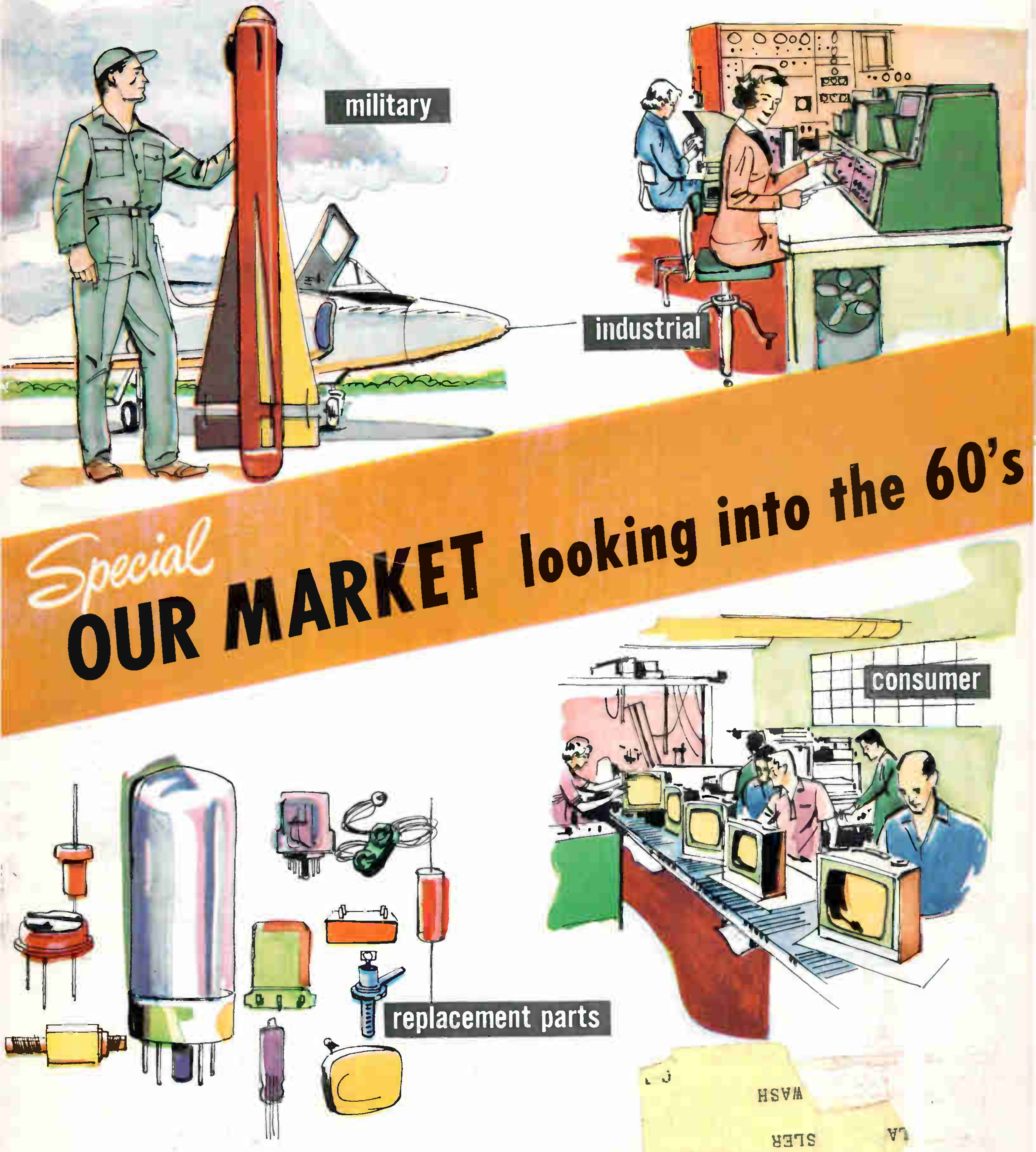
JANUARY 1, 1960

electronics

A McGRAW-HILL PUBLICATION VOL. 33, No. 1 PRICE SEVENTY-FIVE CENTS



UTC NEW EXPANDED

DO-T AND DI-T SERIES

Revolutionary transistor transformers hermetically sealed to MIL-T-27A Specifications.

UTC DO-T and DI-T transistor transformers provide unprecedented power handling capacity and reliability coupled with extremely small size. Comparative performance with other available products of similar size are shown in the curves (based on setting output power at 1 KC, then maintaining same input level over frequency range). The new expanded series of units cover virtually every transistor application.

DO-T

ACTUAL SIZE

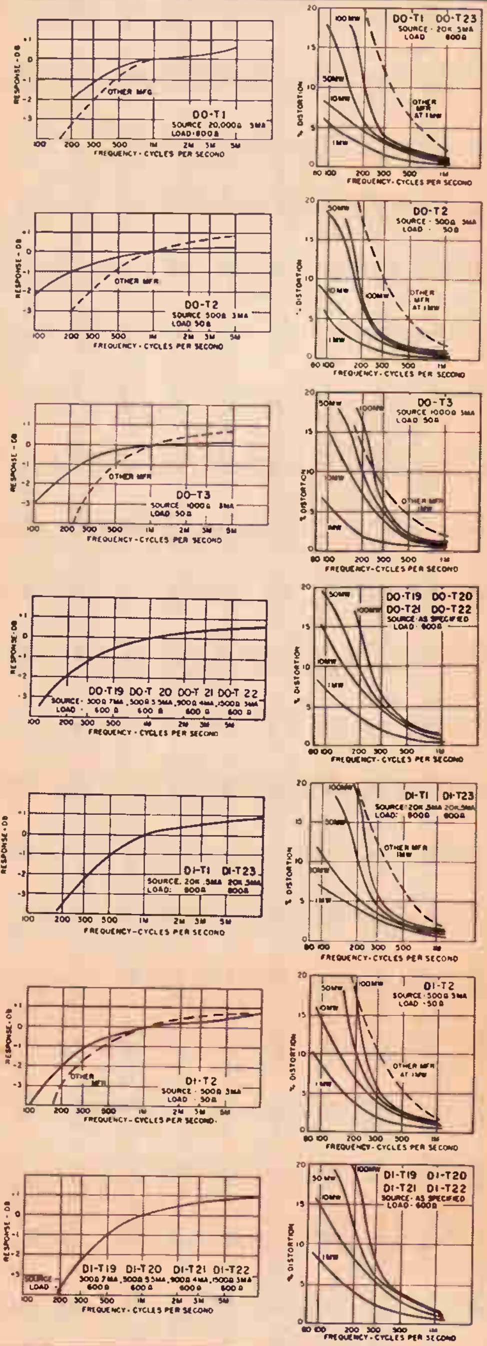
5/16 Dia. x 13/32, 1/10 Oz.

- **High Power Rating** . . . up to 100 times greater.
- **Excellent Response** . . . twice as good at low end.
- **Low Distortion** . . . reduced 80%.
- **High Efficiency** . . . up to 30% better.
- **Moisture Proof** . . . hermetically sealed to MIL-T-27A.
- **Rugged** . . . completely cased.
- **Anchored Leads** . . . withstand 10 pound pull test.
- **Printed Circuit Use**...plastic insulated leads.

DI-T

ACTUAL SIZE

5/16 Dia. x 1/4, 1/20 Oz.



DO-T No.	MIL Type	Application	Pri. Imp.	D.C. Ma.‡ in Pri.	Sec. Imp.	Pri. Res. DO-T	Pri. Res. DI-T	Level Mw.	DI-T No.
DO-T1	TF4RX13YY	Interstage	20,000 30,000	.5 .5	800 1200	850	815	50	DI-T1
DO-T2	TF4RX17YY	Output	500 600	3 3	50 60	60	65	100	DI-T2
DO-T3	TF4RX13YY	Output	1000 1200	3 3	50 60	115	110	100	DI-T3
DO-T4	TF4RX17YY	Output	600	3	3.2	60		100	
DO-T5	TF4RX13YY	Output	1200	2	3.2	115	110	100	DI-T5
DO-T6	TF4RX13YY	Output	10,000	1	3.2	790		100	
DO-T7	TF4RX16YY	Input	200,000	0	1000	8500		25	
DO-T8	TF4RX20YY	Reactor 3.5 Hys. @ 2 Ma. DC, 1 Hy. @ 5 Ma. DC				630			
	TF4RX20YY	Reactor 2.5 Hys. @ 2 Ma. DC, .9 Hy. @ 4 Ma. DC					630		DI-T8
DO-T9	TF4RX13YY	Output or driver	10,000 12,000	1 1	500 CT 600 CT	800	870	100	DI-T9
DO-T10	TF4RX13YY	Driver	10,000 12,000	1 1	1200 CT 1500 CT	800	870	100	DI-T10
DO-T11	TF4RX13YY	Driver	10,000 12,000	1 1	2000 CT 2500 CT	800	870	100	DI-T11
DO-T12	TF4RX17YY	Single or PP output	150 CT 200 CT	10 10	12 16	11		500	
DO-T13	TF4RX17YY	Single or PP output	300 CT 400 CT	7 7	12 16	20		500	
DO-T14	TF4RX17YY	Single or PP output	600 CT 800 CT	5 5	12 16	43		500	
DO-T15	TF4RX17YY	Single or PP output	800 CT 1070 CT	4 4	12 16	51		500	
DO-T16	TF4RX13YY	Single or PP output	1000 CT 1330 CT	3.5 3.5	12 16	71		500	
DO-T17	TF4RX13YY	Single or PP output	1500 CT 2000 CT	3 3	12 16	108		500	
DO-T18	TF4RX13YY	Single or PP output	7500 CT 10,000 CT	1 1	12 16	505		500	
DO-T19	TF4RX17YY	Output to line	300 CT	7	600	19	20	500	DI-T19
DO-T20	TF4RX17YY	Output or line to line	500 CT	5.5	600	31	32	500	DI-T20
DO-T21	TF4RX17YY	Output to line	900 CT	4	600	53	53	500	DI-T21
DO-T22	TF4RX13YY	Output to line	1500 CT	3	600	86	87	500	DI-T22
DO-T23	TF4RX13YY	Interstage	20,000 CT 30,000 CT	.5 .5	800 CT 1200 CT	850	815	100	DI-T23
DO-T24	TF4RX16YY	Input (usable for chopper service)	200,000 CT	0	1000 CT	8500		25	
DO-T25	TF4RX13YY	Interstage	10,000 CT 12,000 CT	1 1	1500 CT 1800 CT	800	870	100	DI-T25
DO-T26	TF4RX20YY	Reactor 6 Hy. @ 2 Ma. DC, 1.5 Hy. @ 5 Ma. DC				2100			
	TF4RX20YY	Reactor 4.5 Hy. @ 2 Ma. DC, 1.2 Hy. @ 4 Ma. DC					2300		DI-T26
DO-T27	TF4RX20YY	Reactor 1.25 Hy. @ 2 Ma. DC, .5 Hy. @ 11 Ma. DC				100			
	TF4RX20YY	Reactor .9 Hy. @ 2 Ma. DC, .5 Hy. @ 6 Ma. DC					105		DI-T27
DO-T28	TF4RX20YY	Reactor .3 Hy. @ 4 Ma. DC, .15 Hy. @ 20 Ma. DC				25			
	TF4RX20YY	Reactor .1 Hy. @ 4 Ma. DC, .08 Hy. @ 10 Ma. DC					25		DI-T28
DO-T29	TF4RX17YY	Single or PP output	120 CT 150 CT	10 10	3.2 4	10		500	
DO-T30	TF4RX17YY	Single or PP output	320 CT 400 CT	7 7	3.2 4	20		500	
DO-T31	TF4RX17YY	Single or PP output	640 CT 800 CT	5 5	3.2 4	43		500	
DO-T32	TF4RX17YY	Single or PP output	800 CT 1,000 CT	4 4	3.2 4	51		500	
DO-T33	TF4RX13YY	Single or PP output	1,060 CT 1,330 CT	3.5 3.5	3.2 4	71		500	
DO-T34	TF4RX13YY	Single or PP output	1,600 CT 2,000 CT	3 3	3.2 4	109		500	
DO-T35	TF4RX13YY	Single or PP output	8,000 CT 10,000 CT	1 1	3.2 4	505		500	
DO-T36	TF4RX13YY	Isol. or Interstage	10,000 CT	1	10000 CT	950	970	500	DI-T36

DO-TSH Drawn Hipermalloy shield and cover for DO-T's, provides 25 to 30 db shielding, for DI-T's DI-TSH
‡DCMA shown is for single ended useage (under 5% distortion—100MW—1KC) . . . for push pull, DCMA can be any balanced value taken by .5W transistors (under 5% distortion—500MW—1KC)
*DO-T units have been designed for transistor application only . . . not for vacuum tube service. Pats. Pend.

And Special Units to Your Specifications

UNITED TRANSFORMER CORPORATION
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electronics JANUARY 1, 1960

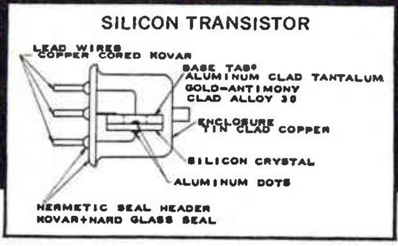
Issue at a Glance

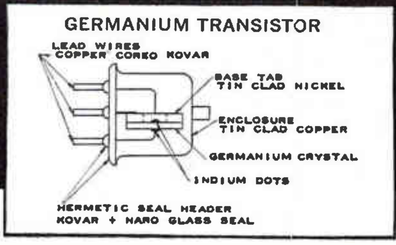
Business

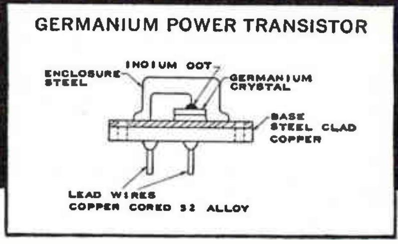
Engineering

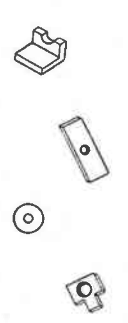
Departments

General Plate Clad Metals
IMPROVE PERFORMANCE – CUT COSTS
In Semiconductor Applications









I BASE TAB MATERIAL

A For Germanium (Single Clad Only)

1. Tin Clad Nickel
2. Tin Clad Alloy 30 (42% Nickel-58% Iron)
3. 63.2% Lead-35% Tin-1.8% Antimony Clad Nickel
4. 63.2% Lead-35% Tin-1.8% Antimony Clad Alloy 30
5. 63.2% Lead-35% Tin-1.8% Indium Clad Nickel
6. 63.2% Lead-35% Tin-1.8% Indium Clad Alloy 30
7. 99% Tin-1% Gallium Clad Nickel
8. 98% Tin-2% Antimony Clad Nickel
9. 95% Tin-5% Antimony Clad Nickel
10. Tin Clad Steel
11. Tin Stripe on Nickel
12. Tin Clad Titanium

B For Silicon (Single or Double Clad & Stripes)

****Solder**

1. Gold
2. 99.5% Gold-.5% Antimony
3. 99% Gold-1% Gallium
4. 95% Gold-5% Indium
5. 99.9% Gold-.1% Boron
6. 99% Gold-1% Aluminum
7. 99% Gold-1% Arsenic
8. Fine Silver
9. 99.5% Silver-.5% Antimony
10. 95% Silver-5% Indium
11. Aluminum
12. High Purity Aluminum

BASE METAL

1. Nickel
2. Alloy 20 (40% Nickel-60% Iron)
3. Alloy 30 (42% Nickel-58% Iron)
4. Kovar
5. Titanium
6. Tantalum
7. Molybdenum
8. Silver
9. Platinum

****NOTE:** These solders may be single or double clad on any of the base metals listed above. Solders in group B may be purchased unclad.

II LEAD WIRE MATERIAL

1. Copper Cored Rodar (Soft Glass Seals)
2. Copper Cored 52 Alloy (Compression Seals)
3. Copper Cored 446 Stainless Steel
4. Nickel Clad Copper Wire
5. Copper Clad Nickel Wire

III WHISKER WIRE MATERIAL

1. 95% Platinum-5% Ruthenium
2. 99% Gold-1% Gallium
3. 99.5% Gold-.5% Antimony
4. 90% Platinum-10% Iridium

IV BASE MATERIAL

1. Aluminum Killed Low Carbon Steel Clad Copper
2. Stainless Steel Clad Copper
3. Nickel Clad Steel (Nifer)®
4. Nickel Clad Copper
5. Nickel Clad Tantalum
6. Silver Clad Tantalum
7. Aluminum & Nickel Double Clad Tantalum

V ENCLOSURE MATERIAL

1. Tin Clad Copper
2. Glass Clad Nickel Silver
3. Tantalum Clad Nickel Silver

If you are seeking metals with useful characteristics that can't be found in a single metal or alloy, investigate clad metals. General Plate Clad Metals do what other metals can't. Made by metallurgically bonding single metals or alloys to other metals in the solid state by exclusive processes*, the composite metals give you the *combined* advantages of the selected metals and can *yield new advantages* such as lower cost, better fabricating qualities, improved parts performance, etc.

The General Plate Clad Metals for semiconductor applications described here comprise only a partial listing. To find out more about these or other combinations to meet your specific requirements, write directly to Industrial Metals Product Manager, or request our special catalog on clad and solid metals for electronics applications.

*Patented processes of Metals & Controls Corporation.

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GENERAL PLATE PRODUCTS: Clad Metals • Electrical Contacts • Truflex® Thermostat Metal • Platinum Metals • Reactor Metals • Radio Tube & Transistor Metals

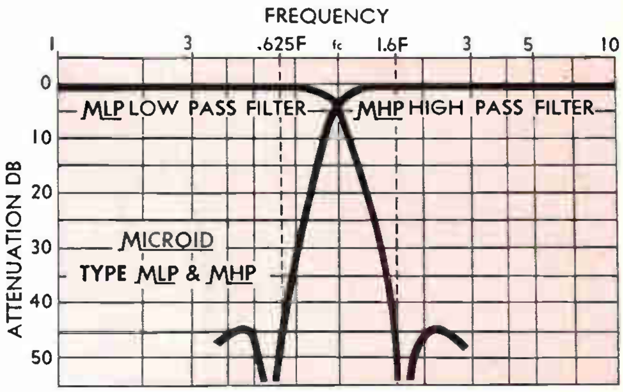
Good anywhere in or out of this world

This system adds greatly to your credit when applied to the development of communications, telemetering, control and other devices. Under terms of membership, a wide range of toroids, filters and related networks are available. These include a complete line of inductors, low pass, high pass and band pass filters employing the new micro-miniature MICROID ® coils so valuable in transistorized circuitry. Type MLP and MHP MICROIDS are micro-miniature counterparts of the popular Burnell types TCL and TCH low pass and high pass filters. The band pass filter results when cascading a TCL with a TCH filter.

Sizes of MLP and MHP MICROIDS	
400 cps to 1.9 kcs	11/16 x 1 15/16 x 1/2
2 kcs to 4.9 kcs	11/16 x 1 5/8 x 1/2
5 kcs and up	5/8 x 15/16 x 1/2

Weight of all MLP and MHP Microids—approx. .3 ozs. each

Send now for your free membership card in the Space Shrinkers Club. And if you don't already have our Catalogue #104 describing Burnell's full line of toroids, filters, and related networks, please ask for it.



Note: First informal meeting of Club members will be held in Burnell Booths 2919-2921 during the IRE Show, New York Coliseum, March 21-24. See you there.

Burnell & Co., Inc.

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electronics

January 1, 1960 Vol. 33, No. 1

Published weekly, including the ELECTRONICS BUYERS' GUIDE and REFERENCE Issue in mid-June as part of the subscription, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948) Founder.

Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 W. 42 St., New York 36, N. Y. Longacre 4-3000. Publication Office: 99-129 North Broadway, Albany 1, N. Y.

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SHOPTALK . . . editorial

INDUSTRY FORECAST. This issue, first in a new decade, features ELECTRONICS' fourth annual report on electronics markets, with forecasts for the year to come.

As early as 1952, we had begun to report the economics of our industry, but not until 1957 had we acquired sufficient background data to make our own forecasts for the future.

Early reports filled only a page or so, and dealt almost exclusively with factory sales of electronic end equipment and replacement parts. This year, several new elements have been added. For example, we now look closely at intra-industry sales of component parts. And we report Defense Department expenditures for research, development, testing, engineering, operation and maintenance of electronic equipment.

This year's report also contains sections about business at the distributor level, and the part manpower plays in our industry's economic growth. For your convenience, major charts are grouped on a full-color 23 x 11-inch foldout.

A report expanded in this manner could not readily be prepared by one editor; three prepared it, including contributions from regional men. We think, and we hope you agree, that it was well worth the effort.

Coming In Our January 8 Issue . . .

HIGH-SPEED PLOTTING. As space research programs gather momentum and the volume of telemetered data grows, the need for faster methods of plotting data becomes more and more pressing. In some cases moving-pen plotters have not been able to keep up with the data-reduction workload and scientists have had to accept results in tabular form.

Next week, R. L. Sapirstein of Lockheed Aircraft Co. in Sunnyvale, Calif., describes a digital system that can plot 4,000 points a second and draw 40 data tracks simultaneously. Plotter accepts a magnetic-tape input and produces X-Y plots complete with coordinate system and alphanumeric characters at paper drive speeds up to 1 in./sec.

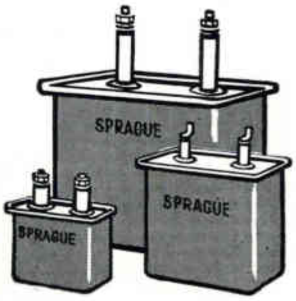
USING TRANSISTORS ABOVE BREAKDOWN. There are many applications in which medium-voltage, low-speed transistor switching is desirable. However, because of the cost of transistors with higher collector-to-emitter voltage ratings, other switching methods are often used.

A technique for using low-cost transistors above their rated breakdown voltage in low-speed switching circuits is described next week by A. Somlyody of Burroughs Corp. in Plainfield, N. J. Technique involves reverse biasing the base-to-emitter junction.

MAGNETIC RECORDERS. Magnetic tape recorders are usually limited by the frequency response of the record and reproduce heads. D. R. Steele of Ampex Corp. in Redwood City, Calif., discusses a recorder developed to take advantage of a recently-designed head having a response 2½ times greater than previously available.

MICROWAVE TERMINATIONS. Cost of a specific microwave termination depends upon its operating requirements, particularly maximum allowable vswr, required power capacity and ruggedness. To help you compromise between cost and performance in a particular situation, G. Bostick of Radar Design Corp., Syracuse, N. Y., has tabulated the four major types of termination. Characteristics and relative cost of each type of coaxial cable and waveguide termination, and the resistive materials used in each, are listed.

Surpassing
MIL-C-25A,
CP-70,
requirements
by a wide margin—



New Difilm® Vitamin Q Capacitors

for −55 to +125 C operation without derating

Sprague's new series of small, drawn-rectangular case capacitors are far and away the best of their type that can be produced in the present state of the art. Surpassing MIL-C-25A Type CP-70 requirements for performance, reliability, minimum size, and temperature range without derating, DIFILM Vitamin Q® Capacitors are made to withstand the most severe operating conditions encountered in military and industrial electronic equipment.

Type 271P Capacitors are designed to operate over the temperature range of −55 C to +85 C, while Type 272P Capacitors will withstand operation at temperatures up to 125 C without voltage derating. Because of the superior electrical characteristics of both Type 271P and 272P Capacitors, their physical size is smaller than mineral oil capacitors customarily used where wide ambient temperature ranges are encountered.

The new dual dielectric used in these capacitors consists of both synthetic polyester film and the highest grade capacitor tissue . . . a combination which offers the *best* properties of *both* materials!

The impregnant is Vitamin Q, a synthetic polymer which has been used by Sprague with outstanding success in paper capacitors for many years.

Capacitor cases are of drawn-terneplate seamless construction with double-roll sealed and soldered covers. The result is a virtually leakproof container with increased reliability over MIL units using fabricated cases.

For complete engineering data on Drawn-Rectangular Case DIFILM Vitamin Q Capacitors, write for Engineering Bulletin 2340 to Technical Literature Section, Sprague Electric Company, 35 Marshall Street, North Adams, Massachusetts.

SPRAGUE®
THE MARK OF RELIABILITY

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS
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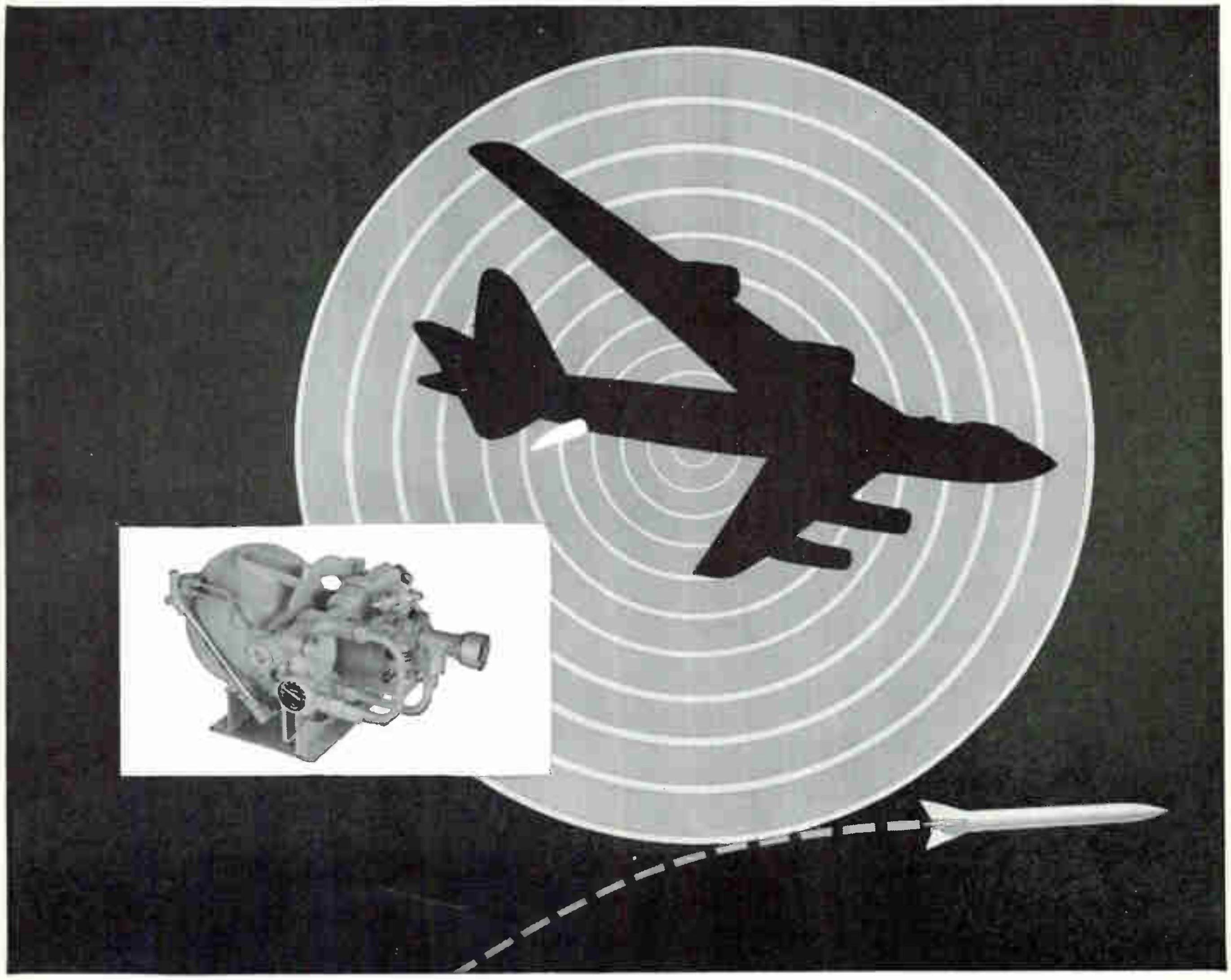
3M COMPANY CHEMICALS **THE RAW MATERIALS OF PROGRESS**



HOW TO HOLD A JAM SESSION 8 MILES UP

Vickers active cooling system (inset) uses FC-75 in countermeasures system

The increasing sophistication of electronic countermeasures systems poses many problems. Among them—how to cool vital components at the environmental and operational extremes encountered in sonic and supersonic aircraft.

For the Sperry countermeasures system, a new airborne active cooling system—capable of dissipating 47KW in a 74-lb. package—was developed by Vickers using 3M Dielectric Coolant FC-75.

This most stable of all fluids offered to electronics has high electric strength of 37KV. It is self-healing, and maintains electric strength after repeated high voltage arcing. It pours at —148°F and boils at 212°F at one atmosphere . . . ideally suited for evaporative cooling.

Compatible with most materials, FC-75 is non-corrosive, non-flammable, non-toxic, non-explosive and odorless. It is thermally stable in excess of 800°F, and will not form sludges or gums under extremely rigorous conditions. These properties make it ideal as a coolant.

Investigate the remarkable properties of 3M inert fluids in terms of your own product design, miniaturization and performance problems. For free literature, write to 3M Chemical Division, Dept. KAX-10, St. Paul 6, Minn.

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

CIRCLE 7 ON READER SERVICE CARD

LOOK!

Constant output level

Constant modulation level

3 volt output into 50 ohms

Low envelope distortion

50 kc to 65 MC

-*hp*- 606A HF Signal Generator

Here at last is a compact, convenient, moderately-priced signal generator providing constant output and constant modulation level plus high output from 50 kc to 65 MC. Tedious, error-producing resetting of output level and % modulation are eliminated.

Covering the high frequency spectrum, (which includes the 30 and 60 MC radar IF bands) -*hp*- 606A is exceptionally useful in driving bridges, antennas and filters, and measuring gain, selectivity and image rejection of receivers and IF circuits.

Output is constant within ±1 db over the full frequency range, and is adjustable from +20 dbm (3 volts rms) to —110 dbm (0.1 μv rms). No level adjustments are required during operation; the instrument has a minimum of controls and high accuracy results are assured due to the constant internal impedance. The generator can be provided with a 10:1 voltage divider and dummy antenna lowering minimum output to 0.01 μv (from 5 ohms) and simulating IRE standards for precision receiver measurements. (See Accessories Available in Specifications.)

The -*hp*- 606A may be modulated by sine waves and complex waveforms from dc to 20 KC. A meter indicates percent modulation. Distortion in sine waves is extremely low due to use of a feedback circuit.

To insure maximum accuracy of frequency setting, the 606A includes an internal crystal calibrator providing check points at 100 kc and 1 MC intervals with error less than 0.01%.

hp offers the world's most complete

Specifications

Frequency Range: 50 kc to 65 MC in 6 bands.

50— 170 kc	1.76— 6.0 MC
165— 560 kc	5.8 —19.2 MC
530—1800 kc	19.0 —65.0 MC

Frequency Accuracy: Within ±1%.

Frequency Calibrator: Crystal oscillator provides check points at 100 kc and 1 MC intervals accurate within 0.01% from 0° to 50° C.

RF Output Level: Continuously adjustable from 0.1 μv to 3 volts into a 50 ohm resistive load. Calibration is in volts and dbm (0 dbm is 1 milliwatt).

Output Accuracy: Within ±1 db into 50 ohm resistive load.

Frequency Response: Within ±1 db into 50 ohm resistive load over entire frequency range at any output level setting.

Output Impedance: 50 ohms, SWR less than 1.1:1 at 0.3 v and below. BNC Output connector mates with UG-88A/B/C/D.

Spurious Harmonic Output: Less than 3%.

Leakage: Negligible; permits sensitivity measurements down to 0.1 μv.

Amplitude Modulation: Continuously adjustable from 0 to 100%. Indicated by a panel meter. Modulation level is constant within ±½ db regardless of carrier frequency.

Internal Modulation: 0 to 100% sinusoidal modulation at 400 cps ±5% or 1000 cps ±5%.

Modulation Bandwidth: Dc to 20 kc maximum, depends on carrier frequency, f_c, and percent modulation as shown in the following table:

	30% Mod.	*70% Mod.*	*Squarewave Mod.*
Max. Mod. Frequency	0.06 f_c	0.02 f_c	0.003 f_c (3 kc max)

External Modulation: 0 to 100% sinusoidal modulation dc to 20 kc. 4.5 volts peak produces 100% modulation at modulating frequencies from dc to 20 kc. Input impedance is 600 ohms. May also be modulated by square waves and other complex signals.

Envelope Distortion: Less than 3% envelope distortion from 0 to 70% modulation at output levels of 1 volt or less.

Modulation Meter Accuracy: Within ±5% of full scale reading from 0 to 90%.

