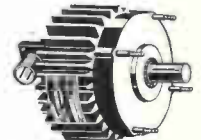
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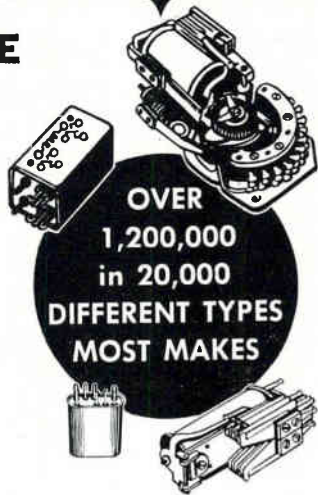
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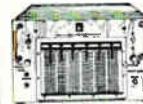
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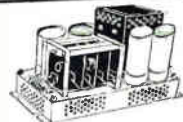
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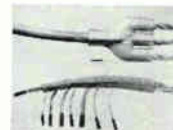
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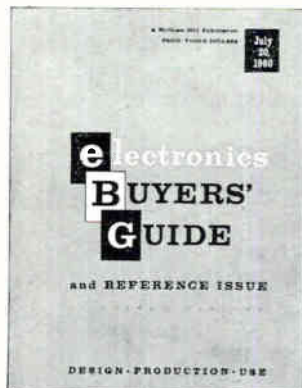
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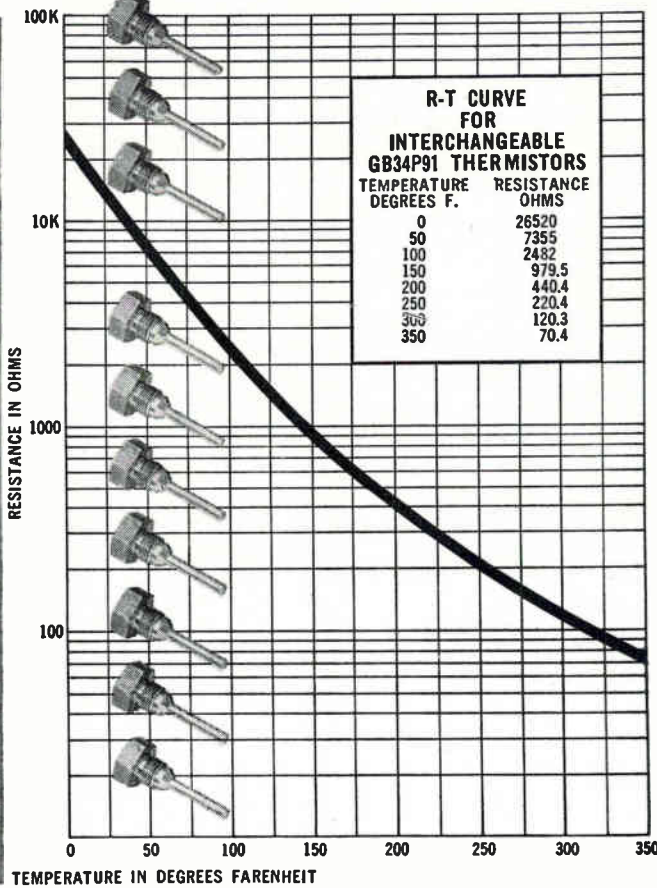