Spurious FM: 0.0025% or 100 cps, whichever is greater, at an output of 1 v or less and 30% AM modulation.

Spurious AM: Hum and noise sidebands are 70 db below carrier.

Power: 115/230 volts ±10%, 50 to 1000 cps, 135 watts.

Accessories Available: *-hp-* AC-606A-34 Output Voltage Divider with 50 and 5 ohms termination (10:1 voltage divider) and IRE standard dummy antenna (10:1 voltage divider). $50.00.

Price: (cabinet) $1,200.00. (rack mount) $1,185.00.

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

Other -hp- Signal Generators—10 to 21,000 MC

Instrument	Frequency Range	Characteristics	Price
-hp- 608C	10 to 480 MC	Output 0.1 μv to 1 v into 50 ohm load. AM, pulse, or CW modulation. Direct calibration	$1,000.00
-hp- 608D	10 to 420 MC	Output 0.1 μv to 0.5 v. Incidental FM 0.001% entire range	1,100.00
-hp- 612A	450 to 1,230 MC	Output 0.1 μv to 0.5 v into 50 ohm load. AM, pulse, CW or square wave modulation. Direct calibration	1,200.00
-hp- 614A	800 to 2,100 MC	Output 0.1 μv to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calibration	1,950.00
*-hp-*616B	1,800 to 4,200 MC	Output 0.1 μv to 0.223 v into 50 ohm load. Pulse, CW or FM modulation. Direct calibration	1,950.00
-hp- 618B	3,800 to 7,600 MC	Output 0.1 μv to 0.223 v into 50 ohm load. Pulse, CW, FM or square wave modulation. Direct calibration	2,250.00
-hp- 620A	7,000 to 11,000 MC	Output 0.1 μv to 0.223 v into 50 ohm load. Pulse, FM or square wave modulation. Direct calibration	2,250.00
-hp- 623B	5,925 to 7,725 MC	Output 70 μv to 0.233 v into 50 ohm load. FM or square wave modulation. Separate power meter and wave meter section	1,900.00
-hp- 624C	8,500 to 10,000 MC	Output 2.23 μv to 0.223 v into 50 ohm load. Pulse, FM or square wave modulation. Separate power meter and wave meter section	2,265.00Δ
-hp- 626A	10 to 15.5 KMC	Output 10 dbm to —90 dbm. Pulse, FM, or square wave modulation. Direct calibration	3,250.00
-hp- 628A	15 to 21 KMC	Output 10 dbm to —90 dbm. Pulse, FM, or square wave modulation. Direct calibration	3,250.00

ΔRack mounted instrument available for $15.00 less.

-hp- 608D vhf Signal Generator

10 to 420 MC. Highest stability. Negligible incidental FM or frequency drift. Calibrated output 0.1 μv to 0.5 v throughout range. Built-in crystal calibrator provides frequency check accurate within 0.01% each 1 and 5 MC. Master-oscillator, intermediate and output amplifier circuit design. Premium quality performance, direct calibration, ideal for aircraft communications equipment testing. $1,100.00.

-hp- 608C vhf Signal Generator. High power (1 v max.) stable, accurate generator for lab or field use. 10 to 480 MC. Ideal for testing receivers, amplifiers, driving bridges, slotted lines, antennas, etc. $1,000.00.

-hp- 626A/628A shf Signal Generators

New instruments, bringing high power, wide range, convenience and accuracy to 10 to 21 KMC range. Frequencies, output voltage directly set and read. Output 10 to 20 db better than previous spot-frequency sets SWR better than 1.2 at 0 dbm and lower. Internal pulse, FM or square wave modulation; also external pulsing or FM'ing. *-hp-* 626A, 10 to 15.5 KMC, $3,250.00. *-hp-* 628A, 15 to 21 KMC, $3,250.00.

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4873A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
CABLE "HEWPACK" • DAVENPORT 5-4451
Field representatives in all principal areas

line of precision signal generators

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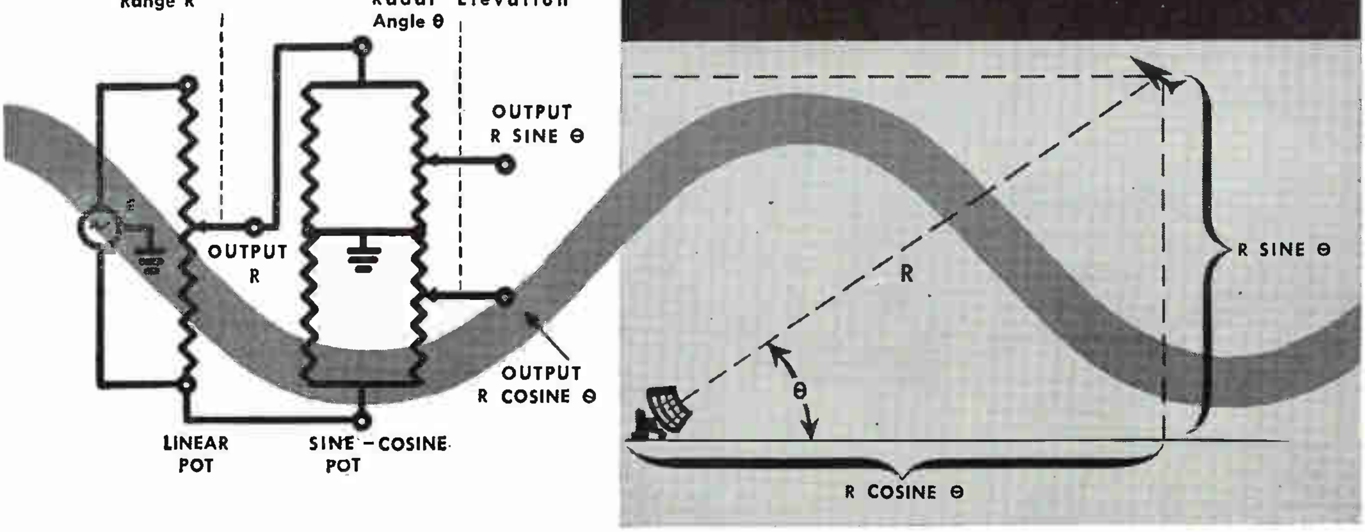
WITH C I C

SINE-COSINE FILM POTS

* 0.015% ACCURACY!
* INFINITE RESOLUTION!



COMPARE SYSTEMS ERROR YOURSELF!

Typical example of Radar Tracking System Problem: To accurately locate target	Error with Wire-Wound Pots		Error with C.I.C. Film Pots	
Range to Target: 50,000 yards Radar Elevation Angle: 45°	Quadrature due to Inductance of Windings (@ 1000 cps)	.35	Quadrature due to Inductance	0
	Resolution	.30	Resolution	0
	Linearity	.50	Linearity	8
		115 yds		8 yds

YOU DON'T HAVE TO ACCEPT THE ERRORS IN WIRE WOUND POTS!

Engineers recognize the obvious superiority of C.I.C. Film Sine-Cosine Pots; THOUSANDS are currently in use in Hawk, Atlas, Nike and other missile systems, as well as in the APS-81, ASG-15 fire control system and AN/ASB-4 Bombing/Navigation system, all used on the B-52 Bomber, AN/APA-125 Radar Indicator, and many others. You too can have superior systems with C.I.C. Film pots. Send us your specifications today!

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C I C
COMPUTER INSTRUMENTS CORPORATION

92 Madison Avenue, Hempstead, L. I., N. Y.

ELECTRONICS NEWSLETTER

TWO SCIENTIFIC BALLOONS larger in diameter than the length of a football field when fully inflated will permit scientists to record cosmic ray particles with energies as high as 10,000 bev over the Caribbean later this month. Operation Skyhook will see the 10-million cu. ft. balloons launched from the flight deck of the USS Valley Forge. Each will lift 2,500 lb, including an 800-lb. block consisting of sheets of pure emulsion for recording the rays at 18 to 22-mi. altitudes. Project is sponsored by the National Science Foundation and the Office of Naval Research. NSF says research at such high energies has been almost nonexistent thus far, adds that the project should open up the possibility of exploring an entirely new field of physics.

In Tokyo some 59,000 Japanese radios were purchased directly from manufacturers by a New York chain of radio and appliance stores so they can be sold 20 to 30 percent cheaper in the U.S. The sets, worth slightly more than $1 million, come from nine small Japanese manufacturers and will be sold under the Vim Stores' brand name.

WALL STREET DATACENTER to be opened in March by IBM (ELECTRONICS, p 11, Aug. 28 '59) will be preceded by an RCA center to house two 501 systems. One of the 501's has just been delivered to the RCA center, is scheduled to work around the clock to handle a wide range of work details for brokerage customers. The second, to be delivered in the spring, will operate on a two-shift-a-day schedule.

Proton synchrotron of the European Organization for Nuclear Research (CERN) has gone into operation, producing a beam of protons of an energy of 24 billion electronvolts.

AIR TRANSPORTABLE NUCLEAR REACTOR, the PM-1, being built by The Martin Co., has reached the instrumentation design study and development stage. Stromberg-Carlson division of General Dynamics will undertake a six-month study to arrive at the advanced design for the reactor's instrumentation. System will be completely transistorized, says S-C, which is building a similar instrumentation and safety system for a new prototype submarine reactor. The PM-1 will have a 9.35 megawatt thermal output and will be installed at Sundance Air Force station in Wyoming.

ACCURATE PULSE-CODE MODULATION system for missile telemetering is now being built by Texas Instruments' apparatus division. Transistorized except for the transmitter final amplifier, the 25-lb. 900-cu.-in. airborne system is accurate to 0.25 percent. Bidirectional servo loop corrects either positive or negative drift of the pulse signal automatically. System can accept serial or parallel digital data and analog information. A 64-channel analog multiplexer using transistor switches can feed either high- or low-level data—or both—to a successive-approximation encoder using a single low-level amplifier. Nominal bit rate is 200 kc. Transistor switches (instead of diodes) and other design advances give the system high reliability with only 51 watts power consumption, TI engineers report.

GALLIUM ARSENIDE DIODES with noise figures of 10, 16 and 24 kmc, and an upper operating limit of 300 C., have been developed for the Air Force by Philco scientists. Frequency response is flat within 2 db over the range of 20 to 300 C. A technical report, which cites solution of problems of crystal growth and fabrication, is available as Order PB 151970 from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for $2.25.

GHANA has ordered $1.68 million worth of short-wave broadcast station equipment from Marconi of Britain. Four 100-kw transmitters and ancillary gear will be installed. System capable of world-wide coverage is slated for use by June 1961.

Waveguide 2,200 ft. long is being delivered to the missile center at Vandenberg AFB by the Airtron division of Litton Industries. Firm says the waveguide system has less than 10 db attenuation per thousand feet compared to 50 db for a conventional transmission line of the same length.

MISSILE TRACKING SHIP now operating near the Atlantic Missile Range's impact point with some $20 million worth of electronic equipment will get some more. Army Rocket and Guided Missile Agency and the Advanced Research Projects Agency have awarded RCA an $8,911,904 contract for installation of new radar gear to improve the missile measuring capabilities of the *U.S.A.S. American Mariner*, and for continued technical operation of the ship. The equipment is also expected to provide new information for ICBM and Counter-ICBM development.

Plastic type transistor has reportedly been developed by Soviet scientist Nikolai Semenov from a synthetic wool substitute known as polyakrylonitril. Tass said the plastic becomes as electrically conductive as germanium and silicon under radioactive bombardment, claims the plastic material is more stable and more easily processed.

RADAR WARNING SYSTEMS that can be airlifted to remote locations and can provide three-dimensional information—range, bearing and altitude—within six hours after being set up will be provided to the Air Force by Westinghouse under a $15 million contract. Mobility is due to a para-balloon antenna 30-ft. in diameter and held up by low air pressure.

WASHINGTON OUTLOOK

AIR FORCE is tightening up still further on the policing of price estimates submitted by contractors, in response to pressure from the General Accounting Office. GAO has been stepping up audits.

The Air Force's latest measures require contractors to certify that "all available actual cost data have been considered and made known" to USAF negotiators in preparing price proposals and negotiating contract prices. The new rules also make provision for an audit by the Air Force of proposals on noncompetitive purchases over $50,000, and for "surveys of contractors' estimating departments" by USAF officials. Lastly, the measures call for increased training of USAF contracting personnel in pricing techniques, and for a campaign to "impress" both USAF and contractor negotiators with "the need for contractors to furnish current, complete and correct cost data."

New and stricter stand results from two GAO reports on Air Force electronic contracts—$19.5 million in subcontracts for radar used in a B-52 fire-control system, and $2.5-million worth of prime contracts for global communications system components.

- **The aircraft industry and its unions** have thrown in the sponge in their long battle to force electronics companies with missile or aircraft contracts to pay the aircraft industry's prevailing minimum wage under the provisions of the Walsh-Healey Act.

  Aircraft labor and management have asked the Labor Department for an "indefinite postponement" of their petition that electronics-industry producers of components for aircraft and missiles be included in the law's definition of the aircraft industry. The unions had also petitioned for an official increase in the minimum pay rate once the electronics producers were brought under the Walsh-Healey umbrella.

  The request comes on the heels of a recent Labor Department decision to exclude producers of airborne and ground electronic gear for aircraft and missiles from a survey of prevailing minimum wages in the aircraft and missile industry.

  The survey was to be made in response to the aircraft industry's petition, will presumably now be cancelled. With electronic componentmakers excluded, aircraft labor and management figure the survey would be meaningless.

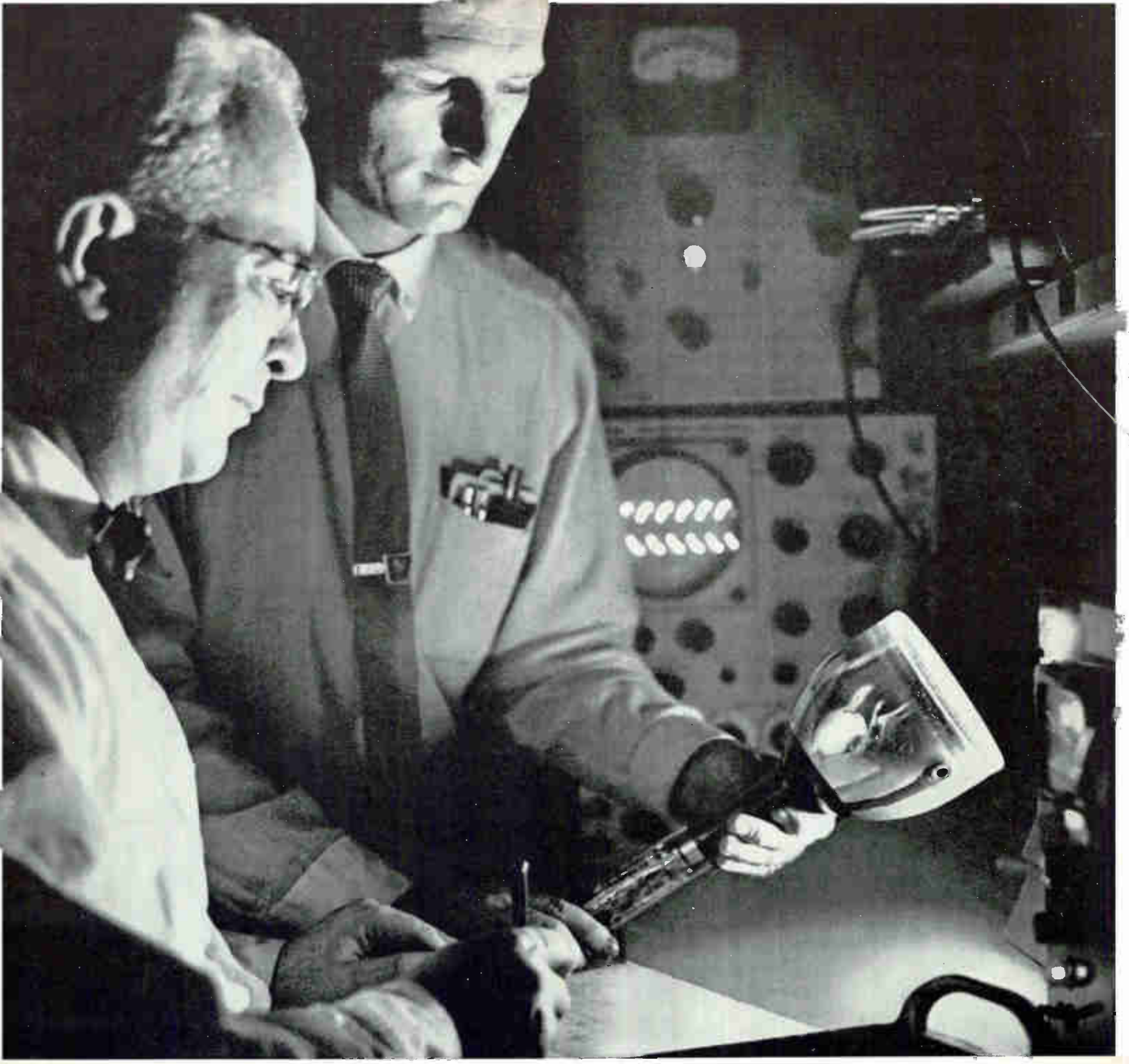
- **Foreign producers are scrambling** for production orders for lightweight wire-guided antitank missiles.

  Among the leading contenders for Army and Marine Corps production contracts are the WS810 Cobra—not to be confused with Navy's antiradar Cobra missiles—which was developed by Bolekow Entwicklungen of West Germany; the SS series of Nord Aviation, France; the Vigilant, made by Vickers, Great Britain; and the Swiss Oerlikon Mosquito.

  U. S. electronics companies have or are dickering for domestic sales and manufacturing rights on the antitank missiles. Daystrom has the rights on the German Cobra; Clevite Ordnance on the British Vigilant. GE is negotiating for rights on the French SS missiles.

  Small quantities of both the Cobra and SS missiles have been bought for evaluation tests.

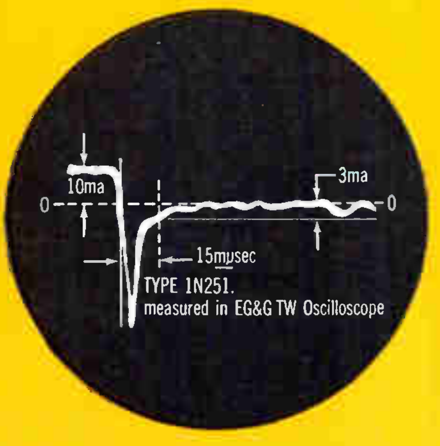
- **Private opinion among some senators** is that the answer to such crippling strikes as the still-unsettled one in steel is government control on automation. If they had their way, these legislators would require a firm to get the government's permission before installing automatic machinery of any kind that would displace workers. The battle will be joined this month when the Senate Labor subcommittee of Sen. John Kennedy (D., Mass.) opens hearings on the steel strike.



NOW AVAILABLE FROM Transitron

NEW
WIDE RANGE OF
JAN
SEMICONDUCTOR
TYPES!

JAN 1N251
(MIL-E-1/1023)



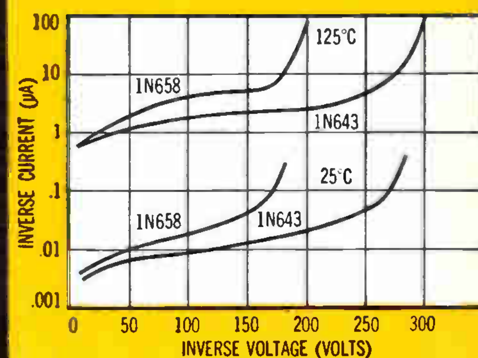
FOR HIGHEST SPEED

Transitron is in volume production of the FASTEST silicon diode meeting military specifications. Typical recovery time: 15 mμsec measured with the EG & G scope. Their excellent high frequency properties make them particularly useful in detector, discriminator, and pulse circuitry.

For further information write for PB-66.

SIGNAL CORPS TYPES

USA 1N643 (MIL-E-1/1171)
USA 1N658 (MIL-E-1/1160)
USA 1N662 (MIL-E-1/1139)
USA 1N663 (MIL-E-1/1140)



FOR HIGH CONDUCTANCE, HIGH VOLTAGE AND HIGH SPEED . . .

These fast-switching silicon diodes are designed to meet the very latest military specifications . . . Diffused junction construction permits the combination of HIGH CONDUCTANCE (100 mA @ 1 volt), HIGH VOLTAGE (100 volts), and FAST-SWITCHING (0.3 μsec) characteristics in ONE diode.

For further information write for PB-66.

JAN 1N457 (MIL-E-1/1026)
JAN 1N458 (MIL-E-1/1027)
JAN 1N459 (MIL-E-1/1028)

FOR LOW LEAKAGE AT HIGH TEMPERATURE

Low inverse leakage; low capacitance. Excellent inverse characteristics at 150°C.

See PB-66.

JAN 2N118 (MIL-T-19500/2)
USN 2N117 (MIL-T-19500/35)
USN 2N119 (MIL-T-19500/35)

See TE-1353P.

SILICON TRANSISTORS

FIRST JAN silicon transistor on the market! And more types coming!

USN 2N332 (MIL-T-19500/37A)
USN 2N333 (MIL-T-19500/37A)
USN 2N334 (MIL-T-19500/37A)
USN 2N335 (MIL-T-19500/37A)

See TE-1353F, 1353G

JAN 1N253 (MIL-E-1/1024)
JAN 1N254 (MIL-E-1/989A)
JAN 1N255 (MIL-E-1/990A)
JAN 1N256 (MIL-E-1/991A)

See TE-1336.

SILICON RECTIFIERS

Identical except for Peak Recurrent Inverse Voltage.

JAN 1N538 (MIL-E-1/1084A)
JAN 1N540 (MIL-E-1/1085A)
JAN 1N547 (MIL-E-1/1083A)

See TE-1351-M-1

JAN 1N126A (MIL-E-1/156C)
JAN 1N127A (MIL-E-1/157C)
JAN 1N128 (MIL-E-1/158B)
JAN 1N198 (MIL-E-1/700)
JAN 1N270 (MIL-E-1/992A)
JAN 1N276 (MIL-E-1/1025)
JAN 1N277 (MIL-E-1/993A)
JAN 1N281 (MIL-E-1/961)
USN 1N63 (MIL-E-1/376B)
USN 1N145 (MIL-E-1/811)

GERMANIUM DIODES

SUBMINIATURE
GLASS TRANSPARENT

Reliable under the most severe operating conditions. Rugged construction and 100% testing of electrical and mechanical characteristics insure excellent performance and long life.

See TE-1319A.

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THREE TOOLS FOR QUALITY CIRCULATION

Members of a select group, the readers of electronics

As fast as subscription orders are received they are examined individually—by Hugh J. Quinn, Circulation Manager, who stamps each card:

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QUESTIONNAIRE — to delay acceptance until information concerning the subscriber—his function, his company, his title are definitely known.

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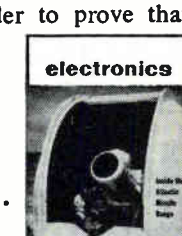

The Electronics Man "buys" what he reads in . . .

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WHY PAY $1000 MORE?

For a Digital Voltmeter with ±.01% Accuracy

FOR FULL FOUR-DIGIT ACCURACY IN VISUAL MEASURING JOBS—production checking, instrument calibrating, laboratory testing, receiving inspection — the NLS 481 Industrial Voltmeter is your best buy in digital instruments. Here's a precision instrument that matches — even surpasses — other dry-stepping switch meters in accuracy, speed, reliability . . . yet sells for $1,000 to $2,000 less! High-volume production techniques enable NLS to offer the 481 at just $1,355.00, complete. Compare its performance with that of higher-cost competitive meters. Many major companies have . . . and they are now using the NLS 481 in quantities of 50 and more!

481 Specifications: Accuracy ±.01% . . . measures DC voltages from ±0.001 to ±999.9 . . . plug-in accessories permit measuring AC or low level DC voltages . . . balancing time: 1 second, average . . . input impedance: 10 megohms on all ranges . . . automatic indication of range and polarity . . . internal standard cell permits verification of calibration . . . one-package design (5¼" high, 15¼" deep for 19" rack) . . . available from stock for immediate delivery . . . $1,355.00 complete.

Originator of the Digital Voltmeter

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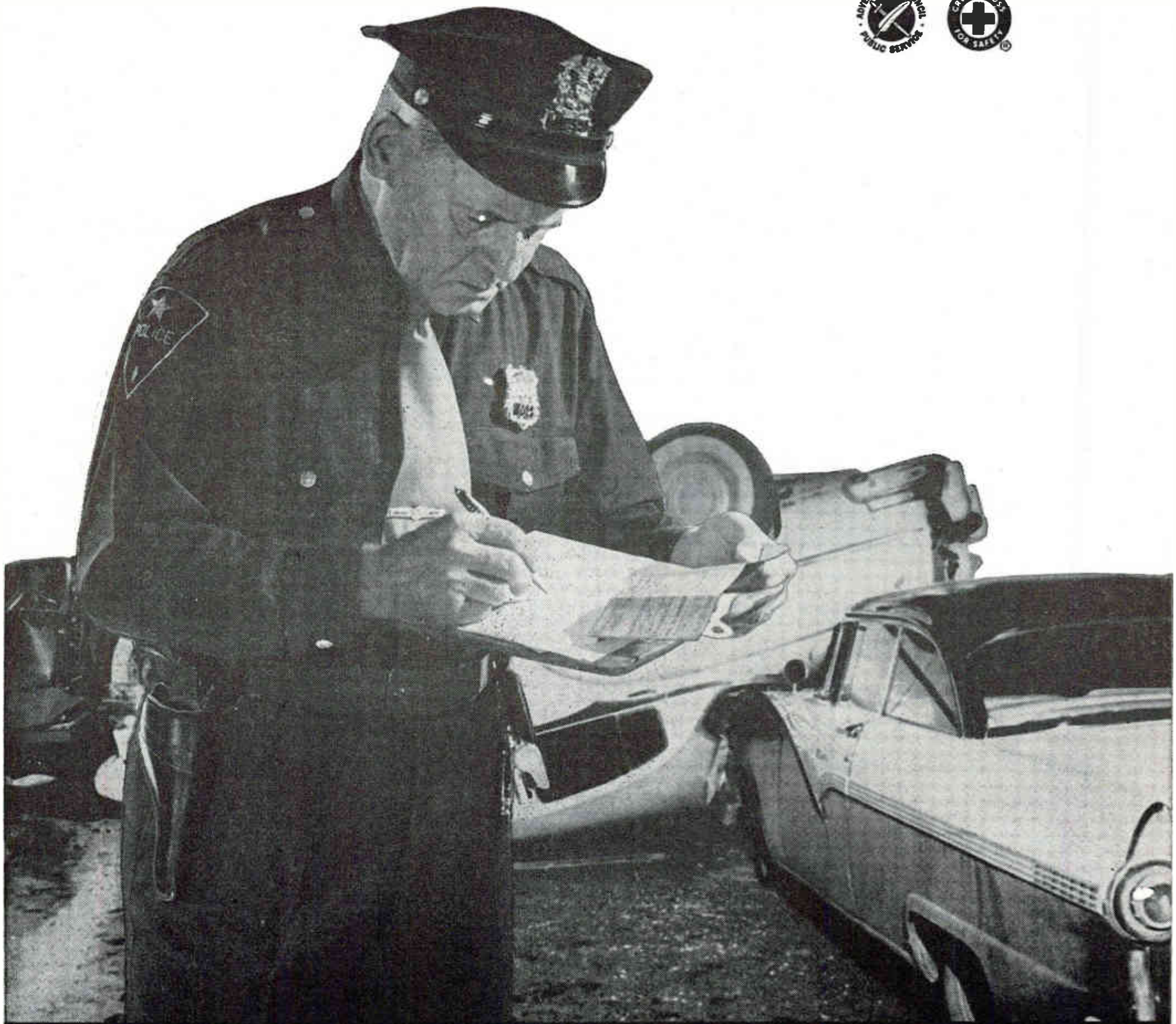
NLS — The Digital Voltmeter That Works . . . And Works . . . And Works!

 CIRCLE 17 ON READER SERVICE CARD



FINANCIAL ROUNDUP

Sales, Earnings Stay High

MAGNAVOX Co. reports total sales of $60 million for the six-month period ended Dec. 31, 1959. Estimated per-share earnings for this period are $1.40. Total sales for the first half of the previous fiscal year were $44.2 million. Company officials expect sales of $125 to $135 million for 1960. Increased emphasis on military and industrial product lines are seen as an important factor in the steady growth of the firm, according to a company spokesman.

• **Packard Bell Electronics Corp.**, Los Angeles, announces record sales of $46,608,062 for the last fiscal year. This is an increase of 24 percent over sales of $37,371,081 for fiscal 1958. After-tax profit rose 37.2 percent to $1,375,346 for 1959, as compared with $1,002,594 reported for the previous year. Net income amounted to $1.73 per share on 792,600 shares outstanding at end of 1959 fiscal year. R. S. Bell, company president, says annual sales of the Technical Products division, which have expanded from $3.6 million to more than $20 million in five years, accounted for 44 percent of total corporate sales for the year.

• **United Control Corp.**, Seattle, Wash., reports an increase of more than 90 percent in sales. Total figure was $11,680,119 with net profits of $696,817 for the 1959 fiscal year. This compares with $6,112,233 and a net of $363,596 for the year preceding.

• **Northrop Corp.**, Hawthorne, Calif., reveals sales and earnings for the first quarter of fiscal 1960 are slightly lower than those of the preceding year. Sales and other income for the three months ended Oct. 1959 were $55,920,951, compared with $61,128,442 for the initial quarter a year ago. Net income was $1,463,242, equal to 80 cents a share on the 1,826,737 shares outstanding at the end of the quarter. In fiscal '59 earnings were $1,539,339 or 92 cents a share.

• **Pacific Automation Products, Inc.**, Glendale, Calif., reports sales of $11,849,675 for the end of fiscal 1959, compared with $9,767,609 for the preceding fiscal year. Operations for the 1959 year resulted in a net loss of $212,744. In the preceding year net income was $403,423. A. P. Jacobs, company president, attributes the losses to cutbacks and rescheduling in government spending. The firm's 80-percent-owned subsidiary, Space Electronics Corp., which does not consolidate its earnings with the parent firm, showed a profit of $40,000 on sales of $800,000.

• **Thompson Ramo Wooldridge Inc.**, Cleveland, has acquired **Radio Industries, Inc.**, Des Plaines, Ill., a producer of radio and tv transformers and ceramic disk capacitors. The company employs about 750 people, has plants in three locations. Price was not disclosed.

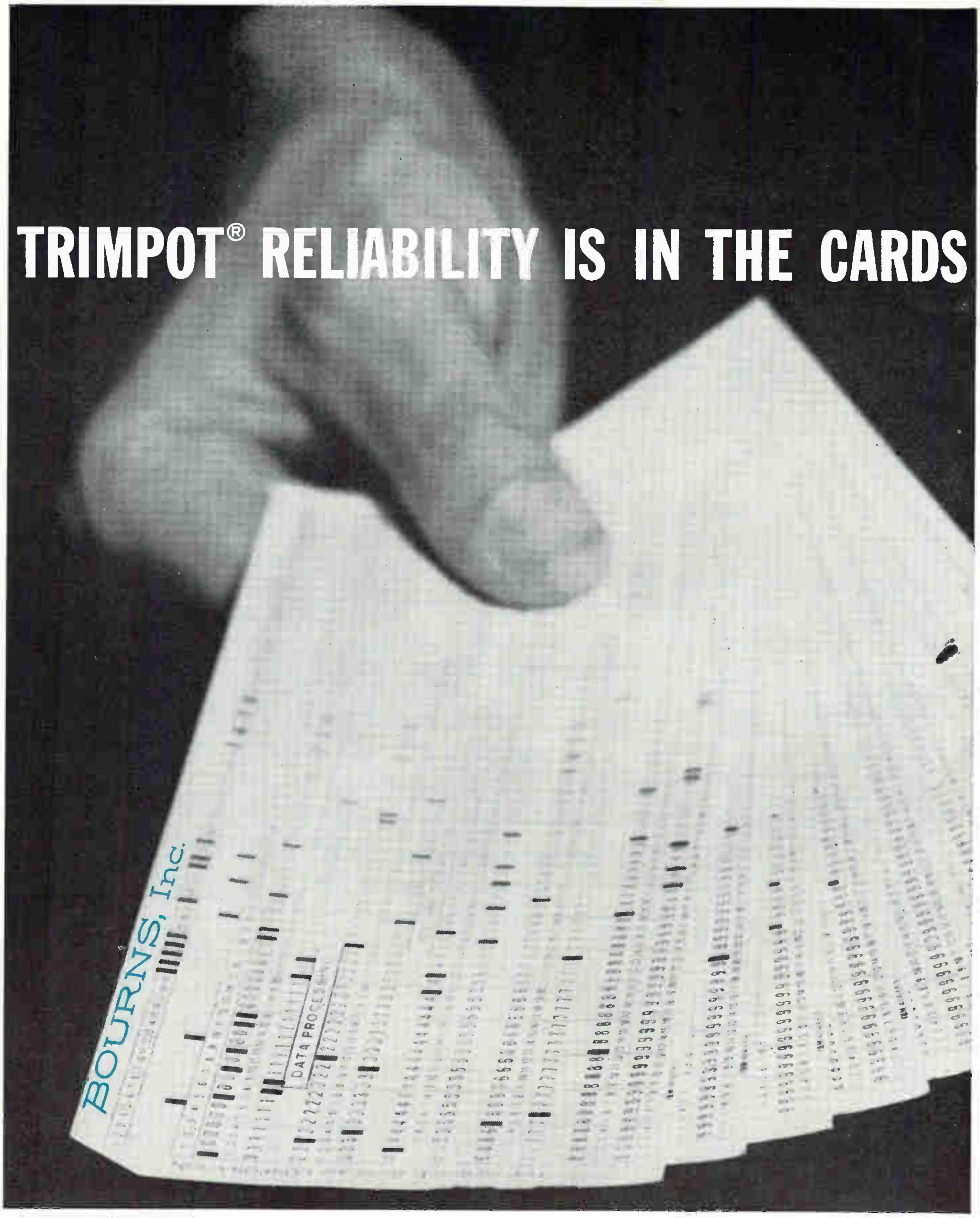
25 MOST ACTIVE STOCKS

WEEK ENDING DECEMBER 18

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Collins Radio	2,410	72⅛	56⅝	66⅝
Sperry Rand	1,519	27⅛	25½	25¾
Philco	1,472	34¼	30¼	33⅜
Avco Corp	1,255	16¾	15⅝	15¾
Dynamics Corp Am	1,234	12⅜	10¾	12
Amphenol Borg	1,043	40½	37½	38½
Elec & Mus Ind	982	12½	11⅝	12
Gen Tel & Elec	832	85⅛	81⅛	83¾
RCA	649	71⅝	68½	69⅞
Burroughs	578	36¼	34¾	35½
Gen Electric	537	94½	92	94
Victoreen Inst	522	13¾	11⅛	13⅝
Reeves Sndcrft	512	13	11¾	11⅞
Gen Dynamics	506	48¼	46⅜	47
Clevite	497	59¼	52¼	52¾
Raytheon	488	54¾	52	52⅛
Univ Control	488	19⅝	17⅝	17⅞
Electronic Comctns	429	35	28	33¼
Int'l Tel & Tel	420	40⅜	38⅜	39
Electronic Spec	408	30⅞	26⅜	28⅝
Lear	363	20¾	19	19⅜
Muntz Tv	324	5¼	4⅜	5⅛
DuMont Labs	319	9¼	8	8⅝
Beckman Inst	309	65¾	59¾	65½
Standard Coil	297	17⅛	15⅜	16¼

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.

TRIMPOT® RELIABILITY IS IN THE CARDS

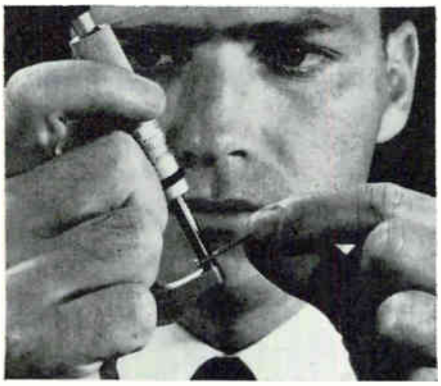


Test information punched in these cards can provide detailed performance reliability statistics on Trimpot production. The cards summarize extensive environmental tests which Bourns regularly conducts above and beyond regular quality control. In Bourns own Reliability Assurance Laboratory, monthly samples are taken at random from factory stocks and completely tested for conformance to all environmental and electrical specifications on Trimpot catalog sheets. Results can then be fed into IBM computers which analyze performance data with corrective action taken immediately, if required!

This program is the only one of its kind in the industry. Only Trimpot potentiometers are tested so thoroughly, so frequently. In short, Trimpot reliability is a fact—one you can put in your next circuit.

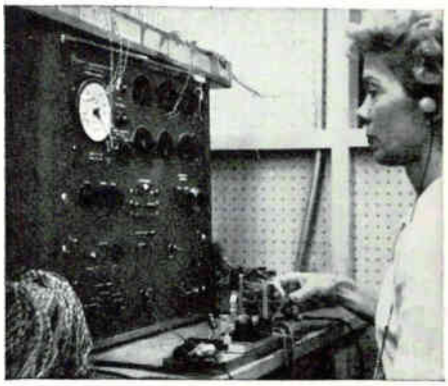
PUNCHED CARDS ARE USED TO TABULATE BOURNS RELIABILITY DATA FROM –

Complete Quality Control Like This..



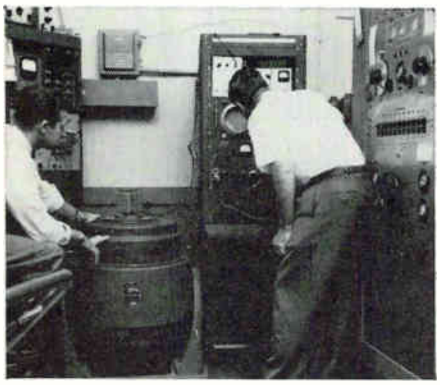
Trimpot reliability starts at the beginning. Here an incoming lot of potentiometer lead-screws undergoes a dimensional check.

From the time the element is wound until the lid of the potentiometer is installed, in-process inspection monitors quality.

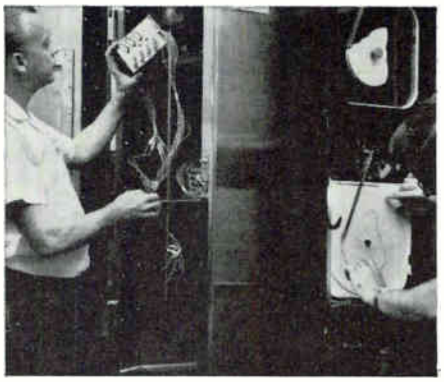


100% final inspection is made possible by this exclusive high-speed system developed by Bourns to test all major electrical characteristics. Critical dimensions of each unit are also checked.

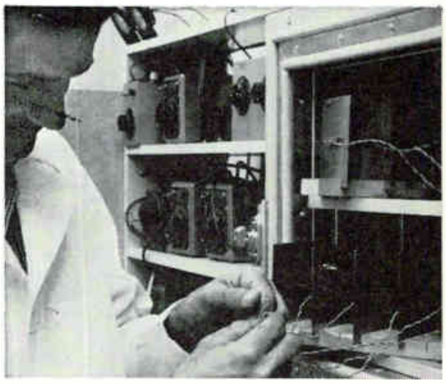
And Reliability Assurance Tests Like These..



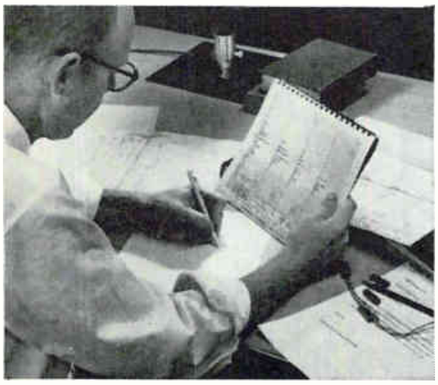
This vibrator for measuring conformance to Mil-Specs is an important part of the extensive equipment in Bourns Reliability Assurance Laboratory.



This chamber subjects potentiometers to standard military tests for humidity, provides important feedback on product performance.



1000-hour load life testing per Mil-R-19A takes place in ovens like this, which hold temperatures at desired levels at full rated power.



When tests are completed and the results tabulated, Bourns engineers plot frequency distribution curves from the steady flow of test results. Analysis of these curves and other data from testing provides a continuing check on all models to see that they meet the most exacting standards of performance. This analysis and the constant flow of information between the Testing and Production departments is your assurance that the Trimpot potentiometers you specify and purchase will meet specifications.

Write for the new 8-page folder describing the Bourns Reliability Assurance Program and a copy of the Trimpot Summary Brochure.

BOURNS Inc.

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

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

CIRCLE 21 ON READER SERVICE CARD

Silicon Controlled Rectifiers

DOLLAR SALES of silicon controlled rectifiers are expected to double in 1960, manufacturers estimate. Estimates of 1959 sales vary between two and three million dollars.

Many firms are even more enthusiastic about the long-term sales outlook for the new rectifiers. One manufacturer looks for an annual volume of 50 million units before 1965. Horseback estimate of last year's unit sales: between 300,000 and 500,000 units.

Others Show Interest

Bright sales prospect for silicon controlled rectifiers has drawn interest of manufacturers of associated components. For instance, Fairfield Engineering Corp. is optimistic about the market for its magnetic-amplifier control units, which are used with silicon controlled rectifiers and thyratrons.

Expectations of sales developments in the next five years are based on the assumption that prices can be reduced to about twice the cost of conventional rectifiers. In the short period silicon controlled rectifiers have been on the market, prices have already dropped considerably. A manufacturer introduced a 200-volt 16-amp unit early in 1958 on a test basis for about $300. When volume production was initiated at the end of 1958 it cost $110. Today it sells for $45.

Silicon controlled rectifiers are now widely used in power-supply equipment for military electronic gear and for missile and airborne control systems. They also may find wider application in providing d-c for motors in machine tools and control systems; in light-brightness controls; and controls for air conditioners, kitchen appliances and other equipment with d-c control components.

• **Minneapolis-Honeywell** president Paul B. Wishart says electronics industry sales will advance on all major fronts in 1960.

He estimates a 9-percent total industry sales gain in 1960 over 1959, with factory-door sales reaching $11 billion this year as compared with last year's $10.1 billion.

Cites Growth Areas

Breaking down the major electronics industry's markets, Wishart predicted sales of consumer products will increase from $2.2 billion in 1959 to $2.3 billion this year; industrial products from $1.7 billion to $2 billion; military products from $5 to $5.5 billion. Components will remain substantially unchanged at $1.2 billion, he thinks.

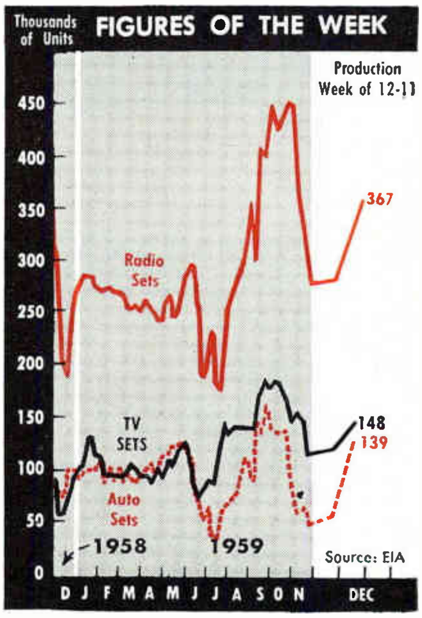
Electronics industry's greatest growth potential is in the field of industrial products, he told a business outlook conference. "Future growth in the industrial market for electronics is very promising, with inevitable application of military developments to the industrial picture," he said.

• **EIA president** David R. Hull estimates electronics industry factory sales for 1959 will total $9.2 billion. Industry sales last year were 16 percent ahead of the previous peak of $7.9 billion in 1958.

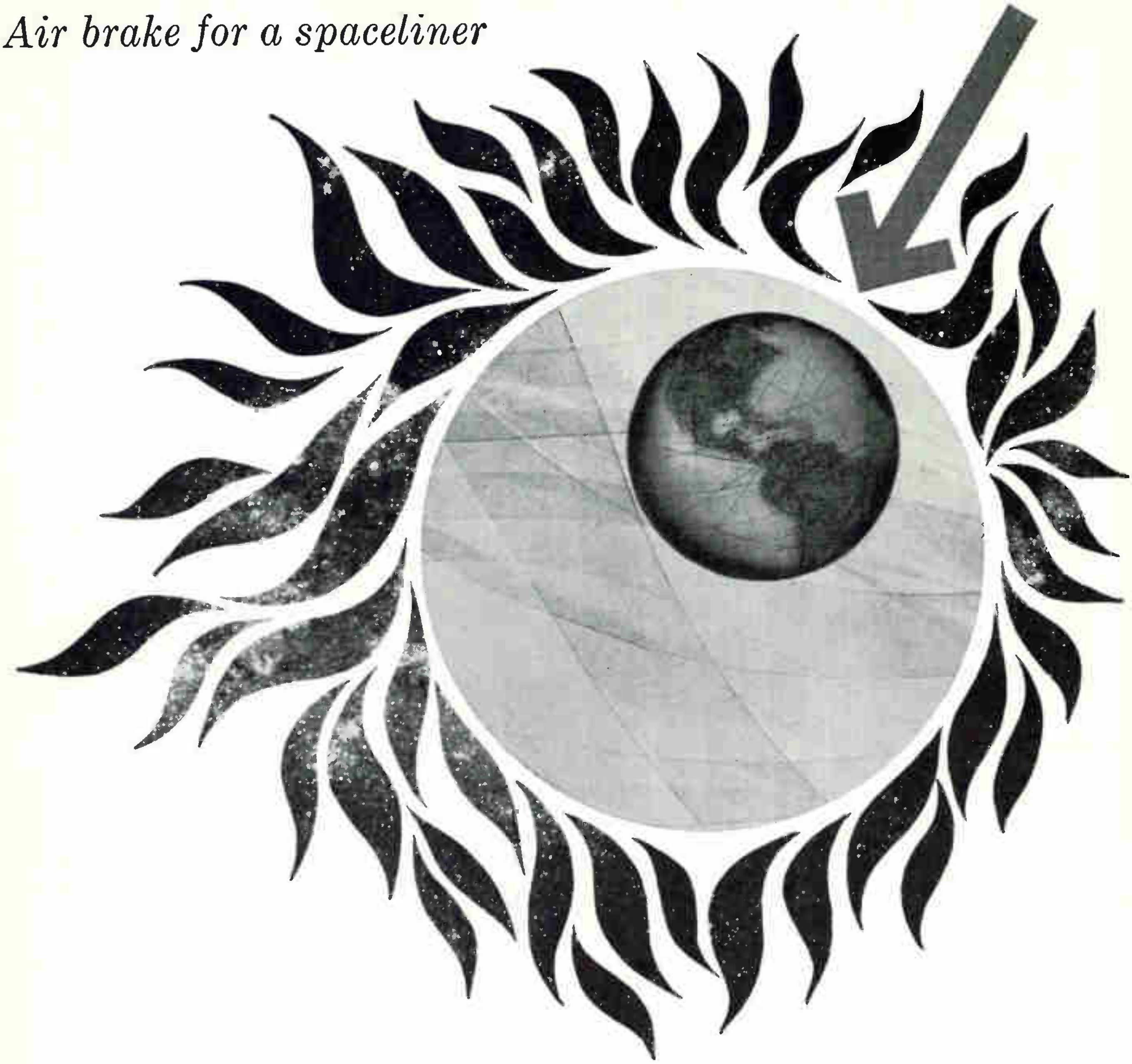
LATEST MONTHLY SALES TOTALS

(Source: EIA)
(Add 000)

	Oct. 1959	Sept. 1959	Change From One Year Ago
Rec. Tubes, Value	$35,527	$34,810	+ 3.4%
Rec. Tubes, Units	42,680	41,989	+ 2.7%
Pic. Tubes, Value	$19,307	$18,067	+ 0.5%
Pic. Tubes, Units	1,007	914	+ 3.8%
Transistors, Value	$22,110	$20,851	+64.2%
Transistors, Units	8,711	8,653	+55.7%



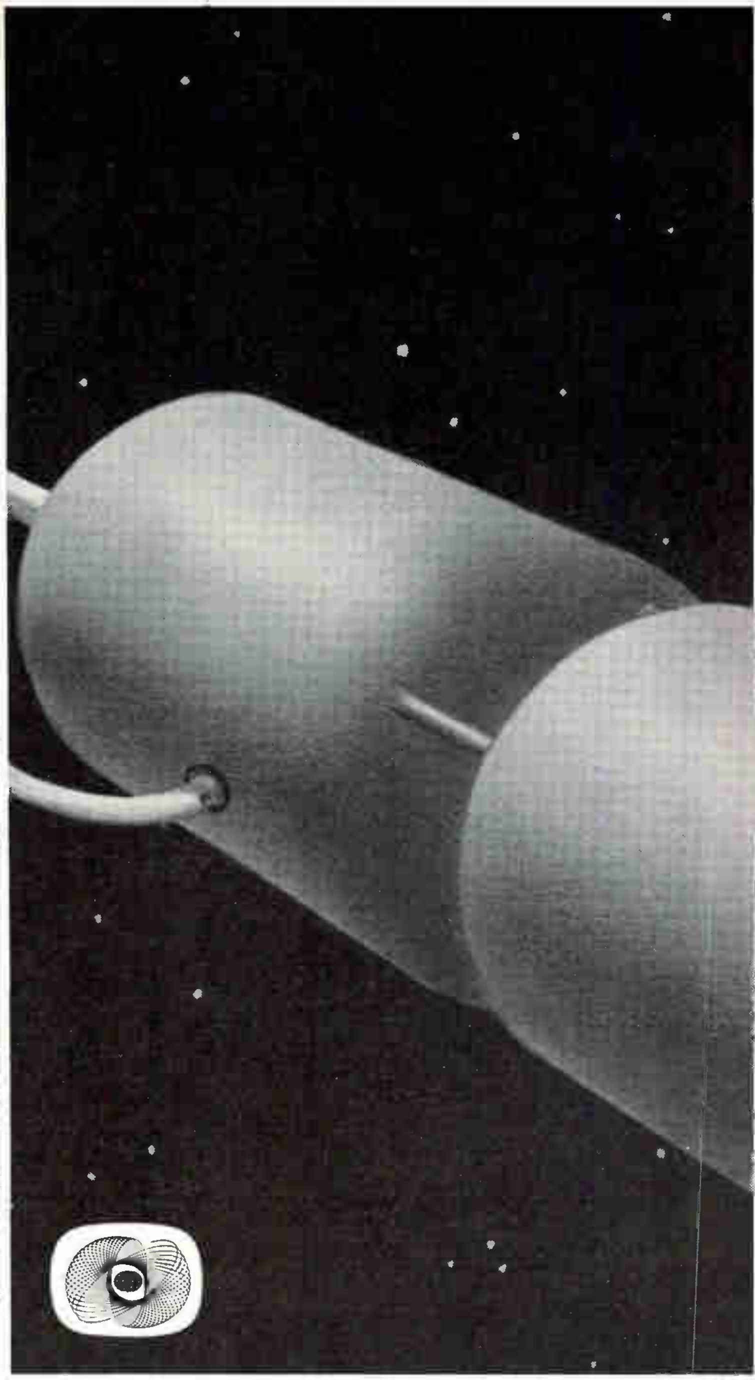
Air brake for a spaceliner



The earth's atmosphere, one of the biggest obstacles to getting into outer space, can be one of our biggest assets coming back. At Douglas we are investigating how we can use its braking effects on rockets returning from deep space trips at far faster than ICBM speeds. Success will allow us to increase payloads by reducing the weight of soft landing systems. This technique also will aid us in pinpointing landing areas. Current reports show real progress. Douglas is engaged in intensive research on every aspect of space planning, from environmental conditions on other planets to the destroyer-sized space ships necessary to get there. We invite qualified engineers and scientists to join us. Some of our immediate needs are listed in the column on the facing page. Please read it.

Arthur Shef, Chief, Advanced Design Section, Missiles and Space Systems, irons out a problem with Arthur E. Raymond, Senior Engineering Vice President of **DOUGLAS**

MISSILE AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND SUPPORT EQUIPMENT



Here is Aldrich Zmeskal, Manager of Balloon Engineering, observing the launching of another General Mills balloon —one of thousands which we and our customers have flown in the past few years. This routine flight was for the purpose of obtaining samples of radioactive material from the stratosphere. Through our balloon research projects, we have amassed a considerable fund of knowledge valuable to future space flight.

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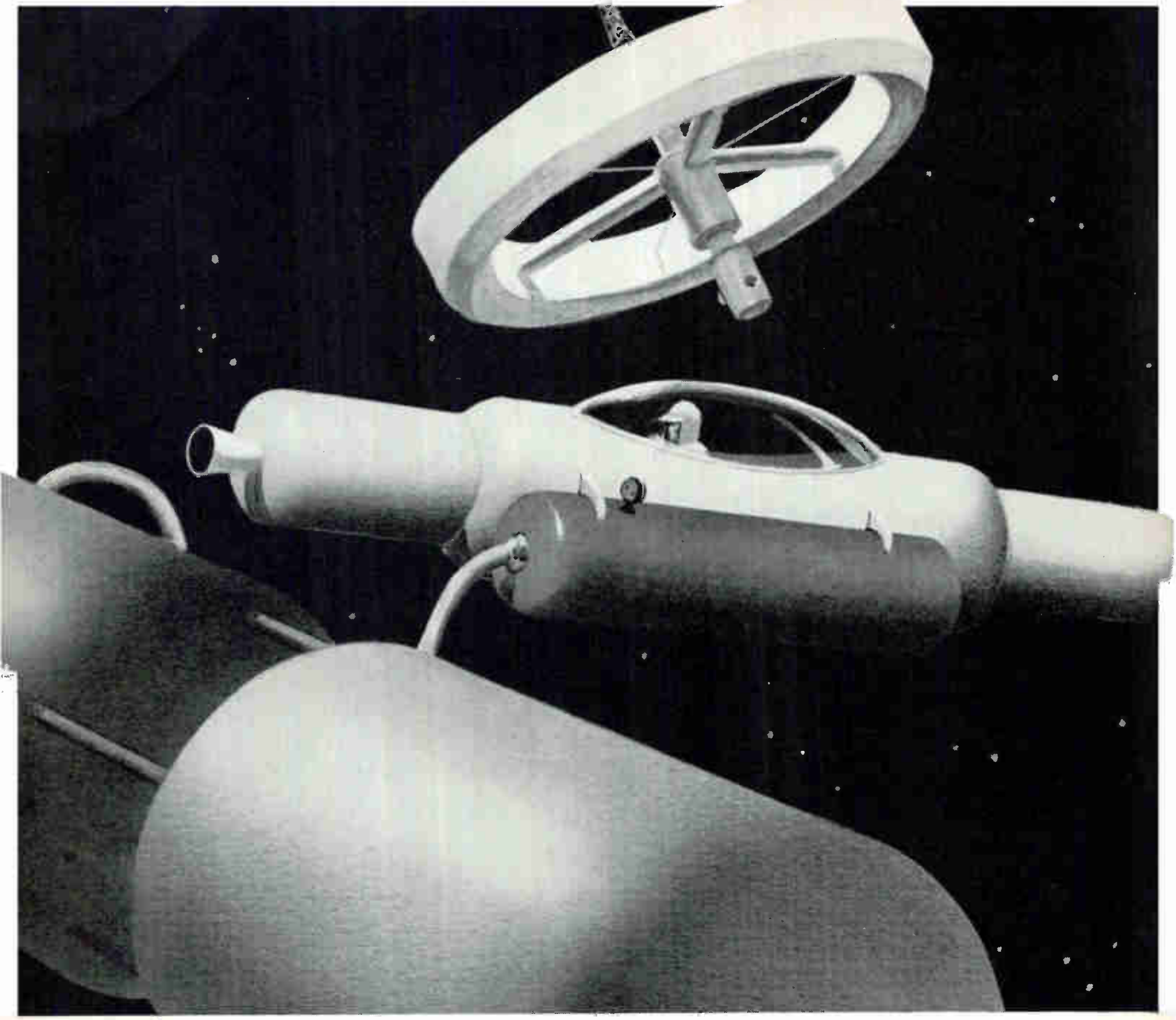
In our engineering department, current projects include: specialized inflatable vehicles and structures, airborne early warning systems, micro wave radar test equipment, antennas and pedestals, infrared and optics,

CIRCLE 24 ON READER SERVICE CARD



Manned vehicle refueling in space . . . illustration from book written for General Mills by Willy Ley.

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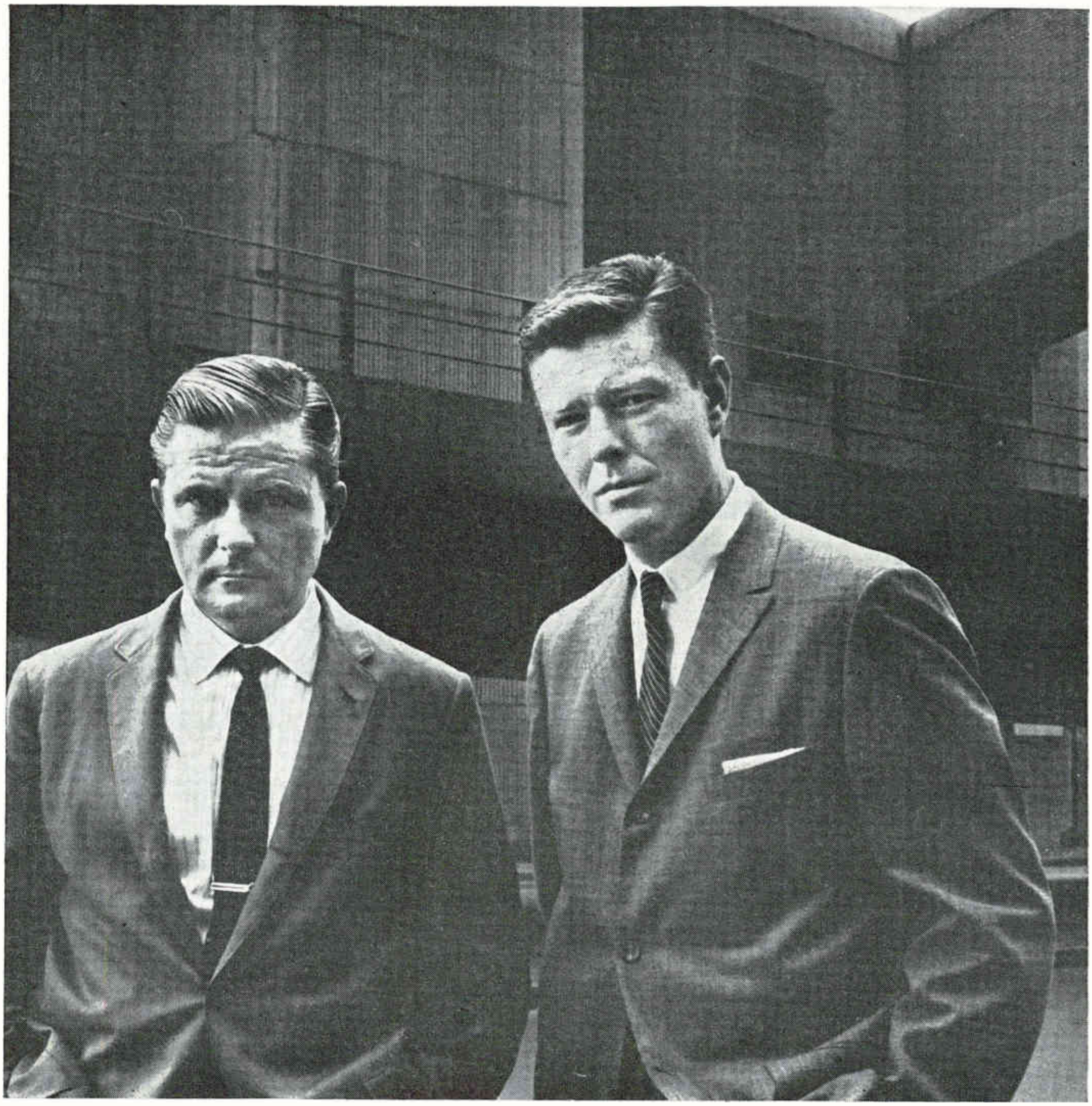

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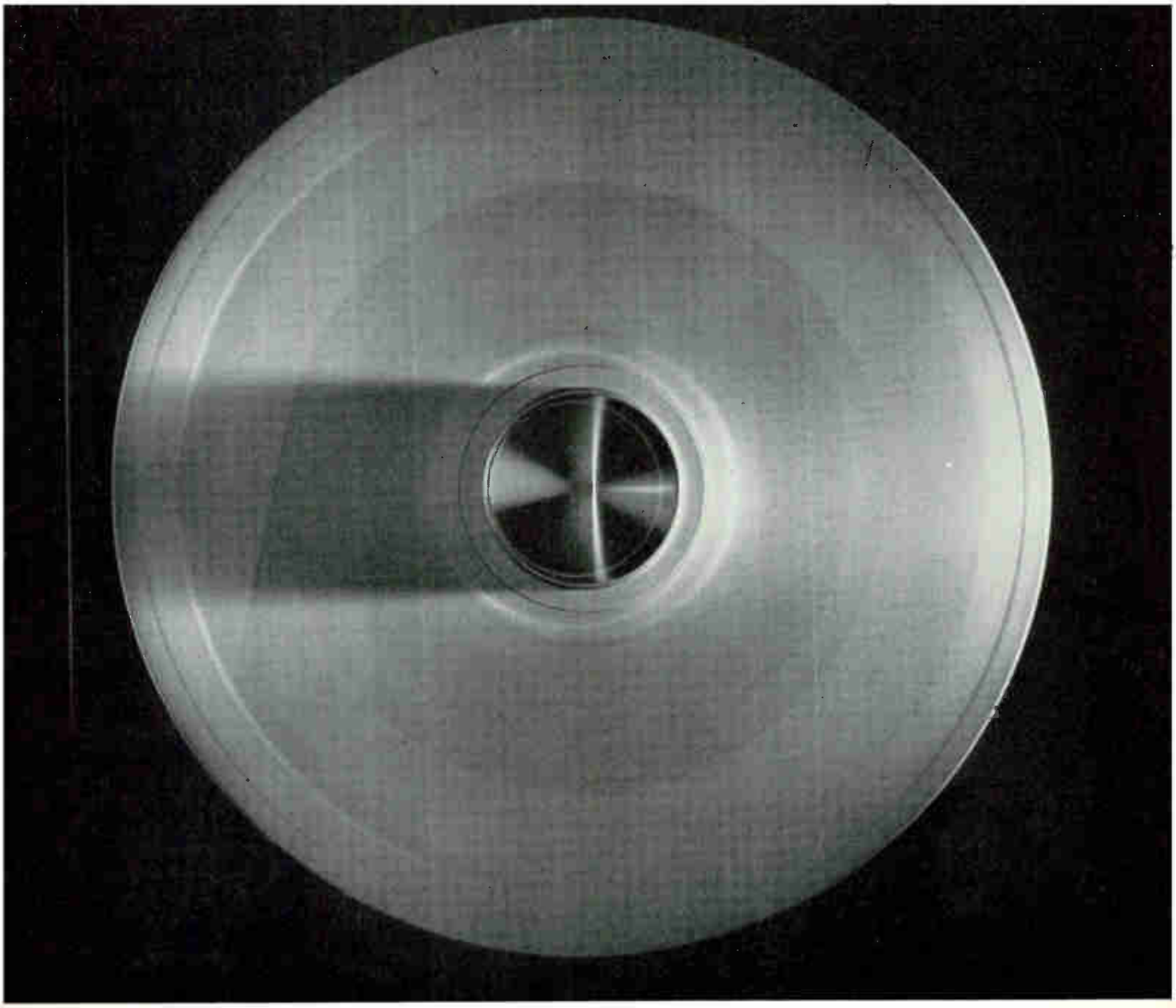
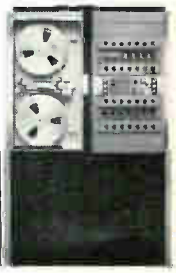


A data recorder is for recording data. Every minute its reels are stopped for warm-up, calibration or maintenance is a minute that it is not really a data recorder. It is instead a delay, a headache, a problem. By cutting every possible source of down-time to a minimum, the Ampex FR-600 literally works twice as many hours as the average recorder in every working day. Switch it on in the morning, for example, and the all-solid-state electronic circuitry is warmed up, ready to calibrate *in less than 10 minutes*. FM adjustments are non-interacting. You make each one only once. In half an hour you can have all 14 tracks ready to use. Then you forget calibrating for the rest of the day because drift is less than 1% in 24 hours. Dozens of other features save time, too. Magnetic heads retract, for instance, never touch the tape during fast forward or rewind. Oxide build-up and head-cleaning time are sharply cut. These studied simplifications make the FR-600 the most time-saving, hard-working data recorder you can use. The full FR-600 story is well worth hearing. AMPEX DATA PRODUCTS CO., 934 Charter St., Redwood City, Calif.