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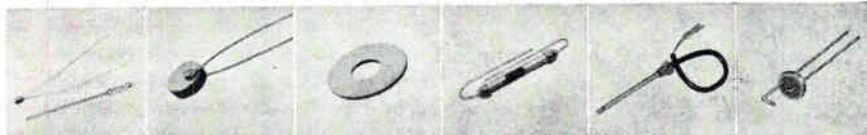


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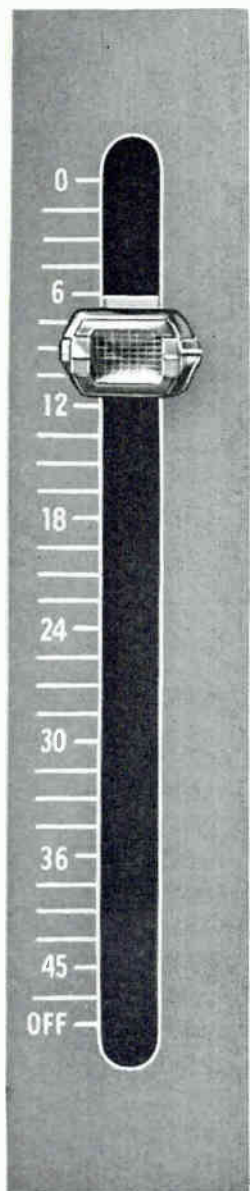
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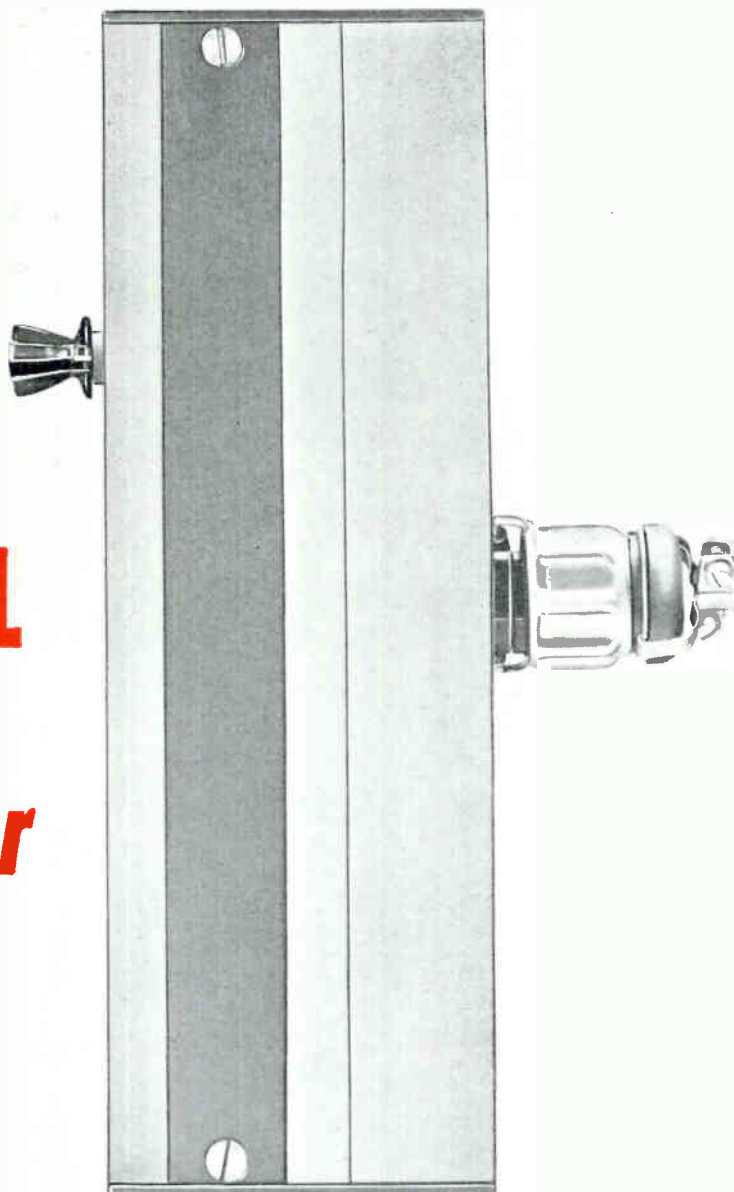
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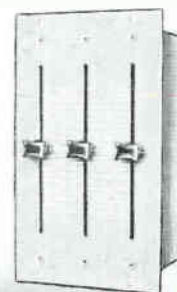
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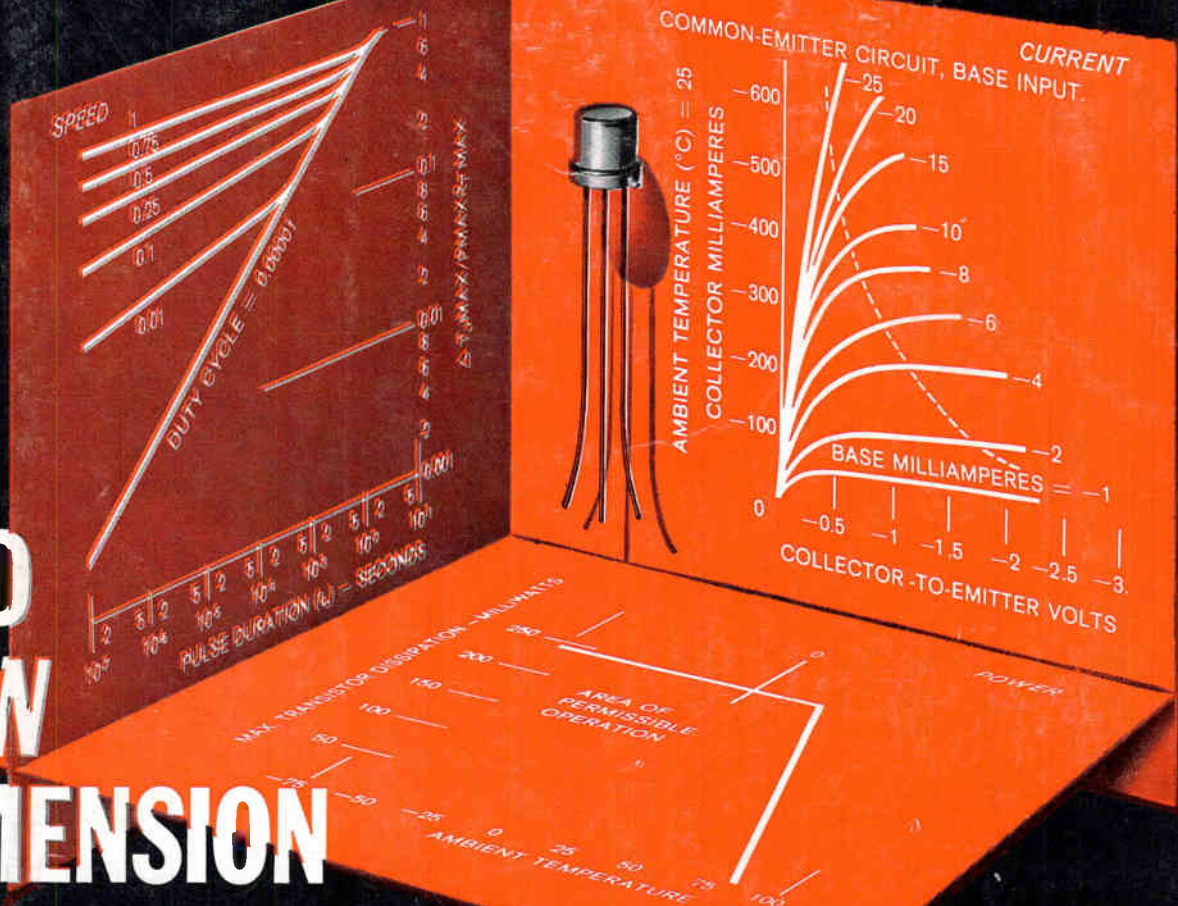
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