This recorder works twice as many hours every working day

FR 600 AMPEX



Export Ban Extension Likely

Electronics firms will remain responsible for policing their overseas sales of strategic goods. One export company was recently fined $5,000 for shipping a $440 electron tube

RECENT COURT ACTIONS involving shipments of strategic goods to Soviet-bloc countries point up two facts of importance to electronics manufacturers:

• The Export Control Act of 1949, extended for two years in 1958, will almost certainly be extended again this year, despite apparent thawings in the East-West cold war.

• Commerce Department's Bureau of Foreign Commerce, which administers the law, will continue to rely in large measure on the cooperation and compliance of industry in enforcing the important export controls.

Manufacturers must bear the brunt of investigating export sales to determine that strategic goods are not being diverted to proscribed markets. The alternative would involve BFC investigation and delays of perhaps eight or ten months in the granting of validated licenses for shipment.

Case in Point

Most recent court case involved New York exporter Minthorne International and its office manager E. J. Sorkin. A two-count indictment charged the defendants with having exported an electron tube, valued at $440 and included on the "positive list" of strategic goods, without having obtained the required export license. The tube was described in a routine customs declaration as being a different tube valued at $15 and not on the positive list.

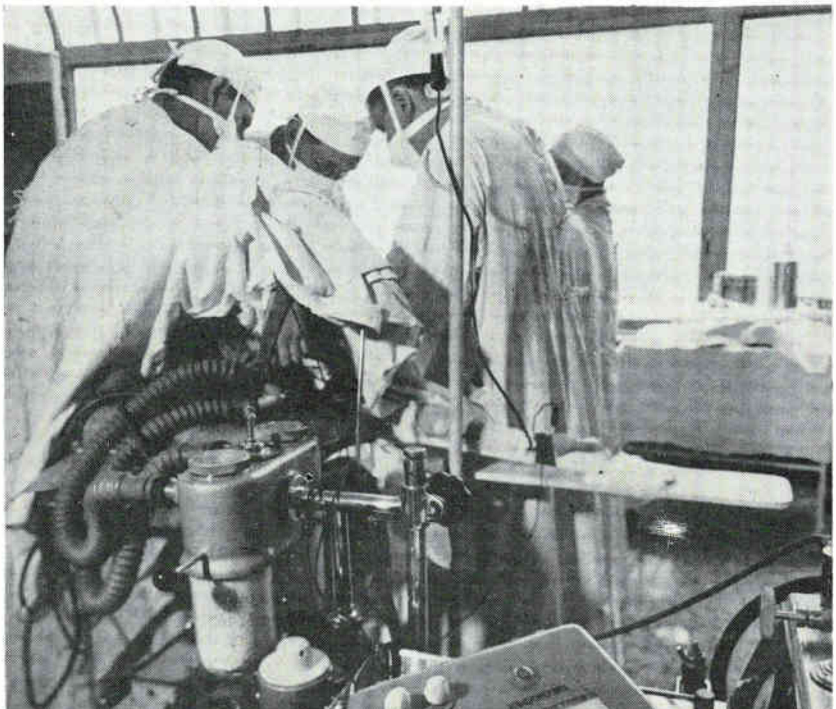
The tube was shipped to a West German firm, Germar Weiss of Frankfurt/Main, after Minthorne had been notified that BFC would reject all license applications for shipment to that firm. BFC investigations had previously determined that Germar Weiss did a lot of business transshipping goods to Soviet bloc destinations, declared that the firm was "an undesirable trade connection."

The trial judge emphasized that the export control act "is considered by our representatives in Congress to be of great importance for the well-being of our country. . . ." The firm was fined $5,000 and Sorkin received a 60-day jail sentence.

Degrees of Strictness

Congressional sources and Commerce officials have both told ELECTRONICS that the easing of U. S.-Soviet tensions will not eliminate the bans on shipment of strategic goods. At the present time there are several degrees of strictness in export control. Yugoslavia and Poland receive more favorable consideration than other nations in the European Soviet bloc, while an almost complete embargo has been clamped on shipments to the Asian Soviet bloc—Communist China, North Korea, North Vietnam. (Sample exceptions to the embargo:

Czech Transistor Cardio-Tachometer



Prototype of Czechoslovakian transistor cardio-tachometer is now being used in a Prague hospital. Device gives visual reading of rhythm of heart pulses and also emits sound impulses, enabling surgeon to hear changes in heart beats

Bibles and other nontechnical books; ashes of deceased Chinese being returned to a final resting-place.)

Restrictions May Ease

Even though the political climate may become friendlier, the act as it stands will probably be renewed. To ease U. S.-Soviet trade, the BFC would merely have to use its broad discretionary powers to change the definition of "strategic" as it applies to goods on the positive list.

At the present time this list—a most fluid document—includes many devices which could improve the industrial or commercial technology of a user nation, without having specific military uses. Items: electron microscopes, centralized railway traffic-control systems, multiplier phototubes and color-tv tubes, ruggedized vidicons.

Items of such limited military use could be removed from the list, while such military equipment as radar, troposcatter systems, detection and navigation equipment, might conceivably remain. This would keep the framework of a strategic embargo and still permit an increase in U. S.-Soviet trade. Sino-American relations are, if anything, worsening; strategic planners want to keep the bans on the Asian Soviet bloc until there is substantial improvement in the attitude of China's officialdom.

Industry Help Needed

BFC legal officers emphasize that industry must share the load of enforcing the Export Control Act. The agency prosecutes "only knowing violations"—and, in the words of one legal officer, "regrettably there are frequent violations in the electronics field."

One cause is the ease with which miniaturized gear can be boldly smuggled out without even going through the formality of transshipment procedure. A Swiss businessman recently was nabbed at New York's International Airport as he prepared to leave the country with $10,000-worth of electronic subassemblies. BFC is still investigating the various vendors with whom he dealt to determine the extent of their culpability.

Another cause is the extent to which electronics producers horse-trade with each other. In 1958, BFC brought an action against an American manufacturer for sales of microwave relay links to an English firm. The English firm was reselling the equipment to East German and Soviet purchasers, according to BFC. The American company was held culpable because "they knew the stuff wasn't staying in England."

Evidence of any knowledge on the part of a manufacturer that the declared shipping destination is not the end point is sufficient to establish culpability, judging by past court decisions.

Goods not on the positive list of strategic goods must still be licensed for shipment to Soviet bloc countries unless they are on another "peaceful list" of goods that may be sent to the European Soviet bloc.

"The presumption," ELECTRONICS learns, "is in favor of licensing goods not on the positive list. But nearly everything destined for the Asian bloc must be licensed."

Three-Nation Network Ordered

VIETNAM — A three-country regional telecommunication network for Thailand, Laos and Vietnam will be designed and installed by Television Associates, Inc. The $26.8-million project is under the supervision of the International Cooperation Administration.

In Vietnam, the system will consist of a broad-band radio-relay system of 125 operational voice channels with a potential capacity of 500. Relay tower positions will be determined by radar profiling of the terrain from Saigon to Cap-Saint-Jacques and along the coast to Hue. This line will serve all main coastal cities of Vietnam and will have two inland branches to Dalat and Pleiku.

Troposcatter will pick up the network at Pleiku, continuing communication to Pakse in Laos and from there to Thailand. From Saigon, the southward branch of the system will serve Cantho and several main towns in the Mekong delta. Final installation of radio equipment, power, towers and building is scheduled for Sept. 1962.

Microwave Liaison

In Laos, TV Associates is working on a $1.8-million project consisting of microwave liaison between main cities, telephone improvement in Vientiane and rebuilding the international radio links.

The related program for Thailand calls for a $17-million telecommunication project similar to the program in Vietnam. The firm is now training Vietnamese and Thai technicians in electronics, radar surveying and microwave design criteria.

'But Why Me?'

Suzie, affectionate beagle used in Smith Kline & French Laboratories' experiments, stands quietly—but a bit puzzled—in firm's new induction heating coil. Device, which is able to open capsules and release drugs at predetermined areas of dog's gastro-intestinal tract, enables scientists to study absorption of oral drugs without any direct electrical or mechanical attachments

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An 18-page Special Report on Electronic Markets will appear in the January 1st issue. An important feature of this report will be an 11 x 23 inch full-color fold-out chart of the market statistics for the electronic industry. The report will also include the latest figures on electronics manpower, exports and imports of electronics equipment and components, and channels of distribution for electronics products.

To cover actual reprinting cost, handling charges, postage, etc. for this Special Report the following prices will be charged: 75 cents for single reprint copies; 60 cents each for quantities of 10; 50 cents each for 25 or more.

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Labs in Tunnel Diode Race

Interest in the fast-developing device heightens. Next month many technical papers will be presented. Pilot samples now available

ESAKI TUNNEL DIODE development is taking on the appearance of a scientific race at a number of important electronic R&D laboratories as 1960 begins.

What is most baffling to observers is that nobody can be quite sure where, in terms of higher and higher frequencies (ELECTRONICS, p 70, Oct. 30 '59) and new concepts of circuit applications, the R&D race will end and the applications engineering and sales race will begin.

So far, few technical papers have been presented on the development and use of tunnel diodes. A technical article discussing the action and properties of the device appeared in ELECTRONICS (p 54, Nov. 6 '59).

Information Coming

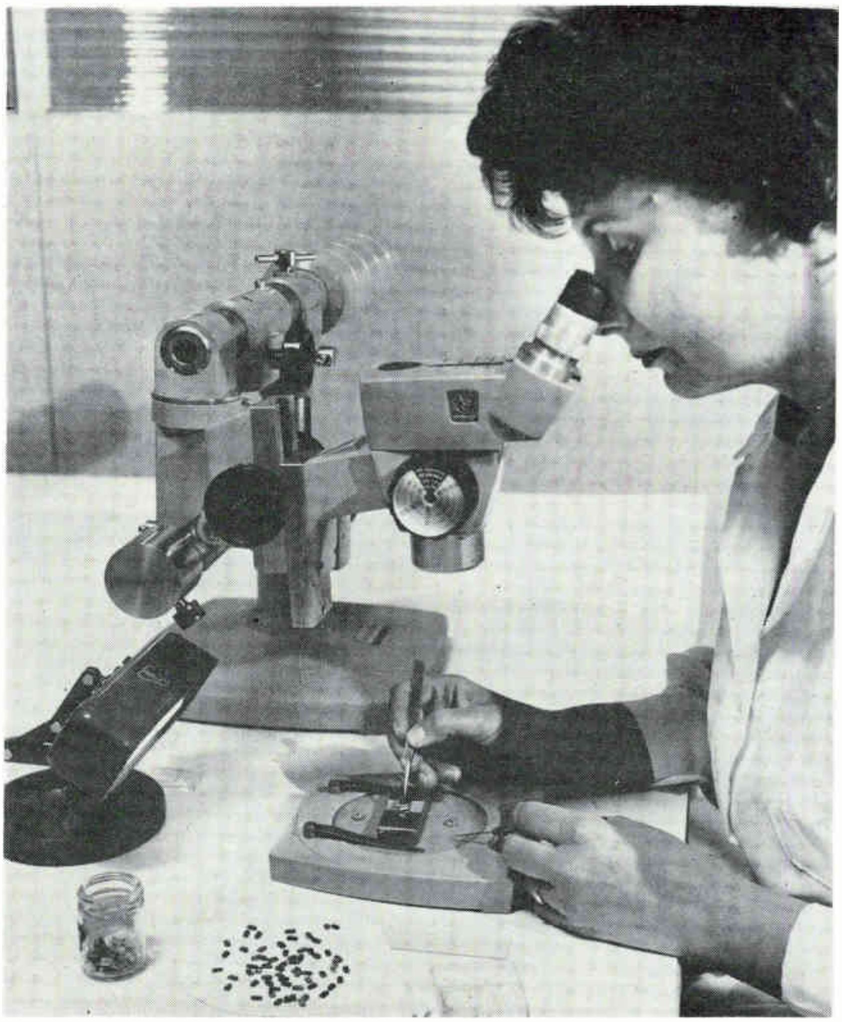
Companies, for competitive reasons, have generally been tight-lipped on technical details of advanced work in the field. However, new information will be available at The 1960 International Solid-State Circuits Conference, which will be held in Philadelphia on Feb. 10, 11 and 12.

The conference, sponsored by the University of Pennsylvania, the American Institute of Electrical Engineers and the Institute of Radio Engineers, will include six papers in a session on applications of tunnel diodes, two informal panel discussions of the device and other papers on the tunnel diode as a memory element, for amplification and for digital circuit use.

This will be the largest array of technical papers on the tunnel diode yet presented. Companies scheduled to be represented among the tunnel diode papers are Bell Telephone Laboratories, GE, RCA, IBM and Airborne Instruments Laboratory.

Regardless of the precise state of the art, upon which the conference should shed light, several commercial implications were getting keen management attention as the old year ended:

- Pre-production sample units are available from at least two companies, GE and RCA. Customer feedback thus looms significant in the later stages of device development. GE offers samples at $60 and $75 each. RCA offers samples ranging from $50 to $140 in a dozen types. It is understood that semiconductor users are being given preference over other semiconductor manufacturers in the sale of samples.



Technician at RCA inserts preproduction sample of tunnel diode into its miniature low-inductance case

- It appears likely that whole families of special-purpose tunnel diodes will eventually be produced for different types of applications.

Closer Relationship

The tunnel diode R&D meteor which streaked across the electronics industry in 1959 underscores a trend in the industry toward a closer relationship between solid-state device development men and equipment design engineers. This relationship is being forced by the pressures of technical innovation and obsolescence, and by competition between products that use solid-state devices.

Computermen, in particular, in both the U. S. and Japan, are hopeful that tunnel diodes can eventually meet their demand for higher frequency and faster switching devices.

Unanswered Questions

The simplicity of the tunnel diode compared to the transistor makes it attractive from the production point of view. However, some questions of fabrication will probably not be ironed out until a thorough market research job is done to determine the performance specifications needed by various users.

One problem arises in circuit design which has received comparatively little attention in technical discussions so far: The tunnel diode is a two-terminal device and, unlike conventional three-terminal amplifying devices, requires that input and output signals must be separated from each other by special techniques.

Apart from the unanswered questions, in the opinion of one R&D observer, is the basic device fabrication problem of obtaining the proper electrical characteristics in a miniature device. Control over impurities is also required, although to a lesser extent than in transistors.

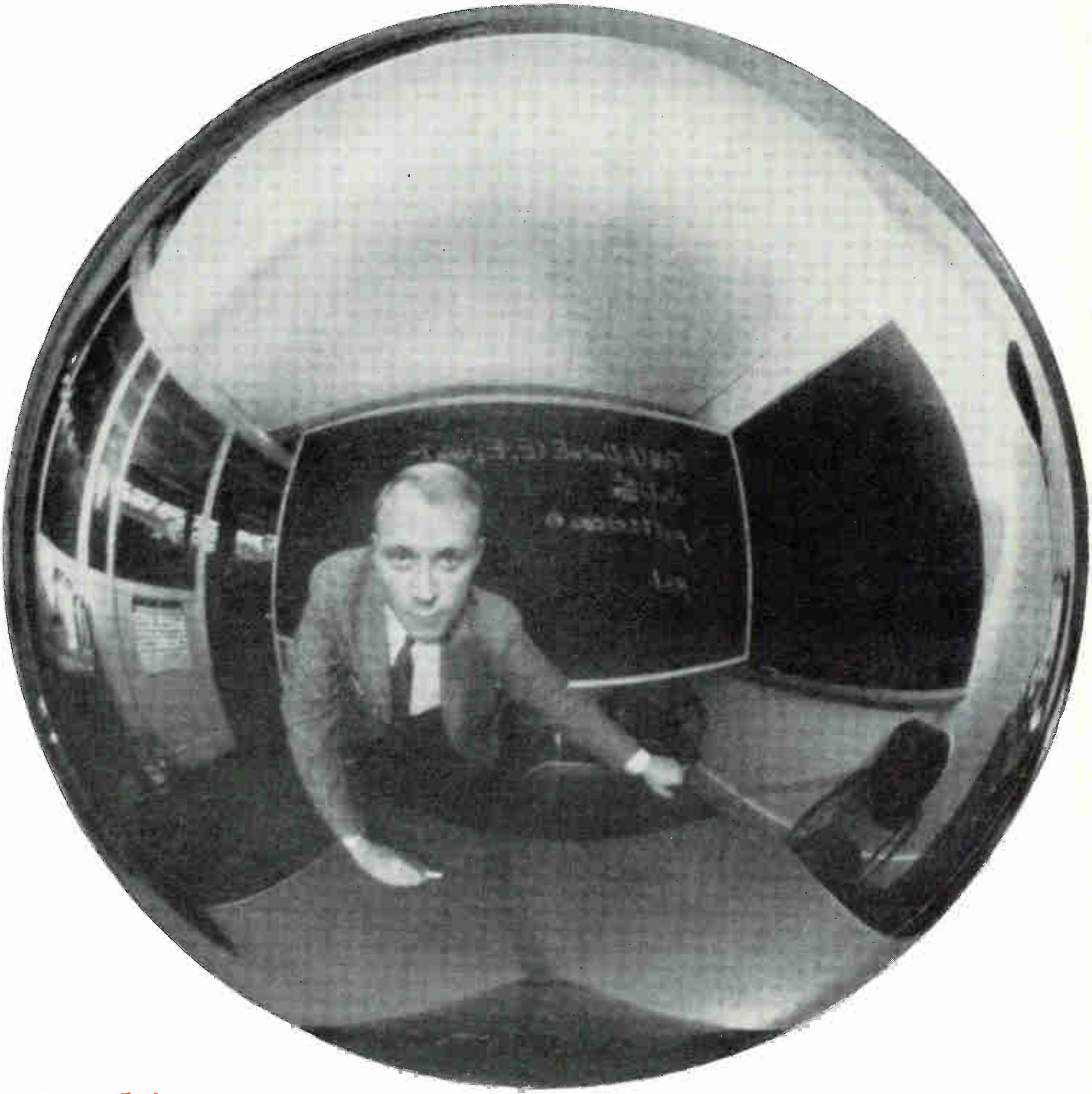
'Important Functions'

Laboratory devices are presently being made of germanium, silicon, indium antimonide and gallium arsenide.

In a recent statement, an RCA official said the company's germanium tunnel diode available to industry for experiment was expected to perform "important electronic functions in missile control and guidance systems."

He said the device functions 100 times faster than a transistor and could withstand cosmic and atomic radiation in vehicles traveling in outer space.

The RCA tunnel diode is said to operate at frequencies up to a billion cycles per second, with higher frequencies expected in future units.



working

The sphere represents perfection in many ways to the designer of inertial instruments. It can be decoupled completely from torques due to external magnetic, electric, and gravitational fields. It has perfect symmetry, can be formed to extreme accuracy by simple machine processes. It is the primary element of Honeywell's electrically suspended gyro.

Fundamental ideas are the basis for continued advances in inertial sensors and systems. Honeywell engineers have a primary concern for developing new systems through applications of just such ideas. A consistent pattern of Honeywell investment in research and development facilities and programs encourages ideas and their application, and is an important factor in Honeywell's continuing growth and reputation.

Typical of the results are electrically suspended navigation gyros, adaptive flight control systems, and guidance and control for space vehicles. Sergeant, Thor, Atlas, Titan, Polaris, F-104, B-58, WS 117L, Scout, Mercury . . . Honeywell equipment is on all of these and many more.

Current expansion has created openings for senior and junior engineers and scientists in these and similar programs. Your inquiry will get prompt and confidential attention.

Stereocasting at Crossroads

Industry groups await decisions from Washington as work progresses on systems for f-m and a-m broadcast equipment and home receivers

THE FUTURE of stereophonic radio broadcasting is being determined in Washington this week.

At stake are a number of things both economic and technical:

- A greatly expanded consumer market for stereo receivers;
- A sharp upturn in demand for stereo program fare;
- A possible change in present background music policies and techniques.

Two groups are at work shaping the forthcoming patterns, the National Stereophonic Radio Committee and the Federal Communications Commission.

Five F-M Systems

NSRC, formed under the auspices of Electronic Industries Association, is made up of six panels established to investigate the various aspects of stereocasting (see ELECTRONICS, p 26, Jan. 30 '59). Presently in the limelight is Panel 1, which is charged with establishing systems specifications. This group has narrowed the field of 11 possible f-m systems. The companies involved are: Crosby, Halstead, Calbest, General Electric, Zenith and Electrical & Musical Industries. The proponents of each of these systems have seen them subjected to tests and demonstrations and will await evaluations at a later date.

The factors governing the final choice of an f-m stereo system present one serious difficulty, that of subjective evaluation by the listener. The sound of music over each system, just as in hi-fi listening, will always be difficult to measure in numerical terms. The technical aspects of transmission and reception, however, are being subjected to rigorous field testing. It will probably be on this basis that a final choice is made. Also to be pondered is the degree of compatibility of each system with existing receivers, and the cost and complexity of new receivers that will have to be produced for the new medium.

All f-m proposals were due to be submitted to FCC last month on December 11. NSRC, however, has asked for an extension to March 15, plus 90 days for field testing. The request is likely to be granted. The Committee has also asked FCC to participate in its operations to a greater extent. Industry spokesmen feel that a member of the FCC should serve as chairman of the meetings, as was done during the work of the Television Allocations Study Organization.

During initial phases of NSRC's formation, FCC did not wish to become involved too heavily for fear of adding to an already ponderous workload. The stereo group feels that its procedures and operations are sufficiently well established that FCC will participate as requested.

Presents Petition

One facet of FCC abstention has been to make RCA and Columbia wary of joining NSRC. A spokesman for RCA said the company wanted prior Department of Justice approval and recognition of NSRC to protect itself against possible antitrust allegations in the future. This was not given. RCA has presented a petition to FCC for broadcast standards for f-m stereo and is preparing to do the same in a-m, with both actions being taken independently of NSRC.

Future development in NSRC action will be to sift the five systems now under consideration and recommend that FCC adopt the final choice. Should the Committee be unable to choose one system, FCC may be asked to make the choice.

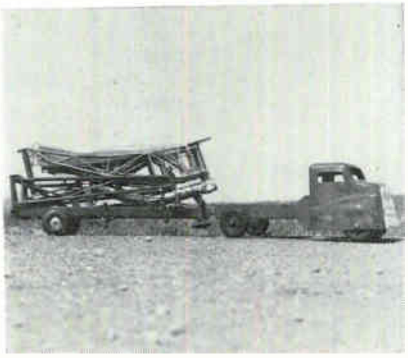
Manufacturers Ready

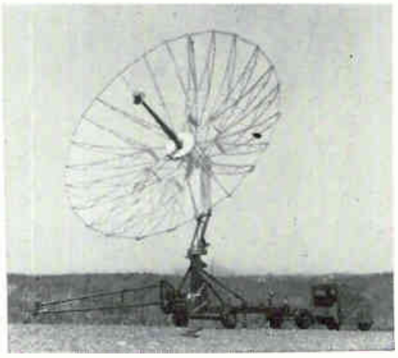
Manufacturers are champing at the bit to get started in production of stereo receivers. Some fears have been expressed that public education still lags behind technical development.

The bulk of receiver producers are not too scared by this, however. NSRC has established a stereo promotion committee which will go after the problem of public education.

According to some opinion, receiver production will follow the pattern of hi-fi some years ago. Component and subassemblies, rather than fully integrated consoles, will dominate the market at first. Basic appeal will be to the same type of consumer that started the trend in hi-fi. The industry will probably proliferate adapter kits, crossover gear and other bits and pieces before making a full-dress effort at the livingroom-furniture consumer.

Antenna Rolls to Site, Then Opens





New tracking antenna, built by D. S. Kennedy, can be collapsed into a compact bundle and towed (left) by a light truck or station wagon to new site, then opened. System consists of a 28-ft folding, cloth-surface reflector, hand-operated elevation-azimuth drive (motors and selsyns can be added if desired), and a self-contained trailer mount and tower

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1N459*	1N464	1N628	1N483	1N485A
		1N629	1N483A	1N485B
		1N662†	1N483B	1N486
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Urges Awards for

West coast manufacturer sees program as aid in battling foreign threat, U. S. inflation

LOS ANGELES—A west coast electronics manufacturer is campaigning to enlist industry and ultimately the government, in enacting a program of "Q" awards to increase the quantity and quality of U. S. production to meet rising foreign competition and combat inflation.

Robert S. Bell, President of Packard-Bell Electronics Corp. here, told two thousand employees at the annual employe meeting in Santa Monica "we are individually and collectively at war. It is a war against foreign ideology and technology and against our own complacency.

"Aside from preparedness, it is not a war of missiles and nuclear weapons, but one of philosophy and production.

"Fundamentally, we are engaged in a war of workmanship. It presents us with a challenge that cannot be ignored, for if we rise to it with all our strength we can make it the most powerful weapon our country can possess."

Starting Own Program

Bell said his company will begin

Covering the Hemisphere

Sixty-ft reflector for 3-axis antenna will provide hemispheric coverage of telemetered data from satellites and missiles. The aluminum, 15-ton dish was designed and developed by Philco under contract to Lockheed for the Air Force. Location is Palo Alto, Calif. Antenna responds to tracking commands of about .11 of one degree, tracks at rates up to five degrees per second, accelerates up to five degrees per second in one second, and can be slewed at 10 degrees per second

Production

immediately to establish a "Q" award program in its factories, urging all industry to follow suit, and if possible, persuade the government to adopt the program on a national basis.

Referring to a recent conclusion by the National Industrial Conference Board, Bell stated the U. S. today stands almost at the bottom of the list of major nations in terms of annual rate of economic growth.

Bell said our Central Intelligence Agency is of the opinion that if Soviet industrial growth persists at the rate of eight or nine per cent per year, as is forecast, the gap between our two economies by 1970 will be dangerously narrowed unless our industrial growth is increased from its present pace.

Many Ways to Help

"There are many ways we can help in this fight to preserve our way of life," Bell stated. "We must be aware of our heritage and the responsibilities that go with it. We can manifest our strength by demonstrating daily in our jobs the power of free men in the pride of doing those jobs to the limit of our abilities.

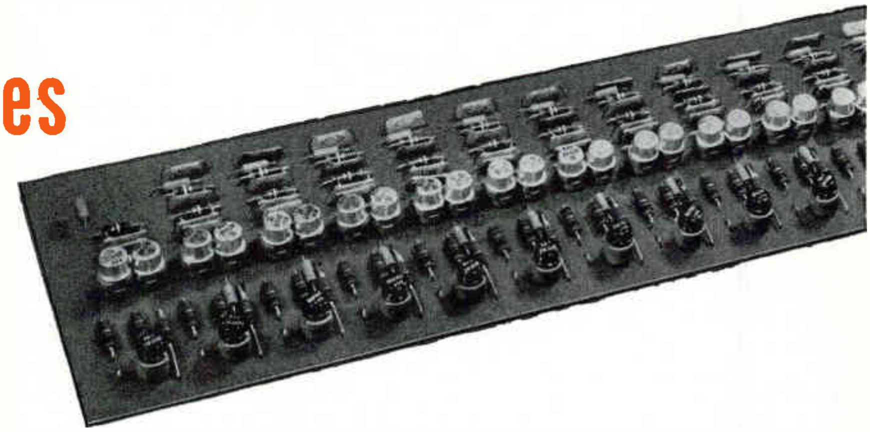
"'Made in U.S.A.' for years has been a worldwide symbol of quality at its highest, craftsmanship at its best. That gives us a head start which is an advantage and an opportunity. But as Allen Dulles pointed out, 'We are falling behind every day.'

"The time has come to stop retreating and start advancing. In the shooting war we had 'E' awards. Now I think we should have 'Q' awards. Only through quantity can we fight inflation and compete in foreign markets; only through quality can we prevail in any market."

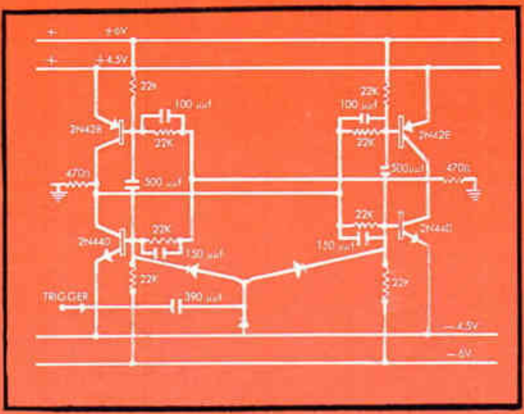
Offers Slogan

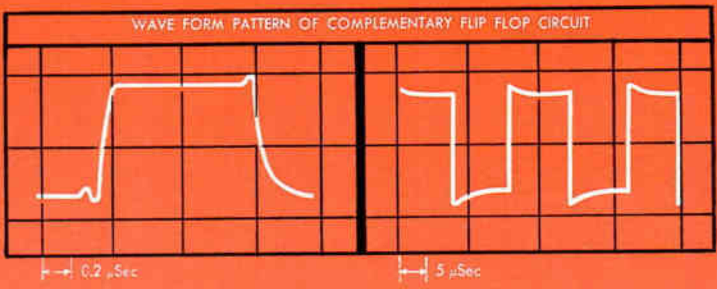
Bell told his employees: "We can't speak for industry as a whole, but as a team we can start the slogan of 'produce better—produce more' for we are fighting for the continuance of our standard of living and for an increasingly better one in the future."

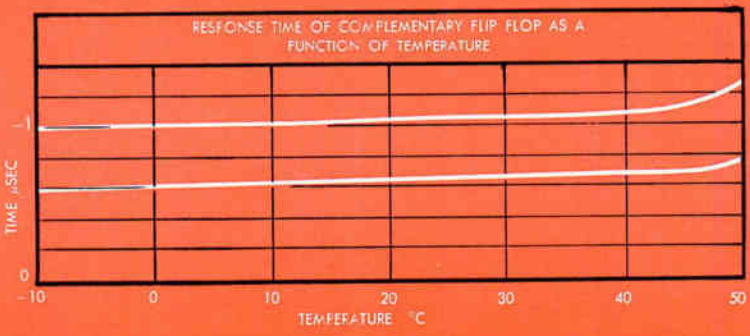
for switches



COMPLEMENTARY FLIP FLOP CIRCUIT







Advantages Over Conventional Flip Flops

- higher efficiency
- symmetrical wave shape
- lower output impedance
- shorter rise and fall times

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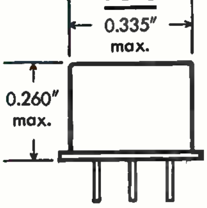
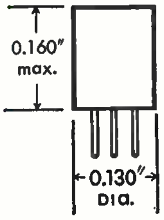
Medium Current Switches

TO-5



SUBMIN



GERMANIUM PNP ALLOY — TO-5 CASE

Type	V_{CE} Volts	$f_{\alpha b}$ Avg. Mc	H_{FE1} $I_B = 1MA$ $V_{CE} = 0.25V$	H_{FE2} Min. $I_B = 10MA$ $V_{CE} = 0.25V$	Rise* Time Max.
2N404	−24	12	—	—	—
2N425	−20	4	20–40	10	1.0
2N426	−18	6	30–60	10	0.55
2N427	−15	11	40–80	15	0.44
2N428	−12	17	60	20	0.33
2N1017	−10	22	80	20	0.27

*$I_C = 50MA$; $I_{B1} = 5MA$; $R_L = 200\Omega$ $I_{B2} = 5MA$

GERMANIUM NPN ALLOY — TO-5 CASE

Type	V_{CE} Volts	$f_{\alpha b}$ Avg. Mc	H_{FE} Min. $I_C = 50MA$ $V_{CE} = 1.0V$	Rise* Time Avg. μsec
2N438	25	6	20	0.7
2N439	20	11	30	0.5
2N440	15	17	40	0.3

*$I_{B1} = I_{B2} = 1MA$; $I_C = 10MA$; $R_L = 1K\Omega$

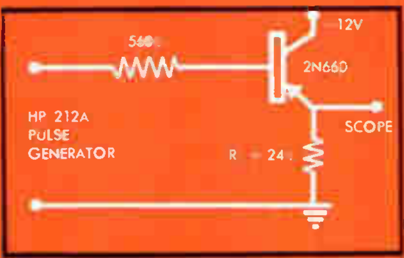
Contact the nearest Raytheon office for data on

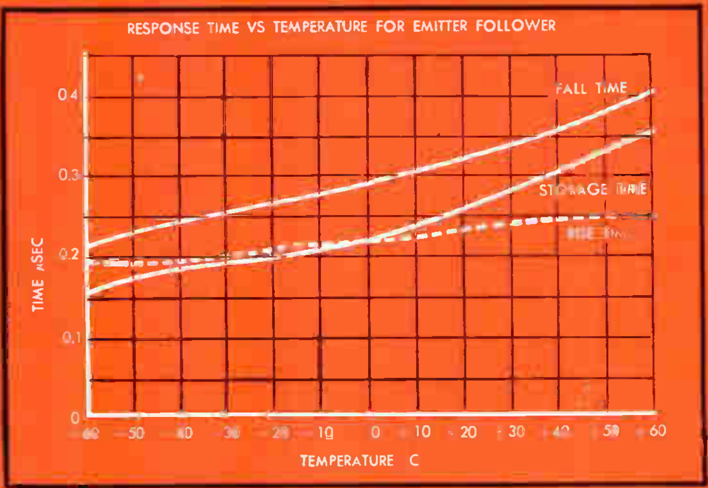
SILICON as well as GERMANIUM Switching Transistors

. . . the switch is to

RAYTHEON TRANSISTORS

EMITTER FOLLOWER CIRCUIT





TESTED FOR COMPUTERS • DEPENDABLE IN COMPUTERS

High Current Switches

GERMANIUM PNP ALLOY — TO-5 CASE

Type	V_{CE} Volts	$f_{\alpha b}$ Avg. Mc	H_{FE1} $I_B = 1MA$ $V_{CE} = 0.25V$	H_{FE2} Min. $I_B = 10MA$ $V_{CE} = 0.35V$
2N658	−24	5	25–80	15
2N659	−20	10	40–110	25
2N660	−16	15	60–150	40
2N661	−12	20	80	55
2N662	−16	8	30	18

Subminiature Switches

GERMANIUM PNP ALLOY — SUBMIN CASE

Type	V_{CE} Volts Volts	$f_{\alpha b}$ Avg. Mc	H_{FE1} $I_B = 1MA$ $V_{CE} = 0.25V$	H_{FE2} Min. $I_B = 10MA$ $V_{CE} = 0.35V$	Rise* Time Max.
CK25	−20	4	20–40	10	1.0
CK26	−18	6	30–60	10	0.55
CK27	−15	11	40–80	15	0.44
CK28	−12	17	60	20	0.33

SEMICONDUCTOR DIVISION

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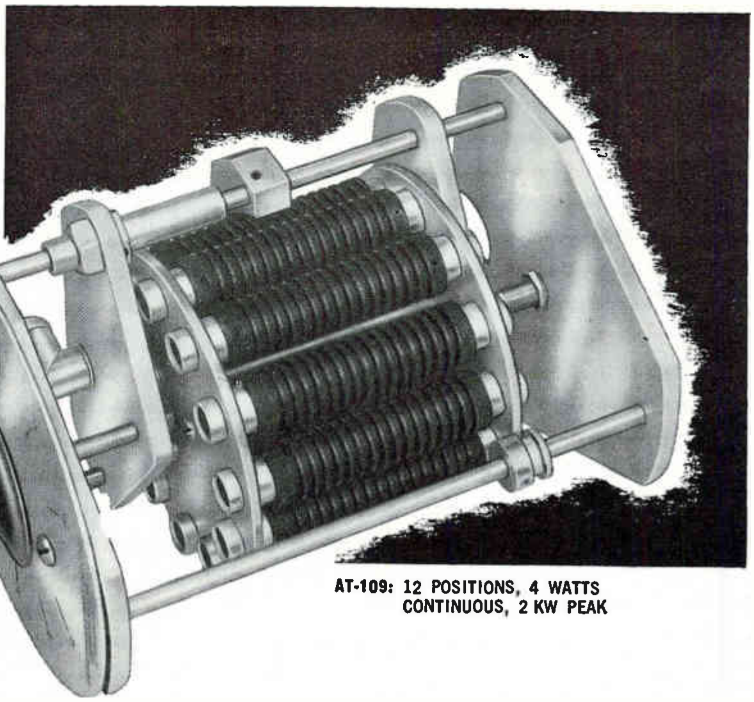
CIRCLE 43 ON READER SERVICE CARD

Accuracy Reliability Versatility



AT-109: 12 POSITIONS, 4 WATTS CONTINUOUS, 2 KW PEAK

EMPIRE COAXIAL ATTENUATORS

AT-50: 1 W CONT., 1 KW PEAK
AT-60: 2 W CONT., 2 KW PEAK

AT-75: 4 W CONT., 2 KW PEAK

AT-106: ATTENUATOR PANEL FOR VALUES UP TO 120 DB USING COMBINATIONS OF STEP ATTENUATORS.

AT-103: 6 POSITIONS, 1 WATT CONTINUOUS, 1 KW PEAK

AT-108: 6 POSITIONS, 4 WATT CONTINUOUS, 2 KW PEAK

AT-104: 12 POSITIONS, 1 WATT CONTINUOUS, 1 KW PEAK

Rated up to 4 Watts

Empire attenuators have been designed and constructed for the reliable performance so essential to modern, complex systems. Their rugged construction ...conservative power ratings for CW and pulse operation...and exclusive deposited carbon precision resistors...enable them to satisfy your microwave attenuation requirements.

Resistive coaxial networks furnished for frequencies up to 4000 MC, higher on special order. Low VSWR and high accuracy are inherent features. Attenuation values up to 60 DB are obtained in individual pads, rated up to 4 watts continuous and 2 KW peak (AT-75) or as six and twelve position step attenuators (AT-108, AT-109). With two or three attenuators connected in series, values up to 120 DB can be obtained.

In many cases our engineering files contain a ready solution to your unusual coaxial attenuation problems.

For complete technical information, write for free catalog A-259.

edp

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NOISE & FIELD INTENSITY METERS • CRYSTAL MIXERS • POWER DIVIDERS • DISTORTION ANALYZERS • IMPULSE GENERATORS • COAXIAL ATTENUATORS

Transistormen Aid Stanford

17 firms plan to give $425,000 over 5 years to support university's solid-state research

COOPERATIVE PROGRAM involving 17 major transistor manufacturers and Stanford University is getting underway this week in Stanford, Calif.

Each member of the group will contribute $5,000 a year for five years—$425,000 in all—to enlarge university solid-state programs and increase liaison with industry.

Firms participating are: Ampex, Fairchild Semiconductor, Hewlett-Packard, Hughes Aircraft, IBM, Lenkurt Electric, Lockheed, Marquardt Aircraft, Motorola, Pacific Semiconductor, RCA, Rheem Semiconductor, Stanford Research Inst., Sylvania, Tektronix, Texas Instruments and Varian.

Joins Faculty

Other industry participation related to the program comes from Bell Telephone Labs' Gerald Pearson, coinventor of the solar battery. He will join Stanford's faculty next semester on six-months loan from Bell.

Also participating is W. B. Shockley of Shockley Transistor Corp., Palo Alto, Calif., who will make himself available for teaching and consulting.

General Electric Foundation is also making funds available to the program. So is Gilfillan Bros., Inc., of Los Angeles.

Student interest is keen, according to Prof. J. G. Linville, director of the program. About 40 students, most of them Ph. D. candidates, are now working on solid-state projects. Enrollment has topped 100 in one transistor course, making it one of Stanford's largest graduate electronics courses.

In addition to graduate courses in solid-state devices and circuits, Stanford now offers new studies in semiconductor theory, magnetic phenomenon at microwave frequencies and parametric devices.

New Radar On Guard

Air Force's massive search radar facility at Thomasville, Ala., is part of vast network protecting America from air attack. Sperry Gyroscope is system manager. Radar feeds target position data into high-speed computers, missiles do intercepting. Antenna weighs nearly 70 tons, is almost width of football field. Self-contained facility houses switching gear, computers, power generator, heating and air-conditioning equipment. Concrete tower is 85 ft high, 60 wide

MEETINGS AHEAD

Jan. 11-13: Reliability & Quality Control, National Symposium, ASQC, IRE, EIA, AIEE, Statler Hotel, Washington, D. C.

Jan. 31-Feb. 5: Comparison of Control Computers, Winter General Meeting, AIEE, Statler Hilton Hotel, New York City.

Feb. 1-4: Instrument - Automation Conf. and Exhibit, ISA, Sam Houston Coliseum, Houston, Texas.

Feb. 3-5: Military Electronics, Winter Convention, Biltmore Hotel, Los Angeles.

Feb. 10-12: Solid-State Circuits Conf., AIEE, IRE, Univ. of Penn., Hotel Sheraton, Philadelphia.

Feb. 11-13: Electronic Representatives Assoc., Annual Convention, Drake Hotel, Chicago.

Feb. 16-18: Nondestructive Testing of Aircraft & Missile Components, Southwest Research Institute, Hilton Hotel, San Antonio, Texas.

Mar. 21-24: Institute of Radio Engineers, National Convention, Coliseum & Waldorf-Astoria Hotel, New York City.

Apr. 4-7: Nuclear Congress, EJC, PGNS of IRE, New York Coliseum, New York City.

Apr. 11-13: Protective Relay Engineers, Annual, A&M College of Texas, College Station, Texas.

Apr. 11-14: Weather Radar Conference, American Meteorological Society and Stanford Research Institute, San Francisco.

Apr. 18-19: Automatic Techniques, Annual Conf., ASME, IRE, AIEE, Cleveland-Sheraton Hotel, Cleveland, O.

Apr. 20-22: Southwestern IRE Conf. & Electronics Show, PGME of IRE, Shamrock Hilton Hotel, Houston, Texas.

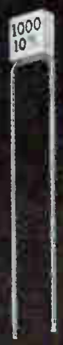
Aug. 23-26: Western Electronic Show and Convention, WESCON, Ambassador Hotel & Memorial Sports Arena, Los Angeles.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 104.

new

MICRO-MINIATURE CERAMIC CAPACITORS OFFER A PACKAGE DENSITY OF 432,000 PARTS PER CUBIC FOOT

excellent for complete assembly encapsulation



actual size

The reliability built into the "VK" Capacitor is a hard, tested fact — backed by the name and reputation of the company that made the "VITRAMON" monolithic porcelain capacitor a synonym for capacitor reliability.

A minutely controlled process, continuous life and environmental testing, plus 100% tests for Dissipation Factor, Insulation Resistance and Capacitance guarantee that each "VK" Capacitor in your circuit will perform as predicted. Pre-production lot-by-lot qualification tests on all materials used, craftsmanship of the highest order and ten years of experience dedicated exclusively to the manufacture of high-reliability capacitors assure that these tiny units will function predictably under the most punishing conditions to which a component of this type is subject.

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VK*

micro-miniature

CAPACITORS

47-10,000 mmf
200 vdc without derating
-55° C to 150° C operation

Square precision molded cases in only two sizes and a single standard 0.2" lead spacing for all values simplify circuit design, guarantee uniformity, facilitate handling, give greater mechanical stability.

The DAPON** resin used in "VK" Capacitor cases assures environmental reliability through every stress to which such components are susceptible.

ENVIRONMENTAL CHARACTERISTICS

Moisture Resistance: Operational in 95% relative humidity at 200 vdc. When tested in accordance with MIL-STD-202A, Method 106, with rated voltage applied, Insulation Resistance is greater than 10,000 megohms at 95% relative humidity. Dissipation Factor is less than 2.5%, and capacity change less than 10% at 25°C and 50% relative humidity.

Temperature and Immersion: When tested in accordance with MIL-STD-202A (with maximum temperature extended to 150°C), Method 102A (test condition C) and Method 104A (test condition B), Insulation Resistance is greater than 10,000 megohms, Dissipation Factor is less than 2.5% and capacity change is less than 10%.

Temperature Shock: "VK" Capacitors show no evidence of electrical damage when subjected to 10 cycles of alternate immersion in silicone oil at 160°C and water at 0°C (±10°C) for a minimum duration of ½ minute each bath.

Vibration: No evidence of physical damage has been found when tested per MIL-STD-202, Method 204 (test condition B) when ⅜ in. lead mounted and vibrated for four hours in each of three mutually perpendicular planes (10 cps to 2,000 cps) at 15 G's. **Shock:** When ⅜ in. lead mounted and subjected to 3 shocks of one milli-second duration in each of 3 mutually perpendicular planes at 100 G's per Method 202A of MIL-STD-202, "VK" Capacitors show no evidence of physical damage.

Altitude: When tested in accordance with MIL-STD-202, Method 105A (test condition D) requiring a minimum of 100,000 feet, "VK" Capacitors suffer no electrical breakdown at 150% of rated voltage.

Life: Following 1,000 hours at 150°C and 200% of rated voltage, measurements at 1 kc and 25°C show a Dissipation Factor less than 2.5% and an Insulation Resistance greater than 10,000 megohms.

Conforms to requirements of MIL-C-11015B

*Trade Mark
**Trade Mark of Food Machinery and Chemical Corp.

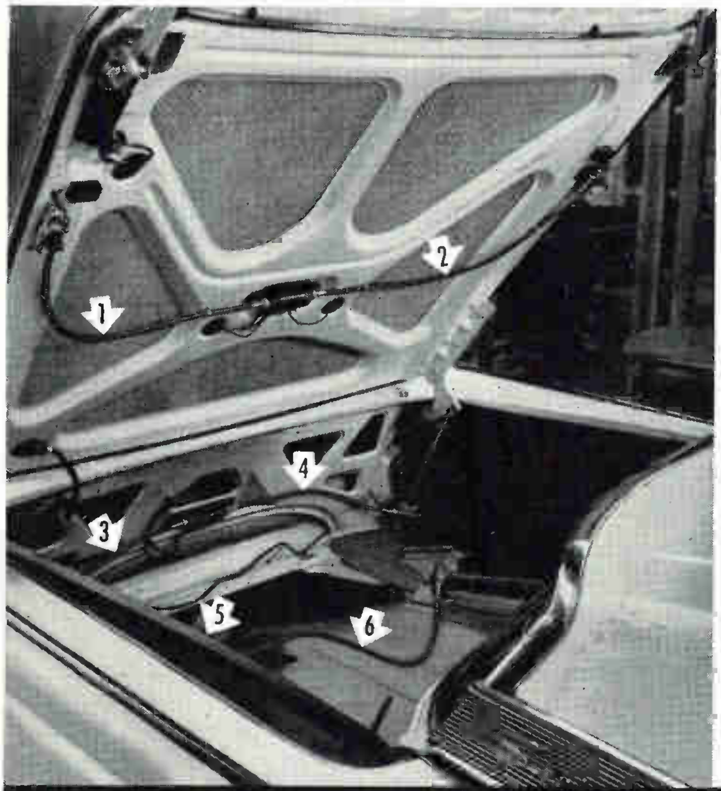
CIRCLE 47 ON READER SERVICE CARD

S.S.White DRIVE AND CONTROL IDEAS FOR ENGINEERS

Tips on better designing with flexible shafts

REMOTE CONTROL AND POWER DRIVE:

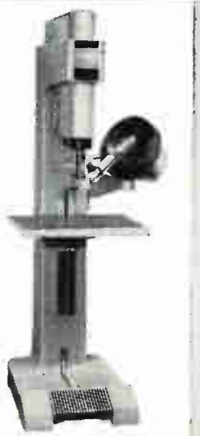
Retractable hard top simplified by flexible shafts.



In the Ford Fairlane 500 Skyliner, the roof retracts into the trunk, and the trunk lid closes and locks. All this is done automatically, within 40 seconds. Powering this ingenious mechanism are six 3/16" high speed, remote control flexible shafts, driven by three reversible electric motors.

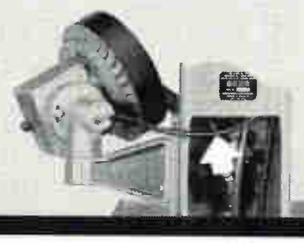
The use of flexible shafts enabled the designers to use only one motor to drive each pair of actuators, thus solving synchronization problems and at the same time cutting down on the number of motors needed.

Flexible shafts (1) and (2) rotate the trunk lid locking screws in and out of engagement. Flexible shafts (3) and (4) drive a pair of screw-jack actuators to raise or lower the trunk lid. Flexible shafts (5—not shown) and (6) drive a pair of actuators and their associated linkage to raise or retract the roof.



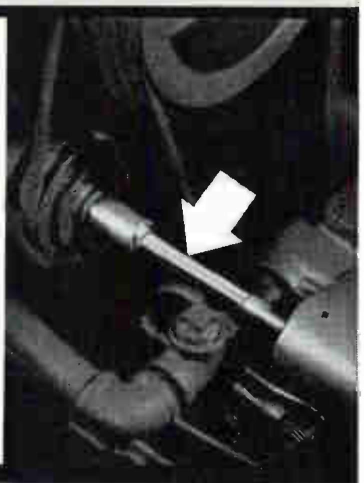
POWER DRIVE:

Powering a movable component... is easily accomplished with flexible shafts. Position of barrel type feeder on this new Detroit Power Screwdriver is highly adjustable, because it is driven by a flexible shaft. Power takeoff is at the main drive motor.



COUPLING:

Solve alignment and vibration problems... with S. S. White coupling shafts — short pieces of flexible shafting without companion casings. Here is one being used between an adjustable pulley and a gear pump.



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Selection of S. S. White standard flexible shafts: complete description and application data available. Write for bulletin 5801.

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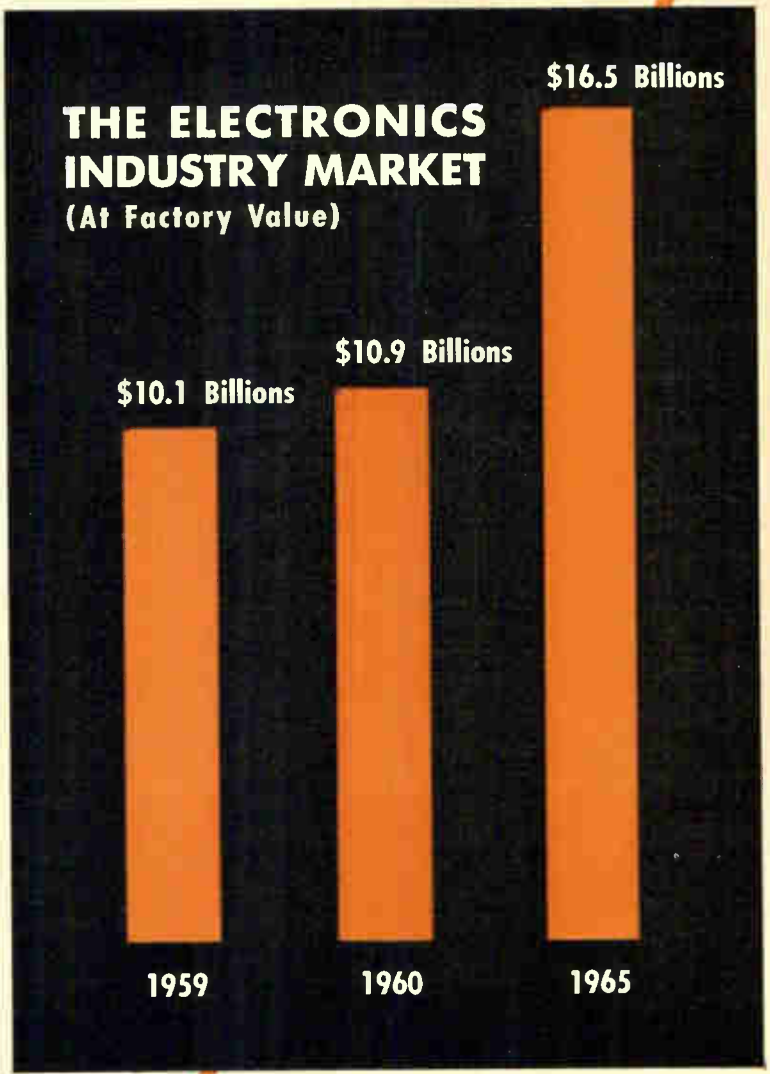
Selection of specialized flexible shafts to meet unusual requirements: useful shaft data and also information on how to take advantage of S. S. White engineering services. Write for bulletin 5601.

THE ELECTRONICS MARKET

looking into the 60's



Our Market

The Manpower Picture

The Electronics Market

Market Research Tables

Buying and Selling Abroad

Getting Goods to Market

By
EDWARD DE JONGH
Market Research Editor
THOMAS EMMA
Associate Editor
HOWARD K. JANIS
Associate Editor
ELECTRONICS

Our Market for '60

Forecast is for increased sales in every major category with military sales leading the way. Industrial and commercial sales are rising fast

ELECTRONICS INDUSTRY sales of end equipment and replacement parts at factory door prices should near $11 billion this year. By 1965, sales should rise above $16 billion.

Last year's sales topped $10 billion for the first time. This mark was an 11-percent gain over 1958 sales. The bright sales outlook reflects recovery from the 1957-1958 recession and a pickup in military spending for electronics.

Expanding business activity expected throughout the sixties, rising population totals, continued high military and government spending support these predictions.

That's the summary of ELECTRONICS' latest year-end market forecast. Sales of all major segments of the industry are participating in the predicted sales growth.

Electronics dollar export totals, equivalent to four percent of total industry sales, registered only a moderate sales gain in 1959 over 1958, although export sales of some specific industrial products fared better.

Imports are up. Estimated electronics imports to U. S. of $120 million in 1959 were more than twice the 1958 figure. More than half the 1959 total came from Japan.

Rising import totals could lead to a negative electronics foreign trade balance in the future.

Growth of electronics markets is paralleled by growing manufacturers' interest in methods of distributing products.

ELECTRONICS finds manufacturers are reexamining their distribution methods and asking such questions as: Are we using the most effective channels of distribution? How can we help to improve existing channels? An increasing number of manufacturers are working closely with electronics manufacturers' representatives and distributors.

MILITARY ELECTRONICS—Moderately rising Department of Defense budgets over the next five years, coupled with increasing dependence of the armed services on electronic techniques and equipment, mean more electronics business for many years to come.

Between 1950 and 1959 our share of DOD spending rose from four to 14 percent. By 1965 it will be 20 percent, as shown in the chart of DOD and military electronics expenditures.

Military customers were the source of 58 percent of all electronics sales last year, taking $5.9 billion worth of electronic equipment and parts. In 1960 military sales are expected to reach $6.3 billion.

Expected military sales of $9.8 billion in 1965 is almost equal to total industry sales today.

Swing to manufacture of missiles in production quantities is an important reason for high military electronics spending in 1959 and 1960.

Missile expenditures of $1.481 billion in 1959 are about thirty percent higher than 1958. Another substantial increase is looked for in 1960 which will boost the missile expenditure total to $1.7 billion.

Rise in missile spending has more than offset a drop in aircraft electronics, expected to fall to $1.5 billion in 1960 from $1.7 billion in 1958 and 1959.

Electronics communications expenditures, backbone of much military air defense system procurement, are becoming a substantial part of the defense business.

By 1960, electronic communications expenditures will reach almost $1 billion and will represent 22 percent of military spending for electronics production procurement.

Few areas of the electronics industry are growing faster than research, development, test and evaluation.

In 1959-1960, sales will jump 36 percent. Estimate for 1960 is one billion dollars as against $733 million in 1958.

The RDT&E budget category was initiated by the government last year. It combines the previous research and development category with expenditures for equipment in test and evaluation and not yet in quantity production.

Missiles and space equipment are presently getting

ELECTRONIC INDUSTRY COMPONENTS

FACTORY SALES

	1959	1960
		millions of dollars
RECEIVING TUBES	$386	$401
TV PICTURE TUBES	189	200
POWER & SPECIAL PURPOSE	250	288
TOTAL TUBES	825	889
TRANSISTORS	250	385
RECTIFIERS & DIODES	195	250
TOTAL SEMICONDUCTORS	445	635
CAPACITORS	240	264
RESISTORS	224	251
TRANSFORMERS	112	114
RELAYS & SWITCHES	201	221
TRANSDUCERS	120	140
ALL OTHER COMPONENTS	887	976
TOTAL	$3.054	$3.490

most of the RDT&E money. Missiles and astronautics got over $1.5 billion of $3.8 billion worth of total new obligational authority for fiscal 1960.

Increasing amount and complexity of electronic equipment used by the armed services is boosting spending in the operation and maintenance budget category.

The O&M category covers repair and overhaul of military equipment. The electronics part of that budget category is expected to be $890 million in 1959. Prediction for 1960 is $950 million.

Over the next five years spending for space exploration and for air traffic control equipment will play increasing roles in the electronics business. Although not wholly for military purposes, these expenditures are included here because of the difficulty of separation.

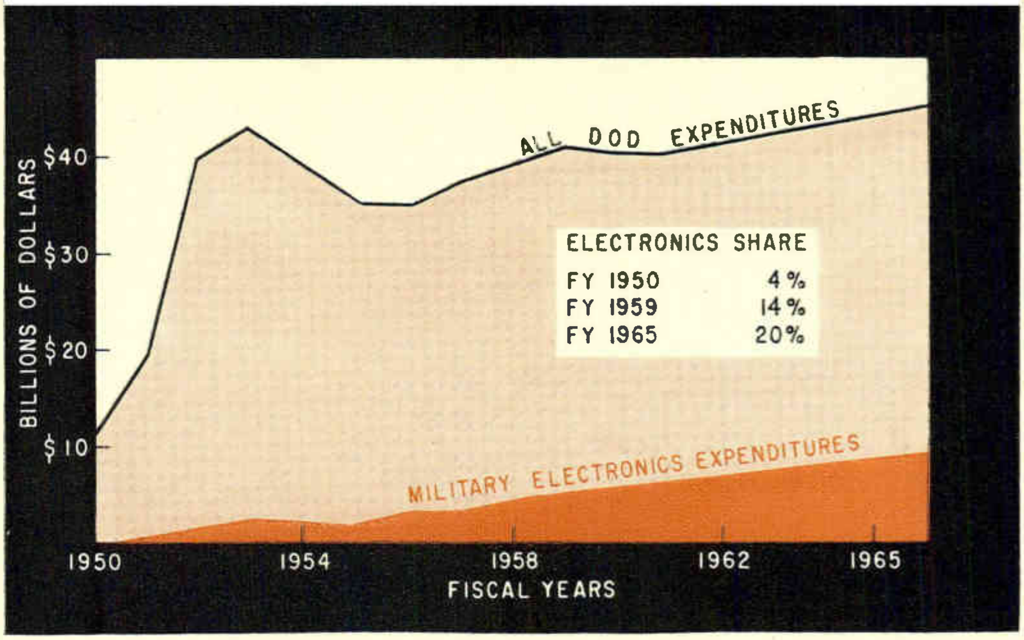
National Aeronautics & Space Administration and Federal Aviation Agency, in combination are expected to spend about $900 million in 1960 and about $2 billion in 1965. Electronics portion is currently estimated at one third and is rising. Figures do not include DOD spending for space, currently running at near $350 million. This sum is split between the RDT&E and missile electronics categories.

Other military growth markets over the coming five-year period are infrared, point-to-point microwave communications equipment and antisubmarine warfare (ASW) equipment.

By 1965 the infrared market is expected to grow from current $110-million level to $425 million. Over the same period a four-fold growth in point-to-point microwave expenditures from present $50-million figure is anticipated.

Estimate of the ASW market have not jelled. Current spending is in excess of $132 million a year. In

DEPARTMENT OF DEFENSE EXPENDITURES VS MILITARY ELECTRONICS EXPENDITURES



the past five years sales grew from almost insignificant levels.

CONSUMER ELECTRONICS—This oldest segment of the electronics business enjoyed a major rally in 1959.

Last year's sales of $1.6 billion were 21 percent ahead of 1958, largely influenced by improving business conditions, higher automobile sales and depleted retailer and distributor inventories.

The steel strike resulted in lower levels of entertainment set sales than anticipated in the last two months of 1959, particularly auto radio. But it had only a minor effect on total consumer electronics sales for the year. Moreover, steel strike sales losses should mean greater gains in 1960.

Forecast for 1960 is for a continued high level of consumer business with a gain of about five percent, which will bring total consumer sales to almost $900 million.

Bulk of gains in consumer product sales are accounted for by tv sets, radio sets and phonographs.

Tv set sales of $853 million in 1959 were 19 percent ahead of 1958 and are scheduled for a five-percent increase in 1959. Radio set sales of $378 million last year were 23 percent ahead of 1959 and are headed for $425 million in 1960. Phonographs with $190 million in sales in 1959 were 20 percent ahead of the preceding year.

Behind the improved black and white tv set business are increases in the number of second and third set homes; annual growth in number of homes wired for electricity and improved business conditions.

Color sets continue as a minor part of tv set total sales. Estimates of sales growth vary from 10 to 25 percent annually. But actual sales figures are not available. Encouraging factor is that three manufacturers now actively pursuing the color set market report rapidly rising sales.

By 1965 table portable tv sets and battery-powered transistorized models may dominate the black and white tv sales picture. Color tv could boom by then.

Improvements in radio programs, which have led to greater consumer interest in radio listening and purchasing, plus big increase in portable sales are major factors behind radio set sales growth.

Growth trend is expected to continue over the next five years with sales rising steadily through 1965. Manufacturers are talking about selling a radio for every room in the house by 1965. Radio set merchandisers say that the trend among consumers to purchase radio sets as an impulse or gift item supports this expectation of future sales.

Rapid consumer acceptance of packaged hi-fi and stereo phonographs is a force behind phonograph sales growth.

Electronic organs and other consumer electronics equipment such as garage door openers, toys, headlight dimmers and kitchen devices accounted only for $74 million of sales in 1959. But rising consumer incomes are expected to build demand for these items considerably in the coming five years. Estimated sales for this group of $93 million in 1960 is 25 percent ahead of 1959.

Tabulation of unit sales of consumer equipment is shown in the table (next page, left).

INDUSTRIAL ELECTRONICS—In the past industrial electronics has been a sleeping giant. Holding the potential for tremendous sales increases, the industrial category has thus far demonstrated greater potential for publicity than sales growth.

However, rapidly rising research and development expenditures, need to modernize industrial plants, necessity of meeting foreign competition by lowering production costs—all point to wider use of electronics equipment by industry.

Growing acceptance of electronics equipment by industrial customers is another major factor in the improving prospects for industrial electronics business. In many product areas such as data processing, testing and measuring and communications equipment, the job of winning acceptance has largely been won.

Electronics industry manufacturers are now striving for acceptance of integrated industrial electronic

CONSUMER ELECTRONICS UNIT SALES millions of units	1959	1960
Black & white tv	5.9	6.0
Color tv	0.175	0.200
Home & portable radio	9.6	10.5
Auto radio	5.1	5.6
Phonographs	5.0	5.2
Tape recorders	0.6	0.6
Electronic organs	0.036	0.037

SNAP-SHOT VIEW OF ELECTRONIC MARKETS	1959	1960
Government Electronics	$5.935 billion	$6.311 billion
Production equipment	4.175	4.361
Other expenditures	1.760	1.950
Consumer	1.585	1.697
Tv sets	0.853	0.898
Radio sets	0.378	0.425
Other	0.354	0.374
Industrial-commercial	1.648	1.876
Replacement parts	0.963	1.028
Total	$10.131 billion	$10.912 billion

systems. Progress in winning system acceptance is expected to be a major factor in development of industrial electronics sales through the sixties.

ELECTRONICS estimates industrial and commercial electronics sales at $1.65 billion in 1959, a 14-percent increase over 1958. Another 14-percent sales increase in 1960 will bring the sales total to $1.9 billion.

Estimated 1965 sales of $3 billion are based on a conservatively estimated 10-percent annual sales growth. Some observers are predicting a 12 to 14-percent growth rate during the period. Many manufacturers say that the electronics industry's greatest growth potential is in the field of industrial electronics business.

Big factors in industrial sales are electronic data processing equipment (EDP), test and measuring equipment and industrial controls.

EDP sales should reach almost a billion dollars by 1965. Sales forecasts for 1959 and 1960 are $350 million and $415 million respectively.

Test and measuring instruments, closely related to spending on research and development are estimated at $275 million in 1959 and $310 million in 1960.

By 1960 industrial controls should register at least $200 million, an average increase of 12 percent over the preceding two years.

Other industrial products worth watching are air navigation, point-to-point microwave communications, land-mobile communications and nuclear electronics equipment.

REPLACEMENT PARTS—Estimate for 1959 replacement parts sales is $963 million, a six-percent advance over 1958. In 1960 sales total should top $1 billion. Continuation of average growth rate will produce sales of replacement parts of $1.5 billion by 1965.

A cloud in the replacement parts business picture is the trend to transistorization, which could eventually curtail consumer spending on replacement parts.

COMPONENTS SALES—Total components sales, including sales of both replacement parts and parts used with initial equipment, are of far greater interest to electronics manufacturers than replacement components sales.

The components business experienced the benefits of increased military spending for electronics and generally healthy business conditions during 1959. Military demand for components with greater reliability plus ability to operate under extreme environmental conditions, which had a healty influence on components sales last year, in continuing.

Tubes are big business in electronic components. Total sales last year of $825 million were 13 percent ahead of 1958.

Anticipated sales increases of 17 percent in 1959 and 15 percent in 1960 are expected to bring total power and special purpose tubes sales to $288 million in 1960. Military demand for microwave tubes is a big factor, with klystrons and travelling wave tubes doing particularly well.

Predicted semicondutor sales in 1959 of $445 million are 89 percent ahead of 1958. Another 40-percent sales jump is anticipated in 1960.

Transistor sales of $250 million in 1959 exceed 1958 by 121 percent. Sales gain for 1960 is conservatively estimated at 50 percent.

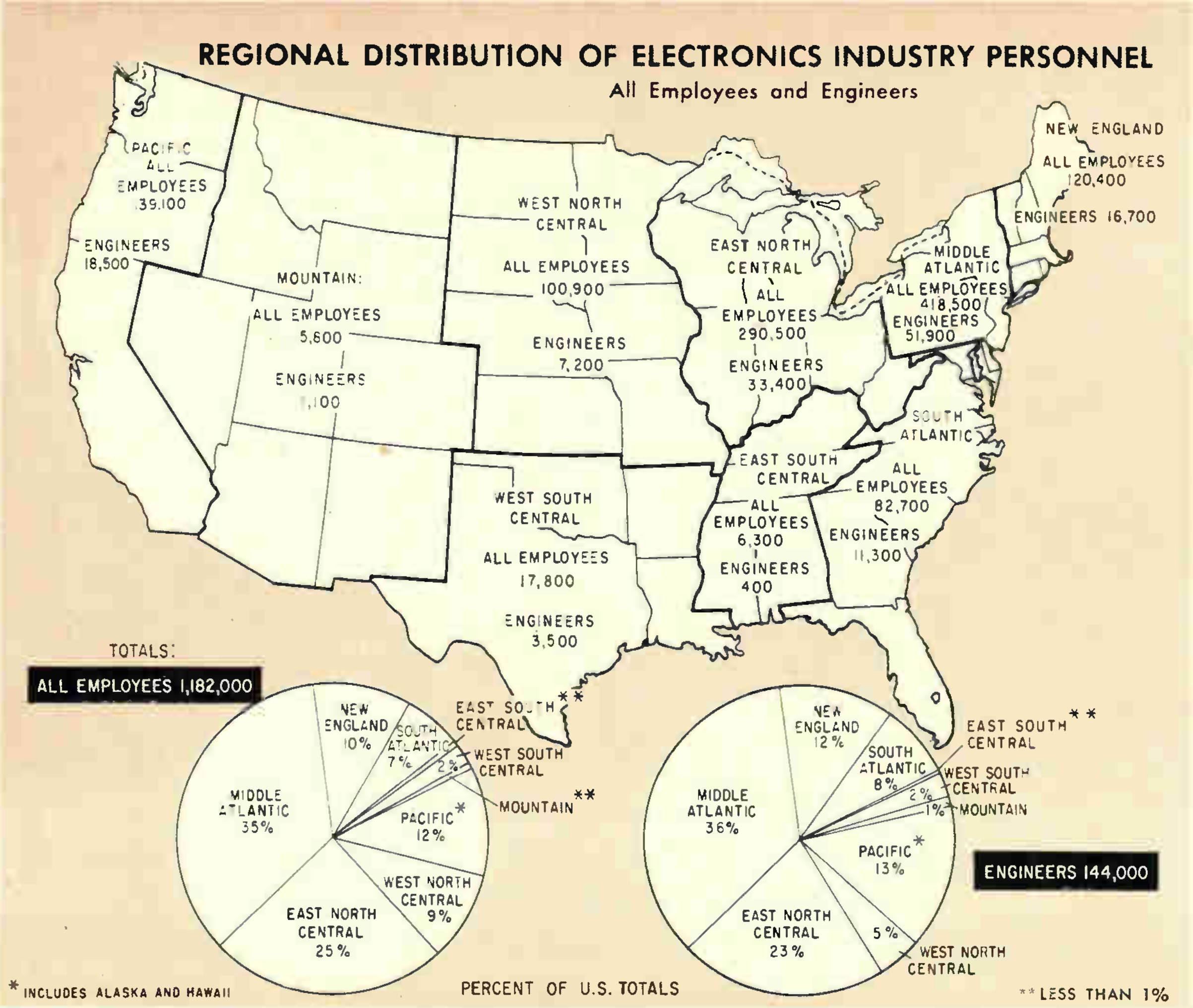
Silicon transistor share of total transistor sales was estimated at $80 million for 1959. Silicon share is expected to increase to $130 million in 1960, one-third of total forecasted transistor sales.

Trend towards transistorization of electronic consumer and industrial equipment, plus increasing specification of transistor components in military equipment contracts, are behind transistor and semiconductor sales growth.

Practically all other broad categories of electronic components are growing at a lively rate.

Last year saw capacitors and resistors snap back from the sales declines they experienced in 1958. Dollar sales totals of both for 1959 are expected to be 20 percent or more ahead of 1958 and further sales advances are expected in 1960.

Table (above, right) lists estimated 1959 and 1960 sales of major components.



The Manpower Picture

LAST YEAR, 1,182,000 employees of the electronics industry, including 144,000 engineers turned out products worth $12 billion, ELECTRONICS 1959 Buyers' Guide survey found.

Previously cited estimate of industry's market as $10 billion excludes $2 billion of components sold to original equipment manufacturers.

Electronics manufacturing and research takes place in every state in the nation.

But, bulk of the industry is concentrated in four regions—Middle Atlantic, East North Central, New England and Pacific, as the map and pie charts show. Together, these four regions have 968,500 employees or 82 percent of the U. S. total and 120,500 engineers, 84 percent of total.

In New England, with strong R&D interests, the ratio of engineers to total employees exceeds that of the U. S. as a whole. In the East North Ceneral region—where manufacturing of entertainment products is concentrated—the reverse is true.

SHAPE OF INDUSTRY—Employment totals which outline the general shape and size of the industry are of special value to management and marketing people. The totals are used as tools for regional market planning and control. These activities include: setting sales quotas and sales territories; compensating salesmen; evaluating work of salesman and distribution groups; estimating regional sales potential; and planning sales promotion.

USING EMPLOYMENT DATA—Two key market planning figures are average sales per employee of $10,000 and average sales per engineer of $83,000. These ratios are obtained by dividing the $12 billion total sales value of products produced by total number of employees and total number of engineers.

One can obtain an approximation of a competitor's business by these rough averages plus employment estimates based on plant size or size of parking lot.

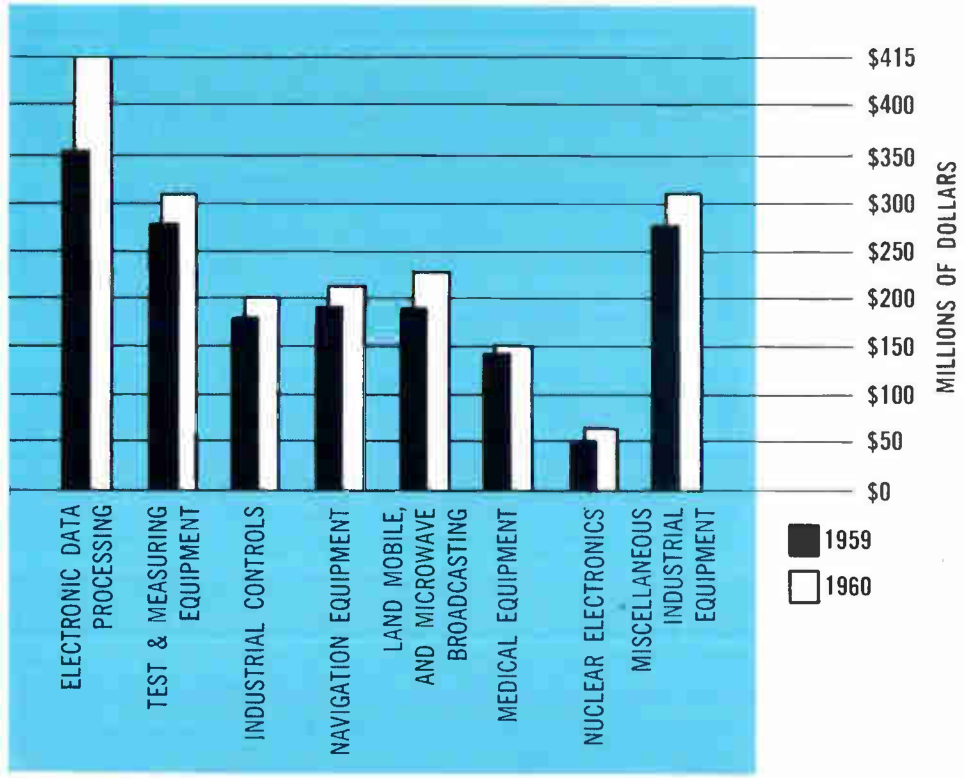
Market estimates based on average sales per employee within a specific type of business such as instrument or components manufacturing will be more accurate for estimating company potential than the overall industry average.

Average sales per employee varies in the electronics industry by type of product, as the table shows. Averages for instruments and controls, radio-tv, components and defense equipment manufacturers are shown.

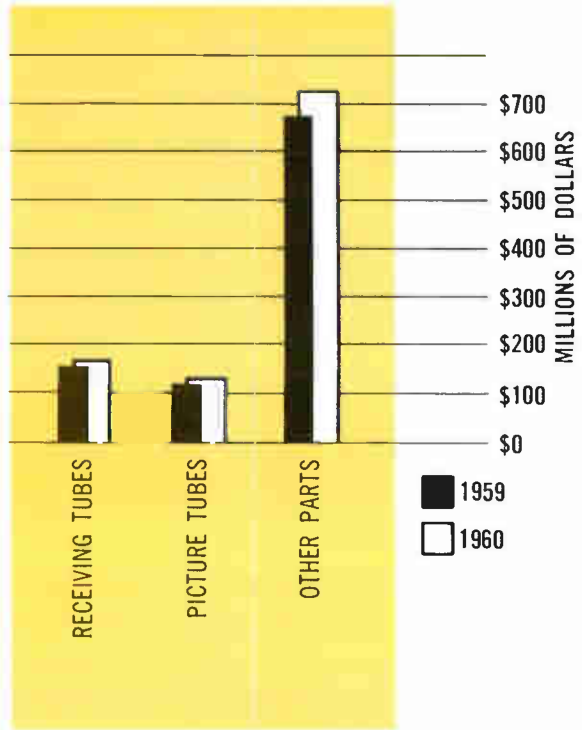
	Average Sales Per Employee		
Products	**Typical**	**Low**	**High**
Instruments & control equipment	$12,500	$10,200	$17,300
Radio-tv sets	17,300	13,100	22,600
Components	7,500	5,300	12,300
Defense equipment	11,500	9,100	15,100

the electronics market /60

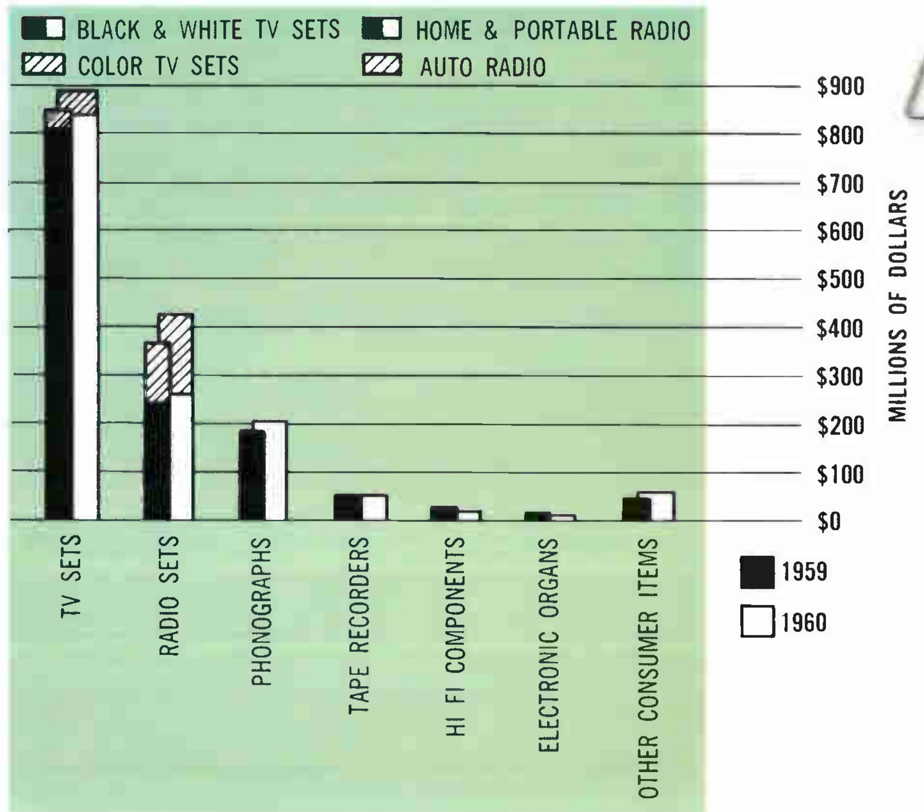
INDUSTRIAL ELECTRONICS



REPLACEMENT PARTS

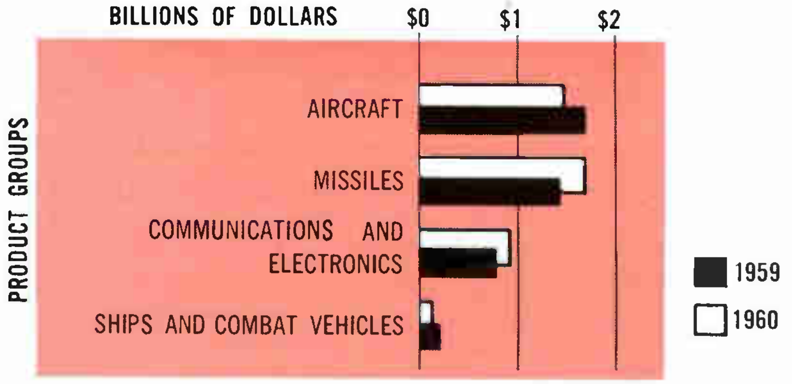


CONSUMER ELECTRONIC PRODUCTS

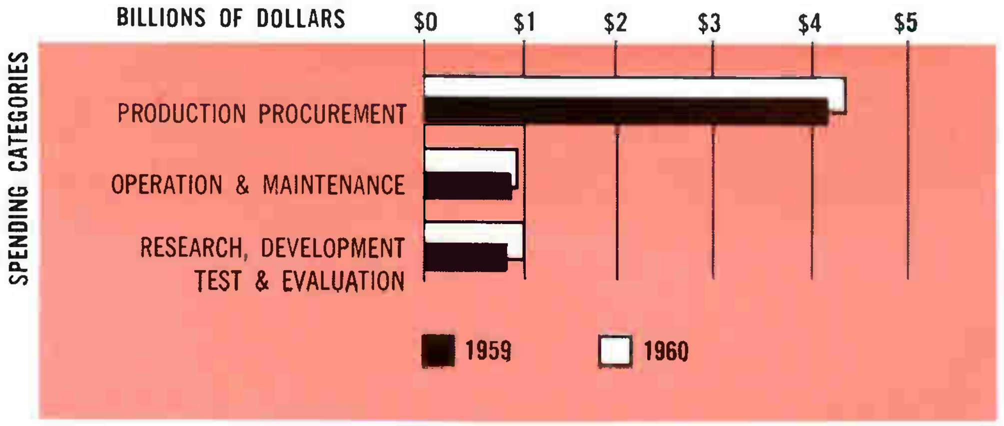


MILITARY ELECTRONICS PRODUCTION PROCUREMENT

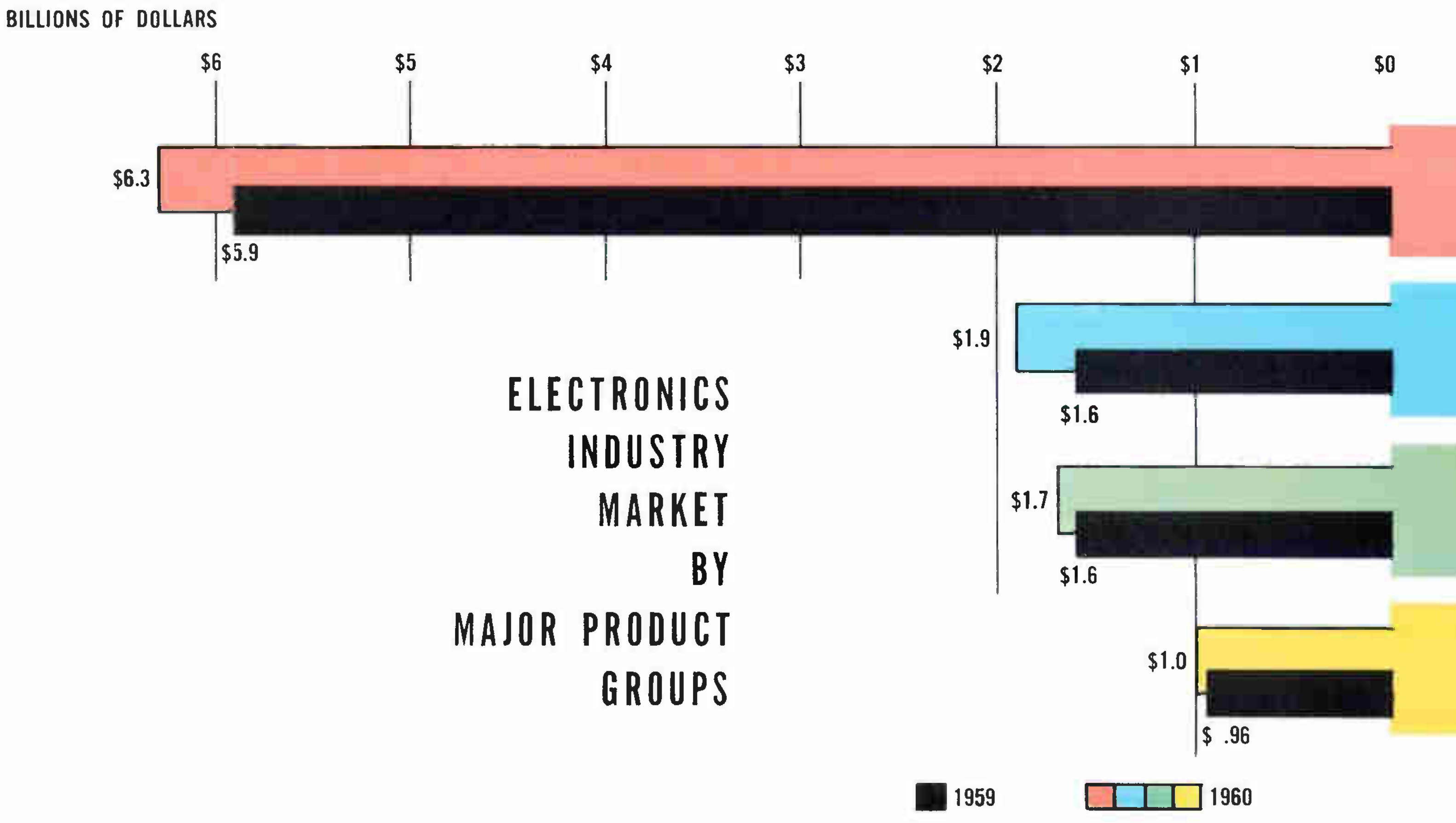
By Budget Groups

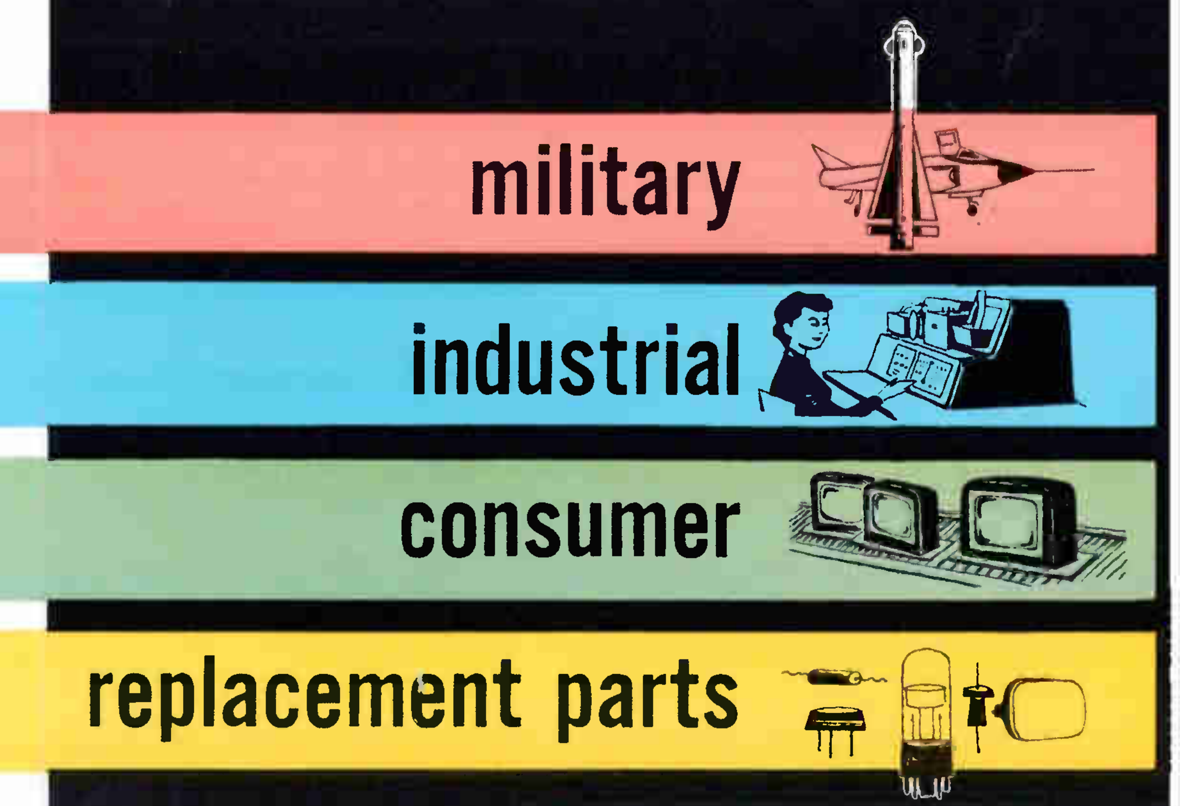


MAJOR MILITARY ELECTRONICS EXPENDITURES



ELECTRONICS INDUSTRY MARKET BY MAJOR PRODUCT GROUPS





Electronic Market Research Tables for '60

	1959	1960
	Billions of Dollars	
Military	$5.935	$6.311
Industrial	1.648	1.876
Consumer	1.585	1.697
Replacement Parts	.963	1.028

	1959	1960
	Billions of Dollars	
Research, Development Test & Evaluation	$0.870	$1.000
Operation & Maintenance	0.890	0.950
Production Procurement	4.175	4.361

	1959	1960
	Billions of Dollars	
Aircraft	$1.705	$1.513
Missiles	1.481	1.708
Communications & Electronics	.798	.963
Ships & Combat Vehicles	.191	.177

	1959	1960
	Millions of Dollars	
Black & White Tv	$802	$840
Color Tv	51	58
Home & Portable Radio	250	280
Auto Radio	128	145
Phonographs (1)	190	203
Tape Recorders	60	60
Hi Fi Components	30	28
Electronic Organs	24	23
Other Consumer Items (2)	50	60

(1) Excludes radio and phono combinations
(2) Includes: Garage Door Openers, Toys, Headlight Dimmers, Kitchen Devices and other items.

	1959	1960
	Millions of Dollars	
Receiving Tubes	$165	$173
Picture Tubes	124	135
Other Parts	674	720

	1959	1960
	Millions of Dollars	
Electronic Data Processing	$350	$415
Test and Measuring Equipment	275	310
Industrial Controls	180	200
Air Navigation	170	190
Marine Navigation	17	19
Land Mobile Radio	85	108
Microwave	35	50
Broadcasting	66	69
X-Ray	93	95
Other Medical	50	53
Nuclear Electronics	50	60
Commercial Sound	105	110
Other Communications	42	45
Tape Recorders	30	40
Theatre Television	42	45
Traffic Controls	13	15
Electronic Heating	25	27
Miscellaneous	20	25

Buying and Selling Abroad /60

Exports stabilizing; imports rising sharply. Japanese take nearly half of import business. U.S. investment abroad expanding rapidly

THE 1960's will bring a new era in foreign trade, one certain to see more management ties between U. S. and foreign electronics companies in both manufacturing and overseas contracting. A number of outside forces are combining to make our industry more truly international in both its technical and business character.

Some of these underlying forces of change in the world are:

(1) Further development of the European common market (Belgium, Netherlands, Luxembourg, West Germany, Italy and France) and the "outer seven" (Austria, Britain, Denmark, Norway, Portugal, Sweden and Switzerland), with perhaps an eventual combination of the two.

(2) Stiffer competition from European and Japanese firms, particularly in the Latin American market, but in Africa, the Middle East and the Far East as well.

(3) High U. S. prices, largely due to high labor costs.

(4) The growing strength of the Communist bloc in electronic technology, coupled with plans for expanded world trade.

One effect of these changes in the world economic picture has been the increase in overseas manufacturing and licensing by American electronics companies (ELECTRONICS p 27, Jan. 24 '58). This trend has been increasing steadily and most observers expect that it will accelerate, even in Canada, long the biggest export market for U. S. electronic equipment.

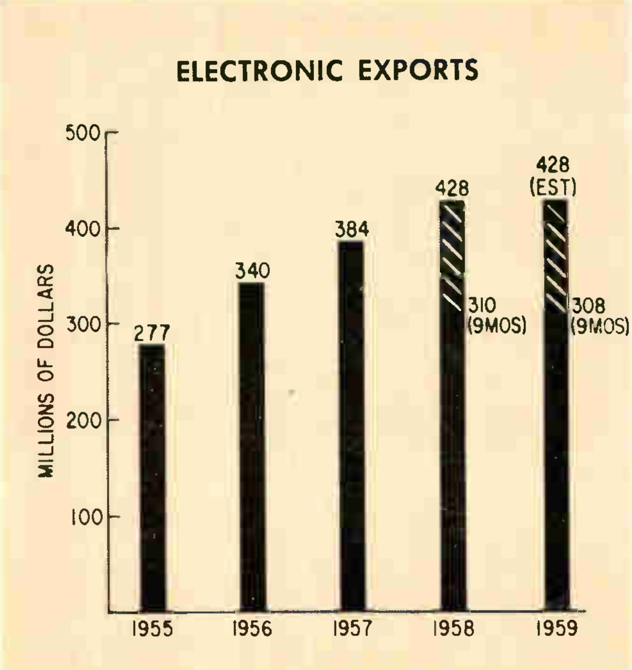
International divisions of big manufacturing firms are now operating under policies that were unheard of a few years ago. One official told ELECTRONICS that his company's new international marketing approach is to manufacture anywhere to sell anywhere else, depending on costs, demands and profits.

EXPORT PICTURE—Outlook for regular export of electronic equipment and products appears to be fairly steady for the time being, with growth of dollar volume limited in the long-term view. Consumer goods exports are more likely to diminish than industrial products.

Statistical data compiled monthly by the Department of Commerce for all export commodities contains 43 electronic items. These are separately tabulated by the international division of Electronic Industries Association.

In 1958 the 43 electronic export categories totaled \$427.6 million, a 10-percent rise over the 1957 total of \$384.3 million.

For the first nine months of 1959 these exports amounted to \$308.3 million compared to \$310.4 million in the similar period in 1958. Total 1959 exports



should, therefore, be close to last year's total of $427.6 million.

Biggest single export category, Radio Communications Equipment, totaled $123.4 million in 1958. Hot item in this category right now is single-sideband mobile and fixed long-range systems. Relatively inexpensive systems are being sold widely abroad for police, military and industrial use. Such systems are said to be finding a good market in many under-developed nations.

One specialist believes that single-sideband equipment, along with scatter transmission gear and broadband microwave relay equipment will constitute big export business for at least the next two to three years.

Second leading export category is Electronic Detection & Navigational Apparatus. Dollar volume amounted to $44.2 million in 1958.

COMMON MARKET—What's been the effect of the common market so far on electronic exports? Will there be much change in the next few years?

"It is too early to assess effects of the common market on U. S. exports to Europe," replied an authoritative source. "However, (recent) loosening of European restrictions on dollar imports should compensate for potential loss from the common market and the "outer seven."

"We believe that U. S. mass-produced products of advanced types will always find overseas markets.

"No great expansion is seen in the export market; U. S. firms may realize greater benefits from their electronics plants or investments in the common market area."

Said an executive of an international division:

"The common market is having a serious effect. We are accelerating our activities in the European common market countries and, in fact, all over the world. We think other electronics companies are doing the same thing—they should be." He said such "activities" included stock participation in joint venture firms overseas.

LATIN AMERICAN EXPORT—Is electronic export to Latin America faltering? What is the outlook?

"Electronics exports to Latin America remain stable," says a reliable source. "This market received approximately the same share of total U. S. exports of electronics during each of the last three years."

However, persons close to the Latin American trade picture told ELECTRONICS that the Cuban political situation was adversely affecting trade. Cuba has consistently been a leading Latin American market for electronic equipment, mostly in the consumer field. One U. S. company said its sales to Cuba have fallen sharply this year but reports that increased sales to Venezuela have made up part of the Cuban loss.

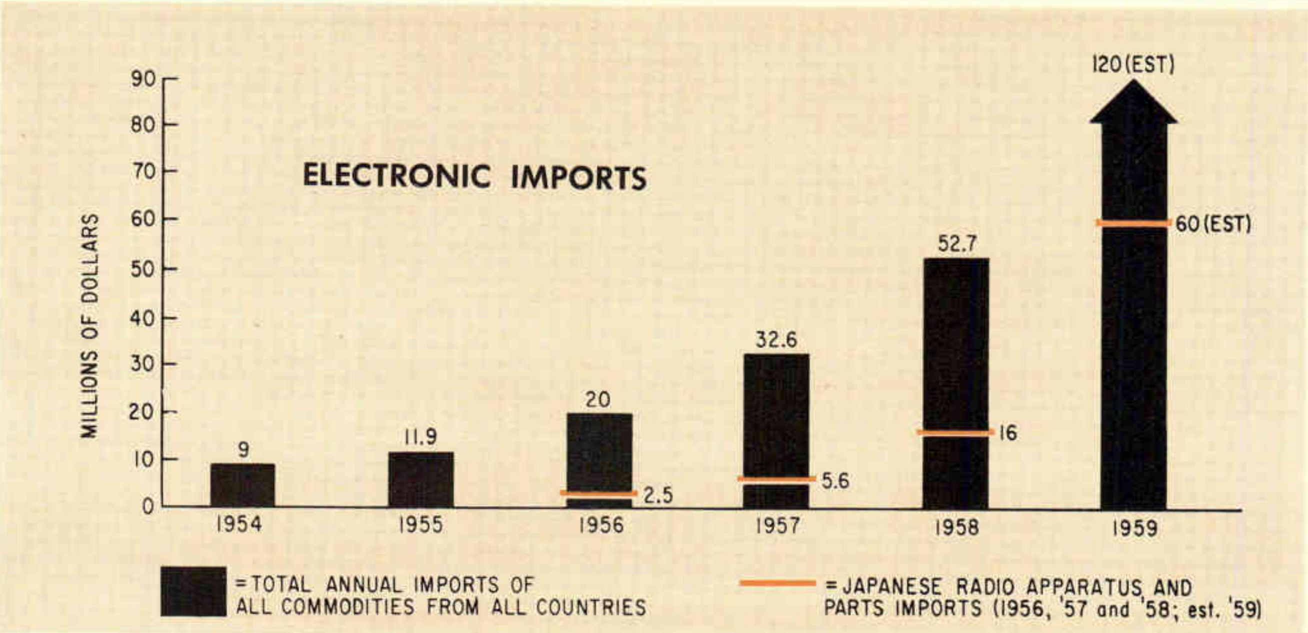
In the consumer field, Latin American demand is strongest for stereo high-fidelity equipment and television sets. On the industrial side, demand is strong for microwave equipment.

Interest in data-processing gear is growing. IBM World Trade Corp. recently reported realignment of its Latin American organization "with an eye toward the expanding economies of Latin America."

Industrialization of the Latin American countries is changing the nature of the market for U. S. electronic equipment to some extent. Peru, Argentina, Uruguay and Paraguay are buying more consumer gear in the form of component kits and chassis and are assembling sets themselves. As a result, says one U. S. firm, it is emphasizing parts marketing in these countries.

Consensus of American specialists in Latin American trade interviewed is that competition from Japan, West Germany and the Netherlands will increase.

Many foreign companies, backed by special government banking operations, offer the Latin American



LEADING EXPORT COMMODITIES

LEADING EXPORT COMMODITIES	1958	1959 (9 months)
Electrical & Electronic Characteristics Testing Instruments, and Special Parts and Accessories	$ 12,452,662	$13,417,304
Radio Communications Equipment	123,403,791	69,881,943
Television Receivers w/Cabinets	20,234,456	12,506,485
Receiving-Type Tubes	17,859,207	11,057,793
Television Picture Tubes (Cathode-Ray)	14,682,800	10,528,931
Electron Tubes	12,786,795	9,333,475
Diodes & Transistors	7,777,812	6,460,596
Electronic Detection & Navigational Apparatus	44,174,697	35,030,192
Recorders (Disk, Tape, and Wire, and Special Parts & Accessories)	12,187,071	8,039,475
Electronic Equipment & Special Parts and Accessories	31,792,440	25,850,728
Electronic Computers, Related Information Processing Machines, & Accessories	14,883,464	12,167,563
Coin-Operated Phonographs, New	11,668,264	8,808,667

countries long-term payment plans running as long as eight years. The foreign government backing the seller takes the credit risk. American firms can't usually afford such attractive terms based on their own resources.

In some instances competition makes strange bedfellows. An American firm that may compete tooth-and-nail with a European concern on one project may offer a joint bid with the same company on another contract, perhaps even vying with another U. S.—European combination.

One executive sees a trend towards building electronic equipment in the Latin American countries to take advantage of any preferred treatment given to the development of industry in those countries.

IMPORT PICTURE—Imports of electronic components, instruments and equipment have shown a sharp rise in the last five years but last year totaled only about one-eighth of the dollar volume of electronic exports.

A check of some 16 Department of Commerce import categories discloses a total import volume of $52,659,021 in 1958, up steeply from the previous year's total of $32,557,472. Observers feel the 1959 total may reach $120 million. Japanese imports may account for half of this total. Graph on previous page shows six-year import picture.

Of special interest to many U. S. electronics firms are the imports from Japan in the category labeled "Radio Apparatus & Parts." This is the top category in dollars, accounting for more than half of the value of 1958 imports. Imports from Japan in this category are rising sharply.

In 1956 Japanese radio apparatus and parts amounted to $2.5 million. Total for all countries was $8.5 million. Total import volume for all electronic items from all countries was $20 million.

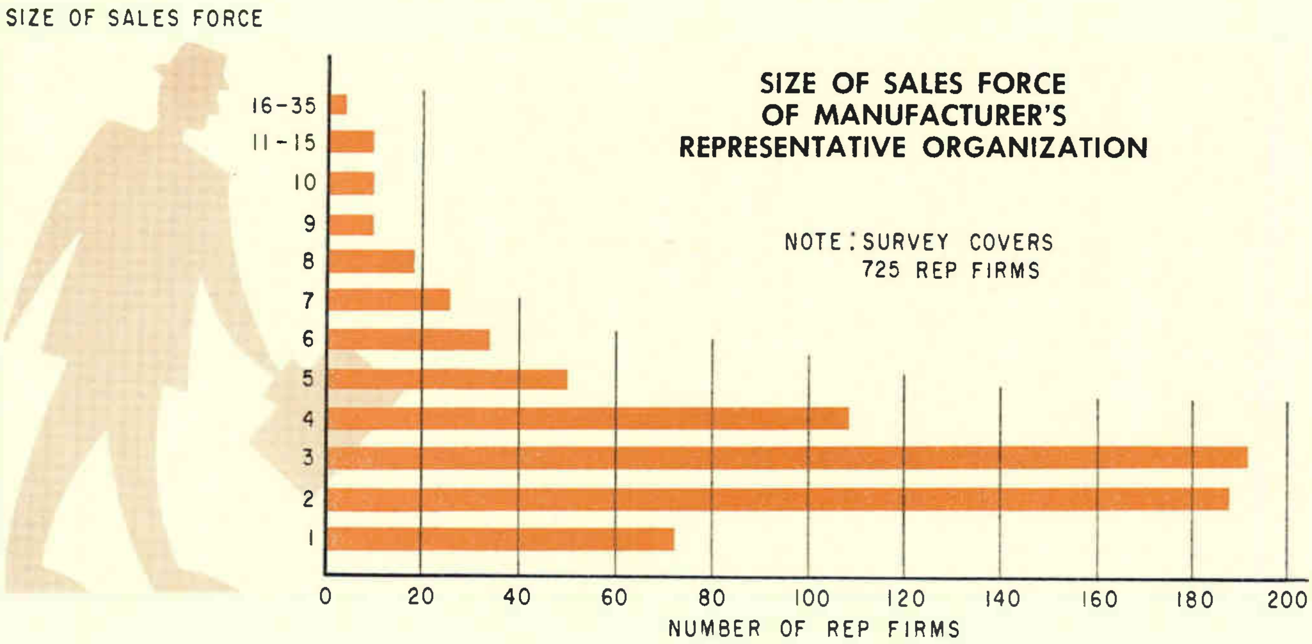
In 1957 the same imports from Japan rose to $5.6 million. Radio apparatus volume for all countries was $15.3 million. Total import volume was $32.6 million.

Last year $16 million worth of Japanese radio apparatus and parts helped boost the total for that category to $28.2 million and the grand total for all imports to more than $52 million.

In the first nine months of 1959 imports of Japanese radio apparatus amounted to $30.8 million. Radio apparatus imports from all countries in the same period totaled $43.3 million. Based on last year's performance, imports of Japanese equipment may reach $60 million in the year just ended.

Getting Our Goods

New approaches to today's changing electronics market are developing new patterns of doing business



VITAL TO THE FUTURE of our industry are the channels of distribution used to get electronics products to market.

Electronics companies sell their products through three basic channels: representatives, distributors and internal company sales organizations.

REPRESENTATIVES—The nature of the electronics industry today is such that manufacturer's representatives are an important link in the distribution chain. The great number of small manufacturers and the emphasis on the military market are two factors in favor of the representative.

The newly formed small company is often unable to put its own sales force in the field and therefore turns to the rep. Since he is paid usually in accordance with his sales performance he does not present the problems that arise when a small firm must maintain salaried company salesmen.

Although the one-man operation is not rare among rep organizations today, there are more larger groups today than in previous years. Expanded product lines and services have often brought about growth to two-man and three-man teams. The three-man team is presently the most common. Some organizations contain as many as 35 persons. (See chart above).

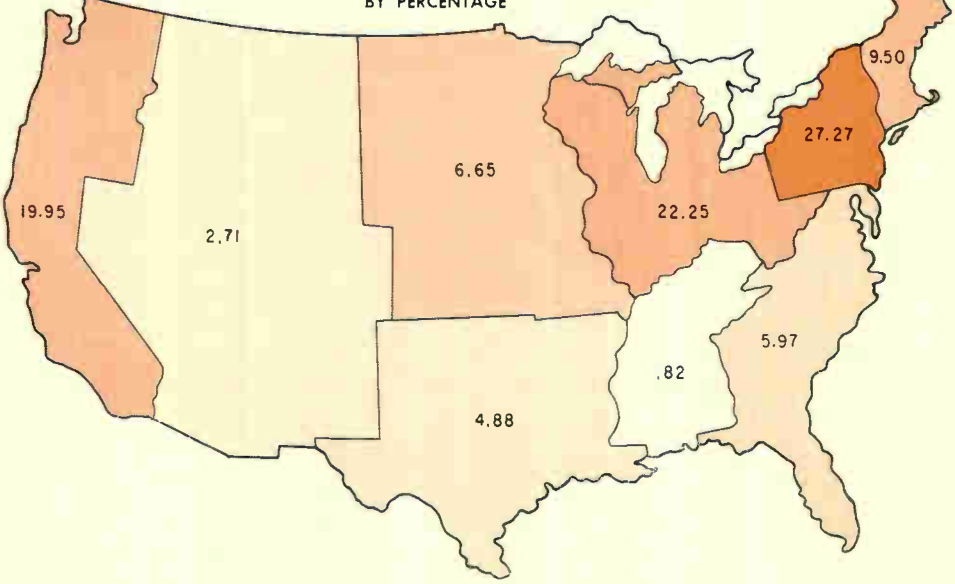
MORE WAREHOUSES—A survey made by ELECTRONICS in 1957 revealed that 50 percent of the representatives questioned maintain warehouse facilities. A similar survey in 1959 found that 53 percent had warehouses. These facilities often reflect expanded lines and usually contain mailroom facilities and service areas for calibration and repair work.

Rep organizations presently number about 1,500 and employ approximately 4,000 persons.

The greatest concentration of rep organizations is in areas of the country where the greatest amount of electronics activity occurs. (See chart next page).

OTHER PATTERNS—Expanding product lines of many electronics manufacturers have brought about a condition where a company may have more than one rep in the same territory. A representative generally

to Market in '60



does not handle competing items. At times a company may want him to take on some new product which would compete with a product he already handles for another manufacturer. To avoid this, the firm will engage another rep to handle the new product leaving the remainder of the line in the hands of the original man. Some complicated situations are arising because of this.

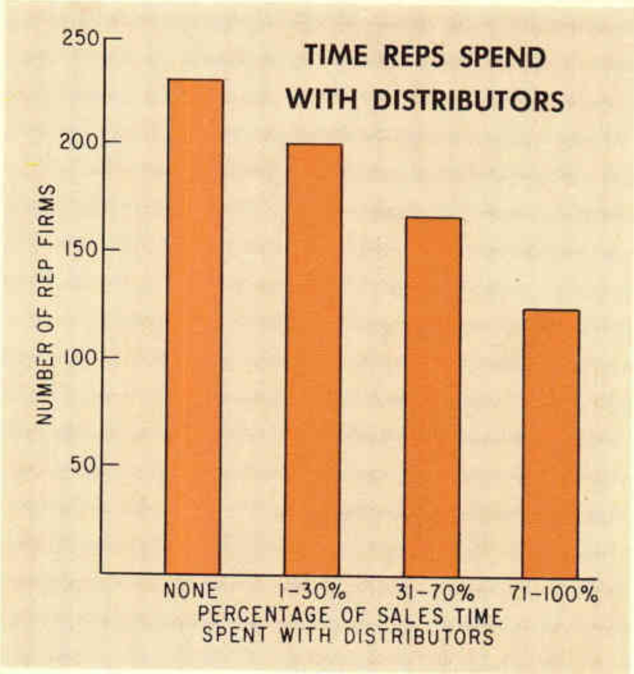
One aspect of the rep business centers around the amount of time reps spend with distributors. Most reps spend a majority of their time with original equipment manufacturers or end users. (See chart, left, next page).

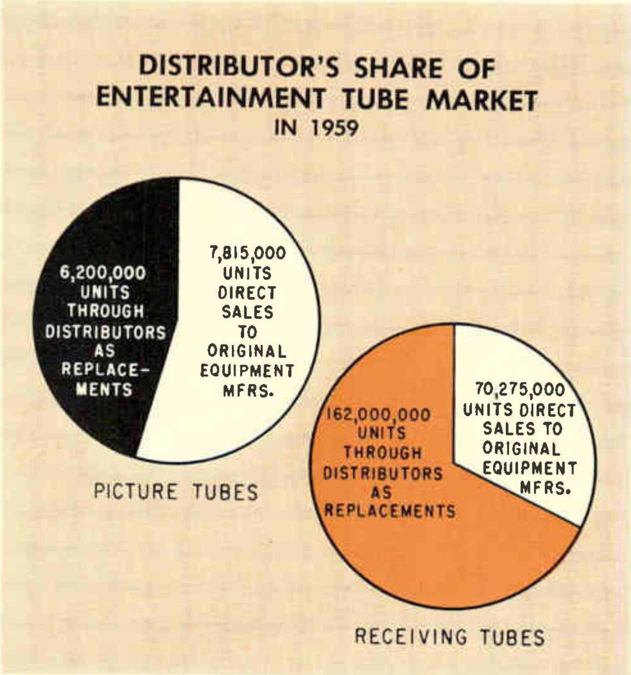
A large percentage of reps spend no time at all with distributors. One explanation of this is that distributors in general handle standard items that move quickly in small lots. These can often be obtained by direct purchase from the manufacturer.

LISTENING POSTS—One function of the manufacturer's representative now gaining prominence is the operation of "listening posts" in commercially strategic military market areas. A company too small to maintain offices in such places as Washington, Dayton, Los Angeles and other centers of military activity will engage the part time service of a representative. This man is paid according to the amount of time he spends in the manufacturer's behalf.

COMMISSION RATIOS—At one time a rule of thumb on commissions to representatives called for 5 percent on components and 15 percent on instruments. This rate today is no longer realistic. Rep commissions now range from as low as ½ percent to 25 percent or more. The determinants are more varied in today's electronics market. The manufacturer and rep consider the amount of competition, the nature of the product and the initial acceptance of a new item in arriving at a commission scale. Also to be weighed is the experience of the rep organization in similar product areas and the regional sales potential.

PRIME MOVERS—The distributor moves the bulk of standard replacement electronic products where





sales are not made directly between maker, user.

There are presently more than 1,800 electronics distributors throughout the United States. Ten years ago there were less than 800. They conduct their business from about 2,500 locations including branches and will net a total dollar volume in excess of $700 million this year.

The number of distributor organizations has climbed appreciably in recent years. In 1957 close to 50 new companies were started. In 1958 some 40 additional firms were formed. The figure for 1959 runs to about 35 more.

TWO QUALITIES—Manufacturers seek two characteristics today in distributors: sales knowhow and adequate financing. One major component manufacturer puts it this way, "I don't care how bright an engineer a distributor is. If he can't sell what I make and if he doesn't have enough money to keep an even keel, I can't use him."

Manufacturers expect the distributor to know and exploit local conditions to the advantage of product sales. He is backed up from the factory with mailing pieces, display items and national advertising campaigns. Expenses incurred by the distributor for advertising may be shared with the manufacturer. This percentage of manufacturer assistance is often predicated on volume of sales made by the distributor.

COST OF DOING BUSINESS—Since the early days of the electronics marketing business, cost of doing business has grown along with the industry. Manufacturers today estimate that a product can increase in price as much as 2½ times between the factory door and the end user.

The geographic growth of the electronics market has resulted in price inequalities due to differing transportation costs. Increased product lines act to raise the cost of inventory taking. Salaries have risen and so has general overhead.

The distributors are aware of these problems and are taking steps to overcome them. In the matter of geographic spread, manufacturers are working with distributors by encouraging bulk shipments whenever possible because of the reduced freight rates available. In addition, there are increasing numbers of manufacturer's regional warehouses which allow the distributor to take advantage of bulk shipping without imposing undue strain on his own storage and inventory facilities.

This method of handling large quantities of components is particularly useful in the replacement market of entertainment tubes. With few exceptions, this market is served through distributors. (See chart above, right). In 1959 almost half the total number of picture tubes shipped by manufacturers went to distributors as replacements. Of a total of more than 232 million receiving tubes shipped last year, 162 million went to distributors.

CHANGING MARKET—The immediate future may find some evolutions taking place in the functions of both the representative and the distributor.

Present military procurement patterns are showing a tendency to run to specialized equipment. If this trend continues, it should mean an increase in volume for reps. It is possible, however, that distributors may be attracted by this growing volume and begin strengthening their technical sales forces.

Another trend is a tendency of some reps to trim their product lines. This is being done to allow individual salesmen to concentrate on specific product areas. It is also coming about because manufacturers are showing reluctance to place their sales prospects in a situation that may find other items taking precedence in the selling efforts made by the rep.

The new concept of electronic equipment manufacture

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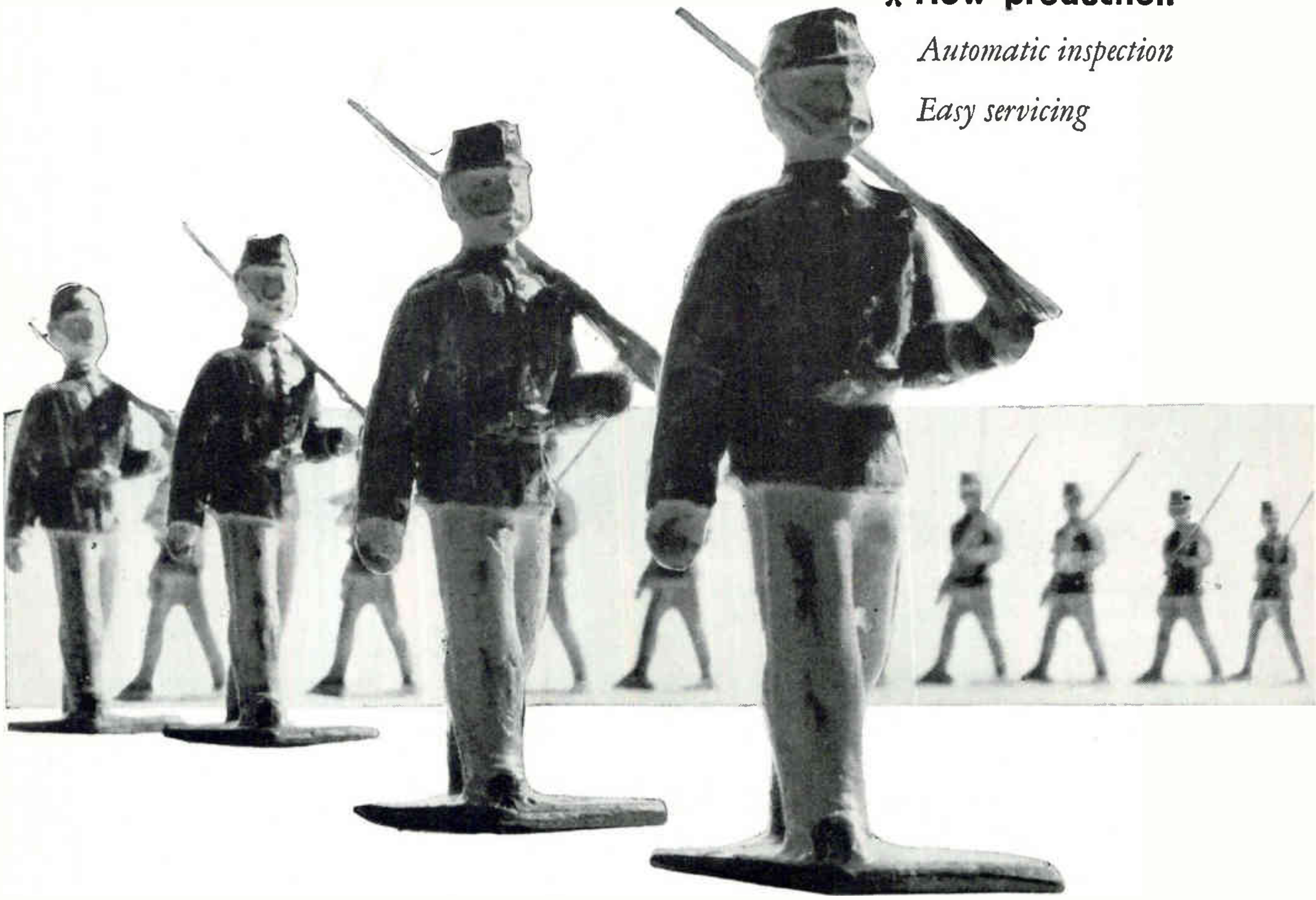

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Measuring ranges:
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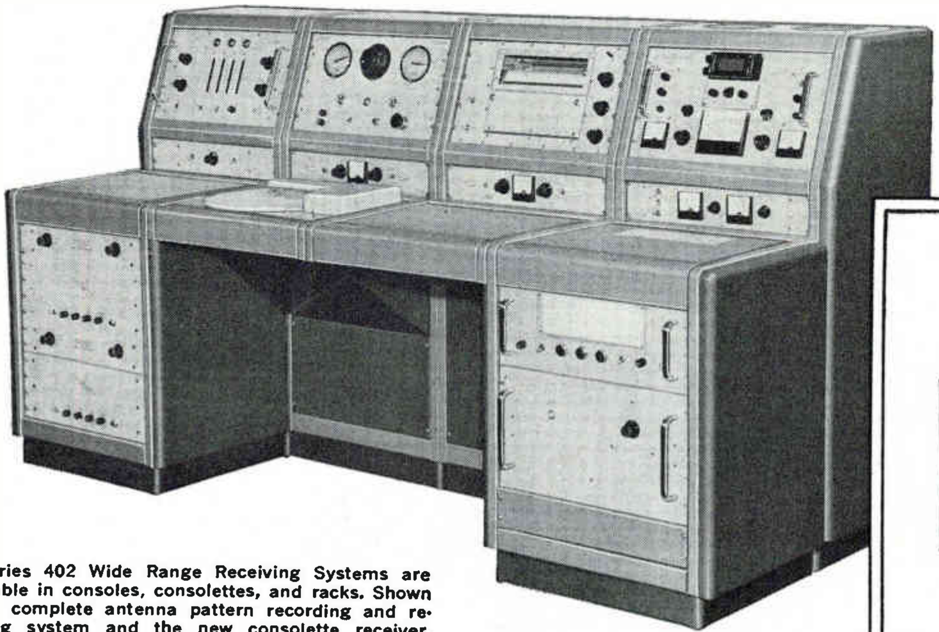
Input impedance:
in range A: 1 MΩ ($\pm$ 1,5%) //15 - 20 pF
in range B: 100 MΩ ($\pm$ 1,5%) // 10 pF
Overall accuracy: 3% $\pm$ 5 μV.
Deflection of pointer: always positive; polarity is indicated by 2 lamps
Mains supply: 110 ... 245 V; 50...100 c/s
5" scale with mirror reading

The price - a pleasant surprise

MAJORS and MINORS

. . . A Message to the Antenna Designer



● Series 402 Wide Range Receiving Systems are available in consoles, consolettes, and racks. Shown are a complete antenna pattern recording and receiving system and the new consolette receiver.

A crowded spectrum plus high power radar and communication systems critically compound the problems of the antenna design engineer.

More than ever, the complete pattern including **all** the major and minor lobes of every radiating element must be graphed for sound engineering evaluation.

S-A Receiver Gets the Whole Signal

Scientific-Atlanta Series 402 Wide Range Receiving Systems are specifically designed for antenna pattern measurements. Unique in design, these receivers combine maximum sensitivity and linearity from 30 mc to above 100 kmc. They are also useful as multipurpose laboratory instruments for microwave testing, monitoring, and measuring applications.

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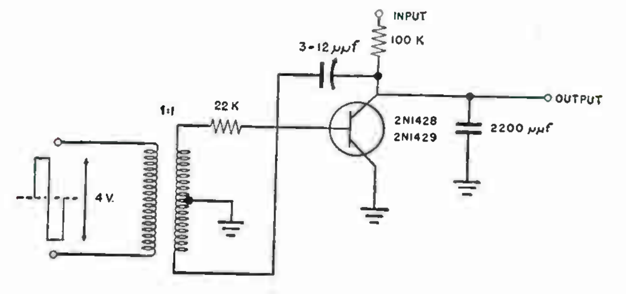

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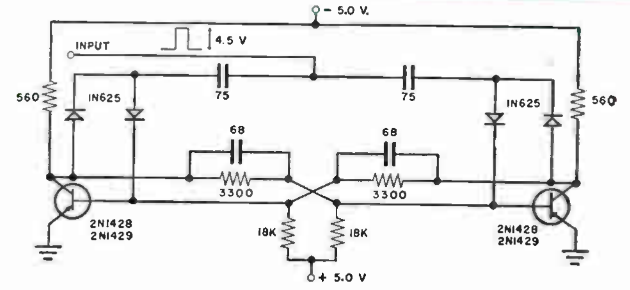

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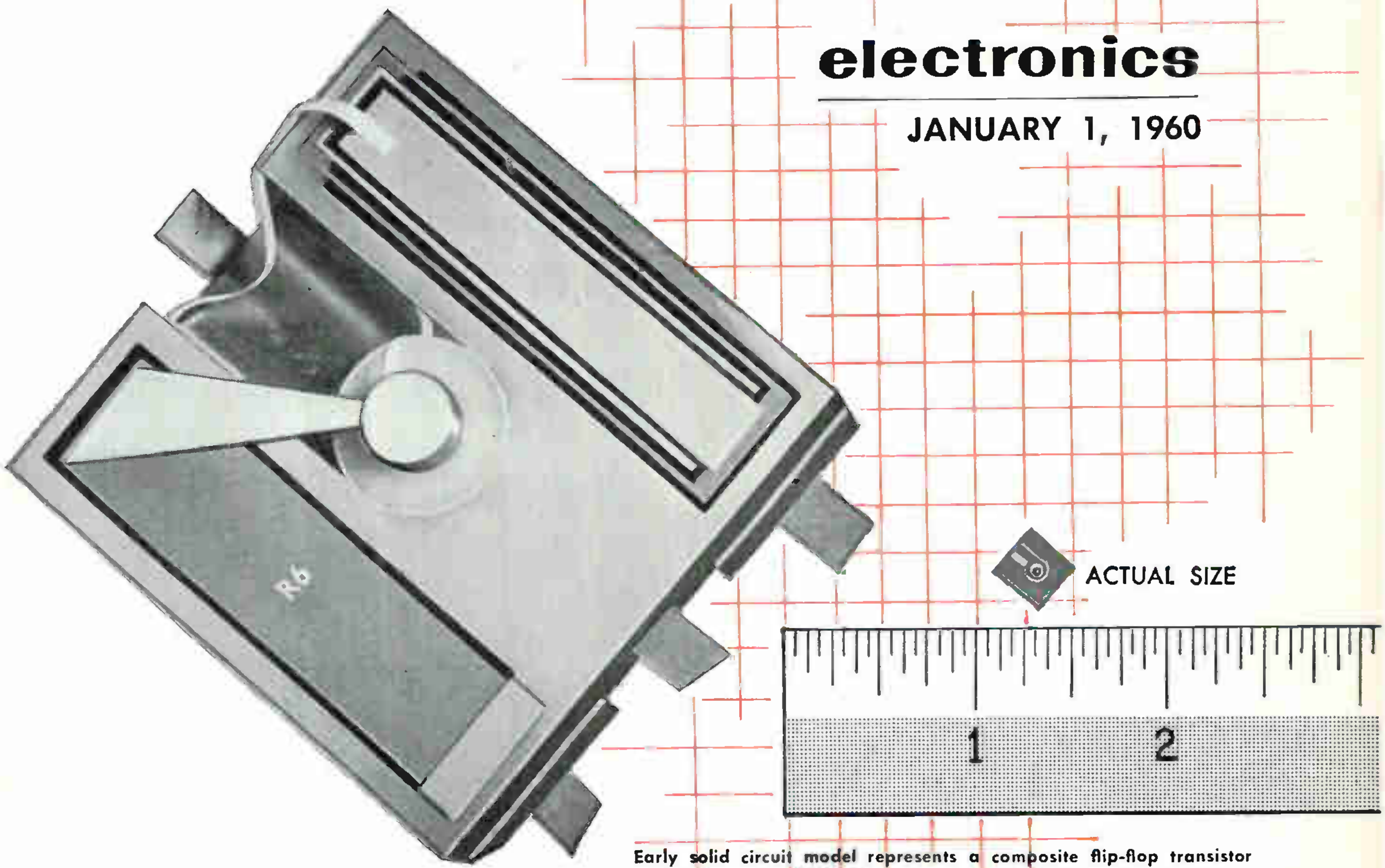


Early solid circuit model represents a composite flip-flop transistor with associated components deposited on its surface

British Approaches to Microminiaturization

Four approaches to microminaturization are outlined. Circuit and solid assemblies are discussed in detail. Problems common to all microminiaturization methods are presented

By G. W. A. DUMMER, Head of Environmental Testing, Components and Construction Techniques, Royal Radar Establishment, Ministry of Aviation, England

MICROMINIATURIZATION has been made possible by the change from tube circuits to transistor circuits, and is now being emphasized by the ever increasing developments in solid state physics. There are two main reasons for developing microminiature techniques: a significant reduction in size and weight and the possibility of increased reliability.

It is this second point which may contain the real value of microminiaturization techniques, particularly from the military point of view. At present, under laboratory conditions, the average reliability of electronic equipment in the United Kingdom is approximately five failures per 1,000 components per 1000 hours life. Failures may be many times higher

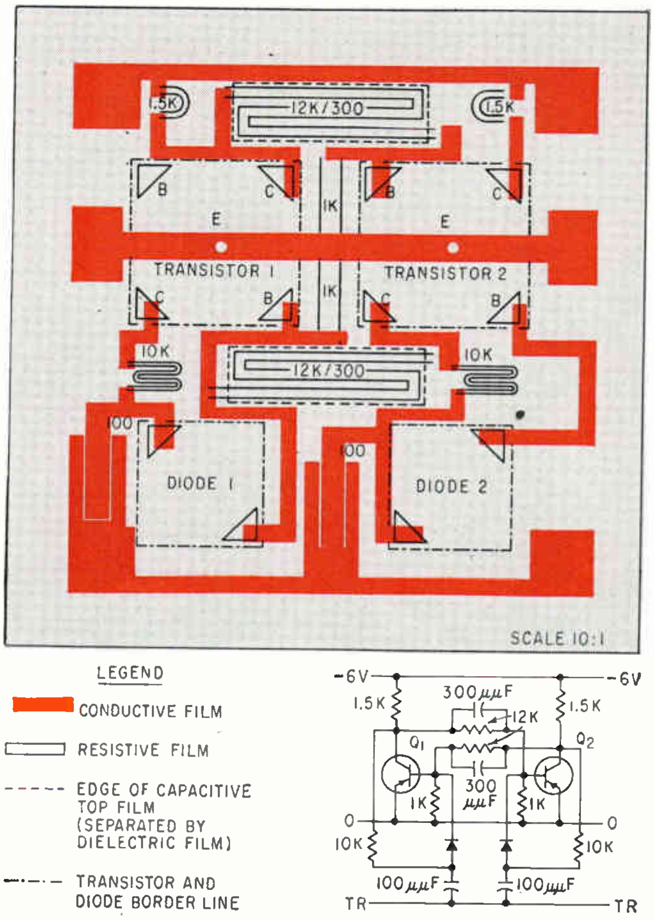


FIG. 1—Proposed layout and circuit diagram of binary counter microcircuit. Module measures ½ × ½ in.

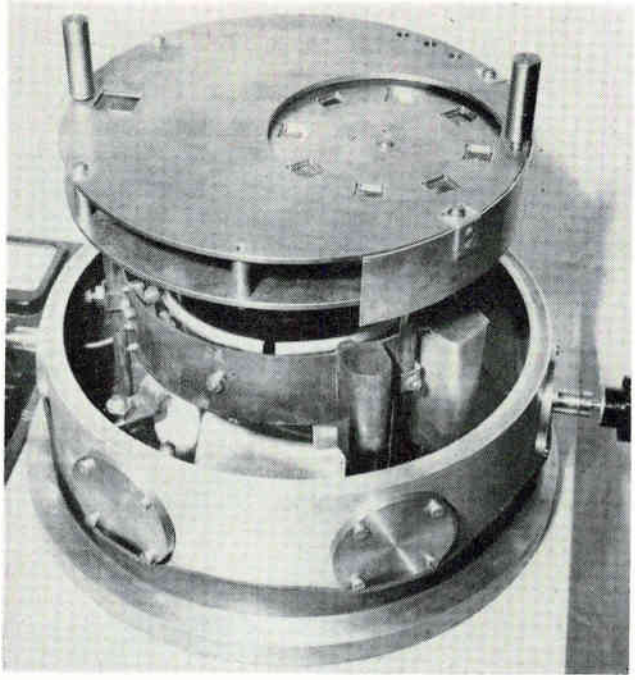


FIG. 2—Evaporation machine has 224 possible masking combinations

under arduous military conditions, particularly in the missile and airborne radar equipment.

Considerable work has been done on improving reliability of conventional tubes and components. In certain cases failure rates as low as a few in 10,000 may be achieved, but this has to be achieved over a whole range of components in a complete equipment. In the author's opinion, failure rates of this order (0.01 percent per thousand hours working life) represent the highest practically achievable with conventional components and present manufacturing techniques.

There has been a steady reduction in the size of tubes and components, from the so-called miniature components to the present range of subminiature components associated with transistors. The low voltage requirements of transistors circuits have enabled components to be designed using almost watchmaking techniques. This again has reached a limit in reliability, as any further decrease in size of conventionally shaped components will undoubtedly result in a further decrease in reliability.

ASSEMBLY TECHNIQUES—There are four possible approaches to microminiaturization:

1. Components Assemblies—single or multiple components on plates stacked and connected by riser wires (Micromodule System).
2. Circuit Assemblies—single complete circuit function on a plate.
3. Solid Assemblies—true solid circuits—single crystals with controlled resistivity areas, etc.
4. Sealed Tube Assemblies—microminiature components sealed in subminiature tube cases.

MICROMODULE SYSTEM—This component assembly system is well known in the United States and in the United Kingdom. It was sponsored by the United States Army Signal Corps Research and Development Laboratory, with RCA as the main contractor. Geared to production of micromodular equipment for Army use, the system is based on a module 0.31 in. square. The system has been described elsewhere. (ELECTRONICS, p 49, Dec. 11, 1959)

The main advantage of micromodules is that com-

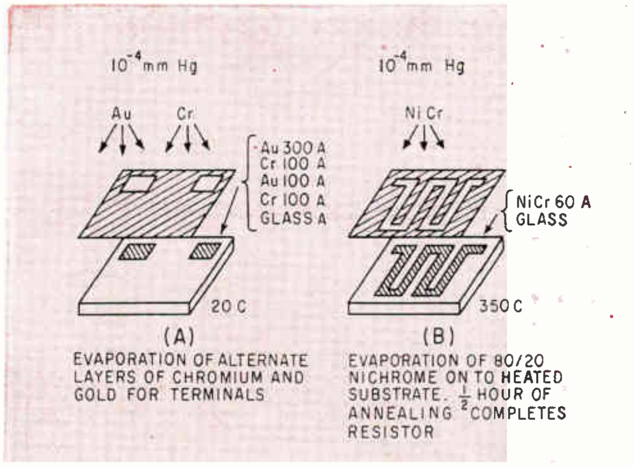


FIG. 3—Method of making evaporated film resistors is outlined

ponents can be tested individually before final assembly. It will be interesting to see how reliable the system proves in practice.

CIRCUIT ASSEMBLIES—Here, a flat plate or substrate is processed to form conductors, resistors and capacitors with transistors and diodes inserted to form a complete circuit function. The construction is almost entirely two-dimensional. This technique lends itself to evaporation processes.

The advantage of this system is that there are less connections between units, but the reject rate of each individual component must be low indeed.

Work at the Royal Radar Establishment has been on this system in preference to the component assembly system, and small, complete circuit functions have been the target. A ½″ × ½″ module has been chosen which can be extended in two planes to become ½″ × 1″, 1″ × 1″, ½″ × 2½″ or any multiple of ½ in. A simple bistable circuit, to be used in a computer, is being constructed. Consisting of eight resistors, two capacitors, two transistors and two diodes, the circuit is shown in Fig. 1.

Some time has been spent in designing rotating work holders in the vacuum chamber used to make resistors and capacitors. Figure 2 shows a holder capable of holding eight plates with seven separate masks and four evaporation sources, making a total of 224 possible positions. Copper masks are made by photo-etching techniques.

FILM RESISTORS—Near the start of the microminiaturization work, it was decided that carbon mix and similar types of resistors would not be used and all the work at the Royal Radar Establishment would be aimed at inorganic resistive materials. A considerable basic study of the processes and substrates is underway and contracts have been placed with research associations under which special studies of binding energies between films and substrates are being made. Particular studies are devoted to depositing nickel-chromium on glass.

Nickel-chromium deposition work is divided into two processes, one for resistors with line widths above 0.015 in. and one for resistors composed of narrower lines.

Resistors with wide lines are made by evaporating nickel-chromium directly on to a heated substrate, the final thickness of the nichrome being approximately 60A. Simple pattern meandering is made by mechanical masking and the resistance elements are annealed at 350C for at least half an hour. This method of obtaining film resistors and their terminals is shown in Fig. 3.

Resistors with line widths down to 0.004 in. are made by deposition of an intermediate layer of copper which is photo-mechanically processed. Deposition of the nickel-chromium on to the heated substrate follows in the usual way. Next, the copper mask is etched away, lifting the superfluous nickel-chromium with it and leaving the required pattern. Annealing follows in the usual way. The stages in the development are shown in Fig. 4.

CAPACITORS AND DIELECTRICS—Using evaporation techniques, both silicon monoxide and magnesium fluoride capacitors have been made experimentally for low voltage operation, but a thorough understanding of the mechanism of adhesion is the prime object of the work. Many research contracts have been arranged to implement this program and four universities are advising the Royal Radar Establishment in this work.

Most of the work at the Royal Radar Establishment has been done with an 18 in. vacuum unit fitted with electrodes for ionic bombardment cleaning, a sub-

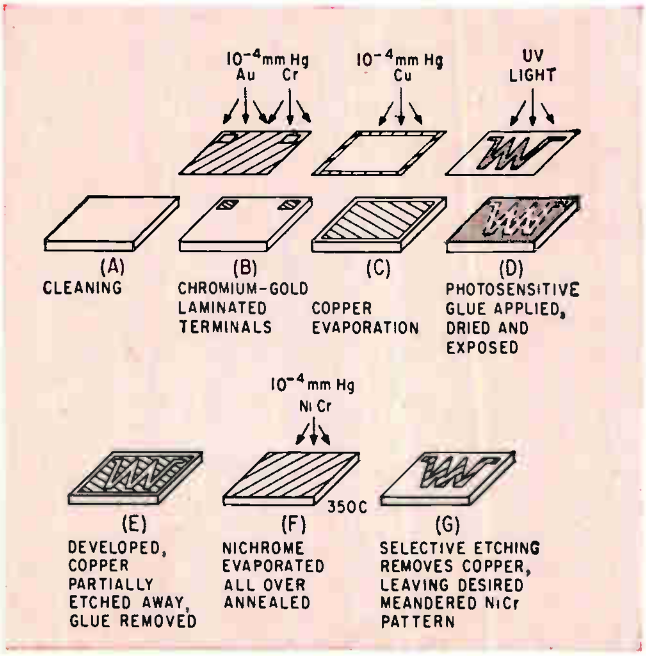


FIG. 4—Stages in production of high-definition film resistors

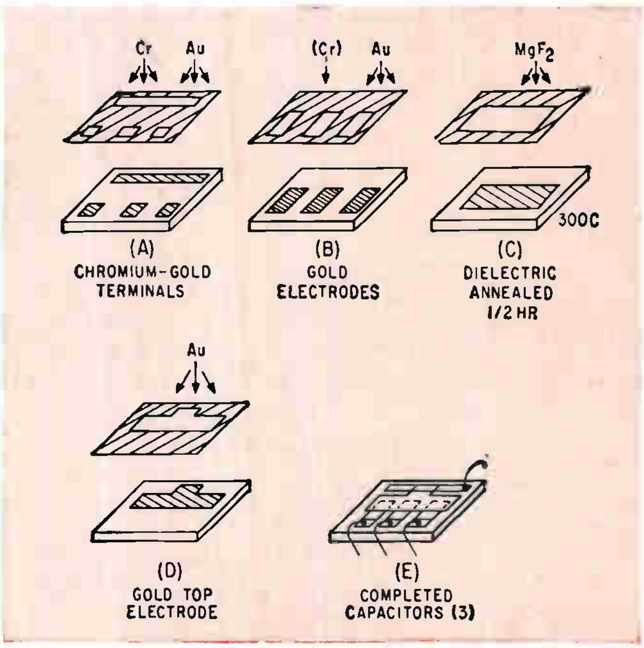


FIG. 5—Stages in production of magnesium-fluoride-gold capacitors

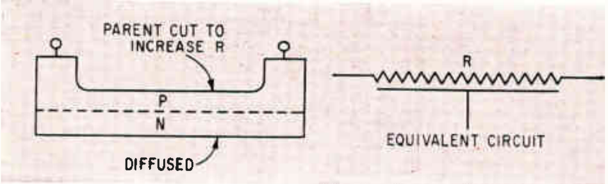


FIG. 6—Doping is used to obtain distributed components from silicon block

strate heater and multiple sources. Glass microscope slides were employed as substrates, although surface imperfections make them far from ideal. Suitable masks were arranged to allow evaporation of four capacitor specimens, each having an area of 0.6 sq cm, on one slide.

Aluminum, chromium, gold, copper and silver were all tried as electrode materials. The most consistent results were obtained with aluminum and this was used for all later work. Initial experiments used magnesium fluoride and zinc sulphide as dielectrics since these were known to be easy to evaporate. Capacitors were made with magnesium fluoride and it was found that films thicker than 5,000A had a tendency to craze but heating the substrate during deposition can prevent this. Figure 5 shows the stages in the process. Zinc sulphide gave good results and thicker films were easy to obtain. Atmospheric moisture, however, caused deterioration over a period of weeks.

Most of the Royal Radar Establishment work has been on silicon monoxide. Initially pure resublimed lump SiO was used but caused spitting from the boat. Mixtures of Si and SiO_2 gave improved results. For best electrical properties, slow evaporation rates, (10-15A/sec), heated substrates and a small residual air pressure (1-3 $\times$ 10^{-5} cm Hg) were all required.

CONDUCTORS—The conductors now used consist of layers of evaporated chromium and evaporated gold, starting with chromium which adheres to the base. The conductors are evaporated on to the cold substrate using mechanical masking techniques. Lines produced by masking techniques can be as narrow as 0.01 in., and the mask apertures are made by etching through copper protected by photo resists.

Most of the work to date has been done on microscope glass slides containing high soda content, as this most nearly matches the expansion coefficient of the evaporated nichrome resistors. It is essential to have a flawless surface for high-resolution pattern resistors. Ceramic substrates have been investigated but do not possess a sufficiently smooth surface. Ion migration in glass should not be a problem as the operating temperature of the substrate is not expected to be above about 80C when germanium is used. Even for silicon transistors the temperature will not be above 150C.

Consultants in the United Kingdom are preparing substrates of various glasses and various expansion coefficients for the Royal Radar Establishment, while glass-faced ceramic substrates are also being investigated to provide higher mechanical strength.

SOLID ASSEMBLIES—Experimental work in doping silicon and germanium crystals has shown that it is possible to control resistivity in parts of the crystal. Capacitance can be produced by using *p-n* junctions. Thus, both active and passive circuit elements can be incorporated in a single block. Provided control conditions are adequate, the intrinsic reliability of such a device should be high. Simple multivibrators and oscillators can be produced by diffusion, evaporation, electrolytic and chemical forming, ultrasonic cutting of the crystal and similar processes.

Doping techniques in silicon are being investigated and a distributed component network has been made by diffusing in *n*-type impurities and cutting to shape as shown in Fig. 6. This formed the basis for a phase-shift oscillator but, as a power gain of 27 db was required for oscillation, a pentode was used as an interim measure in place of a transistor. Amplitude and frequency of oscillation could be altered by changing the bias across the junction. A phase change of 180 degrees was obtained at 0.5 mc.

Oxide masking processes are being investigated for the diffusion techniques. The thickness of the oxide determines the depth of the junction when both *p*- and *n*-type impurities are diffused.

A study on the possibility of constructing a multivibrator, similar to Fig. 1, from a silicon wafer has been made. The general principle adopted has been that the whole circuit should be formed from the silicon wafer, the only external elements being insulating and conducting paths, and the leads. It is possible that, by redesigning the circuit to suit the techniques of solid circuits, a saving of components would result.

The techniques envisaged in this construction would be chiefly diffusion, oxide masking, evaporation of gold and gold compression bonding. The broad shaping of the specimen might be done by an ultrasonic tool, and the final adjustment of resistance values by sand blasting with a mask. Figure 7A shows the symbolic component layout, and Fig. 7B and C show the sides of the silicon block.

SEALED ASSEMBLIES—In this technique individual assemblies of film-type components with suitable interconnections are arranged in three-dimensional form in a subminiature tube envelope. Hermetic seals protect the miniature components inside the tube. Using these component assemblies in conjunction with miniature tubes specially developed for high reliability, complete circuits that take up little space can be made. Effects of nuclear radiation should be reduced in this type of assembly as compared with any of the previous assemblies described.

CONTACT PROBLEMS—Whatever system is used, it will be essential for plates or circuit blocks to be replaced in service. While many connector techniques are possible, this remains a problem on which considerable work will have to be done. One approach is to investigate the use of subminiature wrapped joints. Miniature wrapped joints might offer a practical method of interconnecting microminiature

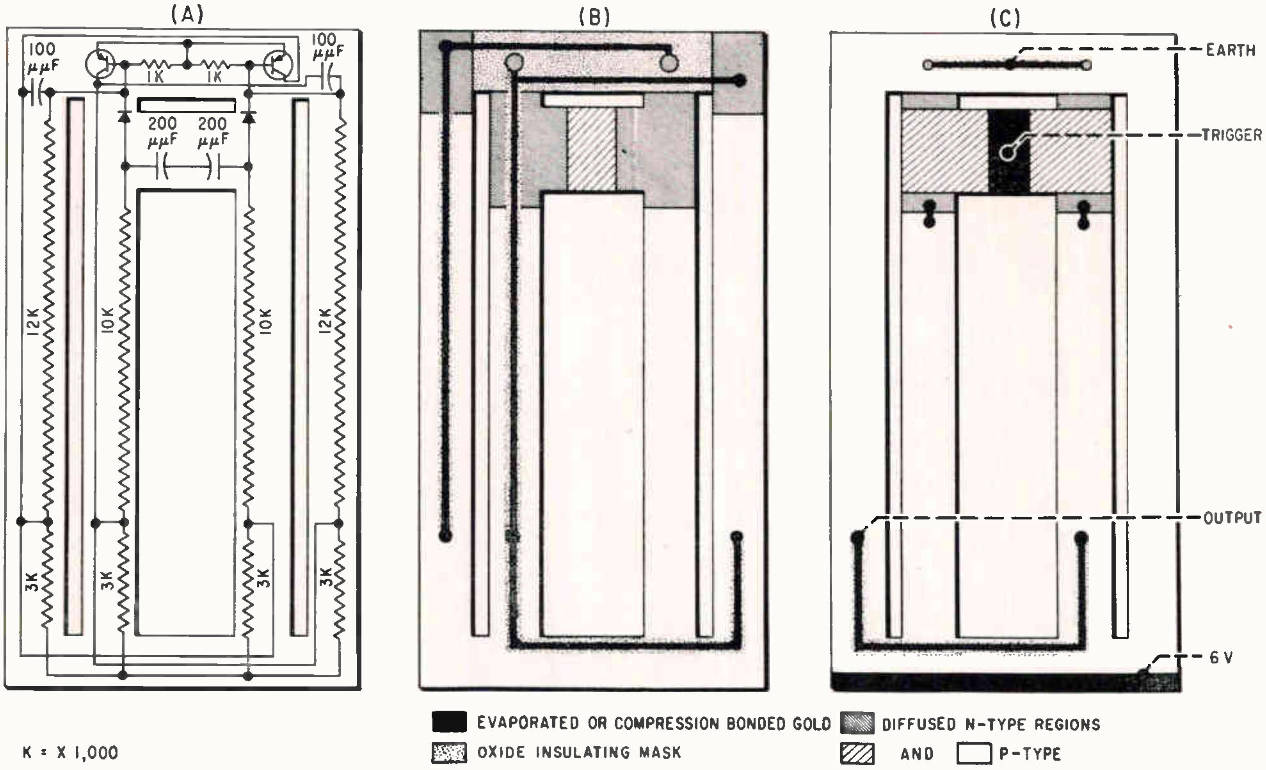


FIG. 7—Symbolic component layout (A) of proposed solid circuit is compared with collector side (B) and emitter side (C) of silicon block

wafers. The advantages would include uniform cold-formed connections and facility to change wafers. Work is also being done on conventional subminiature plug and socket designs and one soldering technique.

TRANSISTORS AND DIODES—The first stage in all flat-plate microminiaturization work is the development of a protected flat-shaped transistor. Attempts have been made to protect the surface of both germanium and silicon active elements. Although some photo resist and silane treatments can be used, the long term effects have not been fully evaluated.

A number of transistor elements were studied and one was selected as being suitable for protection. This was an audio, alloy-type transistor that had its circular germanium wafer mounted inside a circular, shallow, metal-base dish. Transistor types on headers were convenient for the initial exploratory experiments which consisted of measuring leakage currents and current gains followed by double-dipping in a photosensitive polyester resin (eliminating bubbles by vacuum, drying and baking). It was found that this treatment could protect the transistors for at least a few months at room temperatures, without deterioration of leakage current or gain (some cases showed an improvement).

Following this process, nonheader types were similarly treated, followed by encapsulation in epoxy resin in square molds of the required size. In one corner of the mold, a vertical wire was fixed and the transistor dish given a small cant. On grinding down the capsule to the correct thickness, a cross-section of the emitter wire and a small segment of base dish were exposed on one face. In addition, cross-sections of the collector wire and the added wire were coated with a conducting film by vacuum deposition to bring the collector contact to the same face as the base and emitter contacts. Thus, the transistors could be fitted in the circuit shown in Fig. 1.

A range of small flat-cased transistors (fully sealed) is to be developed. These sealed transistors will not exceed 0.125 in. square or 0.125 in. diameter × 0.040 in. in thickness. The transistor will have flush electrode contacts. Diode construction would be similar and fit the same size specification.

CONCLUSION — Microminiaturization techniques will undoubtedly have an influence on low voltage circuits where high packing densities are required. Ideally, the aim is to reduce the size of existing subminiature transistorized equipment by a factor of 10, and to improve the realiability by a factor of 10.

High reliability is a difficult goal to achieve. It is not until production assemblies have passed the test of operational use can their real reliability be estimated. Nevertheless, there is no doubt that in these techniques lies the only possibility of achieving higher orders of reliability than now available.

ACKNOWLEDGEMENTS—The author acknowledges the contributions by J. W. Granville, H. G. Manfield, C. Holm, J. H. Bruce, G. Bradshaw and J. R. Balmer of the Royal Radar Establishment, to this article. All photographs used are reproduced by permission of the Controller, H. B. M. Stationery Office and British Crown Copyright is reserved.

Magnetic Recording of

Time-correction circuits reproduce color hues faithfully by preventing errors caused by the mechanical portions of color-tape record-reproduce system

By **JOSEPH ROIZEN,** Manager, TV Products, Ampex Corporation, Redwood City, California

THE COLOR TELEVISION system in general use in the United States (NTSC) uses two amplitude-modulated suppressed carriers in quadrature at 3.579545 mc. A specific color in the encoded signal is represented by a fixed phase of a 3.58-mc subcarrier signal. A departure of as little as 5 deg from this phase will visibly alter the hue or dominant wavelength of the reproduced color. Transferred to a time axis

1 cycle of 3.58 mc = 0.279 μsec
5 deg of 0.279 μsec = 0.00387 μsec (0.004)

To account for the error in both the record and playback modes, allow only half of 0.004 μsec in each mode; therefore 0.002 μsec becomes the stability requirement for direct color recording. This figure is about two orders of magnitude better than present systems. Although future rotating head assemblies and servo systems may attain this goal, it is now necessary to use electronic time-base correction to magnetically record and playback color television images.

Record-Reproduce System

The color recording process is similar to monochrome[1] in that the amplitude-modulated video signal is transposed into a frequency-modulated signal. The fm carrier is the heterodyned result of two oscillators operating about 5.5 mc apart. One oscillator is fixed and the other is reactance modulated by the video signal. Deviation of the carrier and the sidebands comprises the signal applied to the tape through the recording driver and amplifiers (not shown in the figures).

In Fig. 1, which shows the reproduce-mode, four recording heads of the video head drum contribute signals to preamplifiers. Amplification raises the head signal output

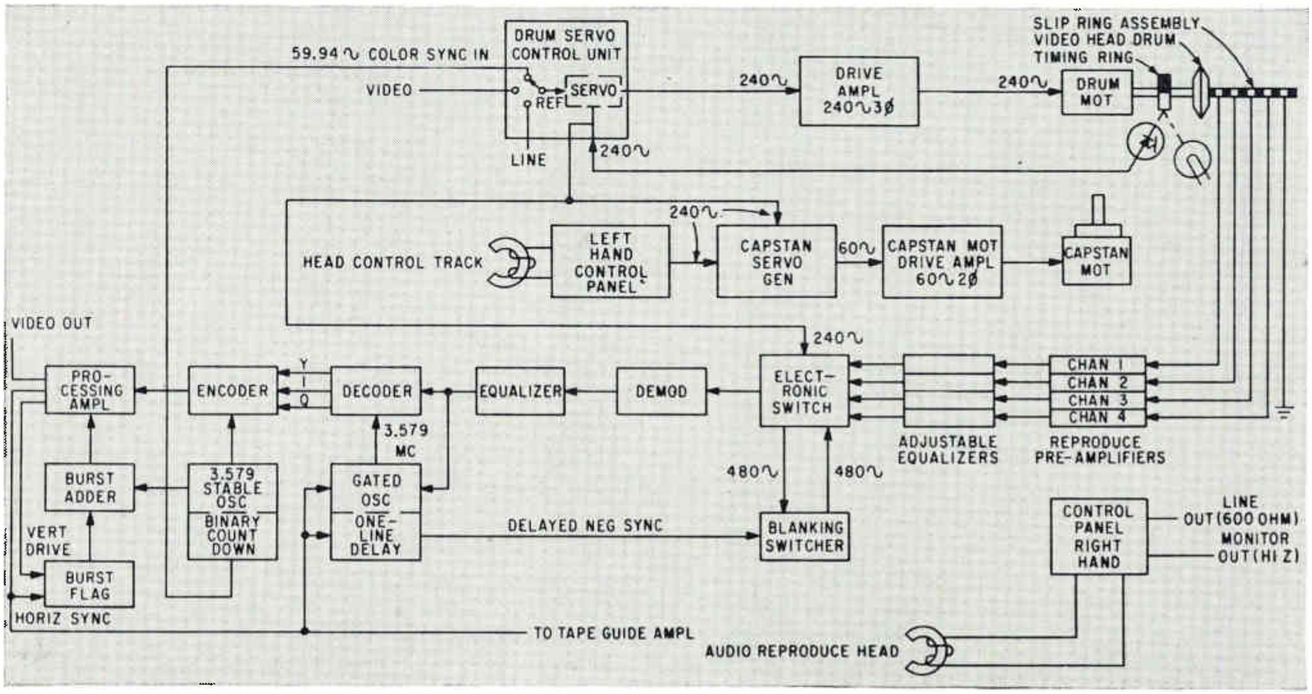


FIG. 1—Reproduce portion of recording system. Four heads in video head drum pick up video signal from tape; audio and control-track heads also pick up tape information. Gated osc and one-line delay comprise the color lock unit

Color Television

level about 65 times. These signals go to equalizers where (adjustable) equalization in each channel permits close matching of the phase and frequency characteristics of all four paths. Equalization overcomes slight differences in characteristics of the four heads and the four preamplifiers that would cause different colors to appear in each head band of the reproduced color picture.

The four signals are time sequenced by an electronic switch controlled by both the second multiple of the 240-cps signal from a photoelectric cell and the delayed sync. Time sequencing assures that switching will occur during horizontal blanking time and so be invisible to the home viewer. The sequenced signal, still in f-m form, then goes to a demodulator which returns it to its a-m form. A single-channel equalizer corrects for any small deficiencies in over-all frequency response by providing either l-f or h-f boost or attenuation. At this point the signal splits, going both to a decoder and a color lock unit.

The color lock unit separates the color-burst signal, generates a 3.58-mc subcarrier and provides an adjustable one-line delay of horizontal sync for switching.

In the decoder, bandpass circuits divide the signal into its luminance and chrominance components. The luminance signal *Y* goes through a 3.2-mc low-pass filter to an encoder. The chrominance signal goes to a pair of diode-clamp demodulators which are driven by the regenerated reference 3.58 mc from the color lock unit. Since the time displacement errors of the chroma information are exactly matched by the errors of the regenerated 3.58 mc, the quadrature demodulation of the *I* and *Q* signals (quadrature components of chrominance) yields stable *I* and *Q* information.

The *I*, *Y* and *Q* signals go to the encoder, which is driven by 3.58 mc from a stable broadcast-standard, subcarrier generator. Signals are encoded and go to a video processing amplifier where sync and blanking are cleaned to meet broadcast transmission requirements. The stable generator also provides two additional signals. One of these is a binary countdown ending in a 59.9-cps color vertical-sync signal that controls the head drum servo. The other signal is supplied to a burst adder which applies a stable burst signal to the back porch of horizontal sync in the processing amplifier. The original burst is destroyed in the reblanking process. The new burst is adjustable through 360 deg of phase angle and can be set to match exactly to reference phase of the reencoded chroma information. Both CBS and NBC use the system described here.

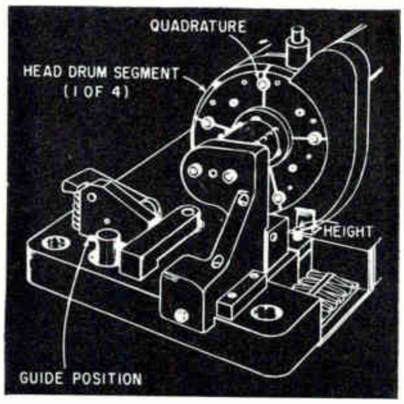


FIG. 2—Each segment carries a video-sensing head. Heads sequentially scan tape; head outputs go to slip rings

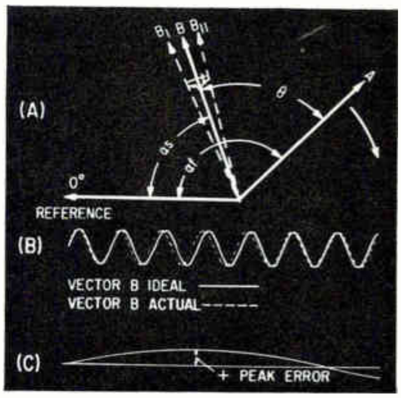


FIG. 3—Vectorial analysis of mechanical errors (A), actual and ideal vector positions (B), and their differences (C)

System Requirements

In magnetic recording of television images, the parameters which control the quality of the reproduced picture fall into electronic and mechanical categories.

Resolution and grey scale are functions of frequency response (bandwidth) and linearity of the electronics in the system, and are optimized by adjustments of carrier frequency, deviation, video level, preemphasis and deemphasis. However, stability and geometry of the visual image are mostly influenced by mechanical considerations. Mechanical uniformity of record and playback conditions must be maintained if geometric displacements are to be eliminated. Difference in quadrature alignment of the head assembly (90 deg between peripheral head gaps) will produce visible vertical discontinuities in the picture. A single inch of scan on a 21-in. home receiver with normal horizontal sweep takes only 3 μsec. An error of only 0.3 μsec will result in a repetitive 1/10-in. displacement, which is objectionable to the viewer. If the speed of the head assembly is slightly different in playback than in record, the 63.5-μsec television line will be compressed or expanded in time and the cumulative error will cause picture skewing.

Geometric distortion has been corrected by tapered screws acting as wedges in slots that divide the drum into four segments. Use of a factory-made alignment tape and this vernier adjustment of quadrature alignment (Fig. 2), as well as other mechanical controls, permits an accurate standard of adjustment.

Another time-displacement error relates to maintaining constant angular velocity of the head drum assembly. The video head assembly is composed of a 240-cycle three-phase hysteresis synchronous motor whose shaft carries a brass wheel containing the four video

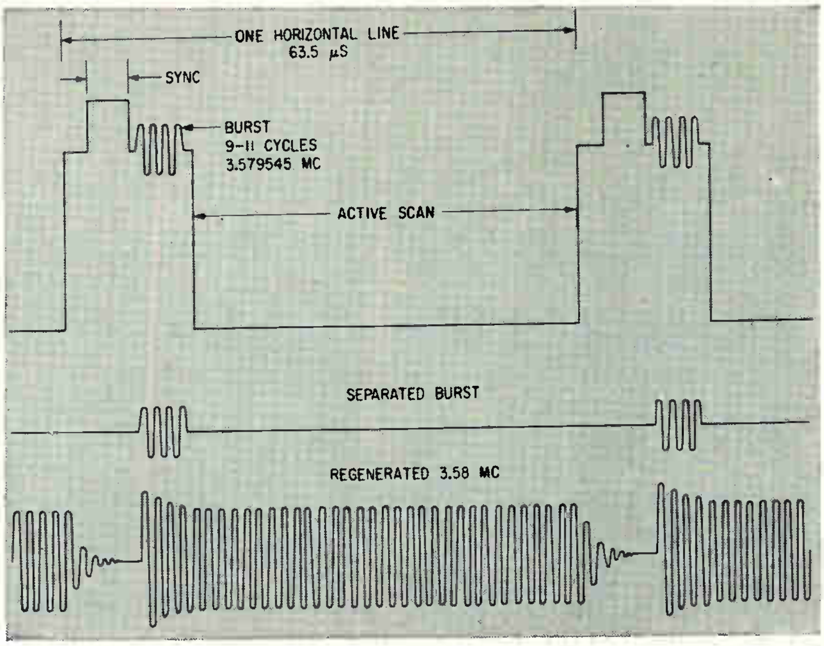


FIG. 4—Waveforms illustrate how time correction is performed electronically

heads. Further along the shaft a slip-ring assembly and brushes connect the video heads to the circuits. Uniformity of angular velocity of the head drum assembly is dependent on the forces acting upon it. Even though the average head drum's rotational speed can be kept at 240 rps accurately by the servo system (Fig. 1), the instantaneous angular velocity can vary over narrow limits. Uneven stator windings, walking bearings and changes in tape pressure because of splices contribute to this error.

Figure 3A is a vectorial analysis of this condition. Vector A is the instantaneous angular position a_f of the rotating field in the stator. Vector B represents the instantaneous angular position a_s of the rotor under constant drag. Angle θ is the fixed angle representing the torque required to overcome this drag and would remain constant if the drag were perfectly constant. Since the drag is not constant, B varies by small amounts representing maxima B_1 and B_{11}. Thus angle θ has a positive and negative error around its average value.

The moment of inertia of the head assembly is too great to respond to small instantaneous amounts of increased or decreased drag. Therefore, the energy represented by small variations in drag is stored in the assembly. This energy is dissipated in a sinusoidal hunt, whose rate is the resonant frequency of the rotating assembly.

Figure 3B shows the ideal and actual positions of vector B over a 7-cycle period. The equilibrium position would be a perfect sine wave as partially shown by the solid line, and would represent a condition of zero time-displacement error. However, in practice, vector B varies (dashed line) and either leads or lags the ideal position. Figure 3C illustrates the difference between the ideal and the actual vector. The peak amplitude of the difference wave is the peak positive and negative time-displacement error. The frequency of the difference wave is the hunt frequency of the rotating assembly (approximately 5 to 10 cps).

A time base displacement not visible to the naked eye in a monochrome presentation would cause a noticable and in some cases objectionable shift in hue of the reproduced color picture.

Time Correction

Consider a single video head scanning one track on the tape. Angular position of the head drum may vary from a desired position by small increments, but its variation is at a slow rate. Inertia of the head assembly is great enough so that in scanning one television line, or about 5 deg of drum movement, velocity will not change appreciably. Calculations based on the acceleration rate show that the color subcarrier phase shift due to head hunting, from the beginning to the end of one picture line, will be 2½ deg or less. The start of each television line contains a burst signal of 9 to 11 cycles of 3.58 mc as a reference phase for the color information on that line. By using the burst to excite a local oscillator that follows the burst accurately in phase and frequency, a continuous 3.58-mc signal is regenerated which has the same time-displacement errors as the color information from the tape. This start-stop oscillator is included in the color lock unit (Fig. 1).

Waveforms in Fig. 4 show the basic operation of this time-correction circuit. Burst is removed from the composite video signal coming from the magnetic tape; it is amplified and gated, then used to ring the gated (start-stop) oscillator (Fig. 5) which has been critically adjusted to follow each burst phase accurately.

The separated burst signal goes to the grid of V_1 and can be controlled in amplitude by R_1. The amplified burst signal goes through C_1 into a resonant tank circuit in the cathode of V_{2A}. A feedback loop through V_{2B} with R_2, an adjustable Q control, is set so that the circuit will barely maintain oscillation in the absence of driving voltage. With the tank adjusted close to the subcarrier frequency 3.58 mc, the circuit will ring at the burst frequency. Even though there is a tendency for the oscillator to drift slowly back to its natural resonant frequency, the amount of drift before the next burst is negligible. To further avoid any carry-over of burst information from one line to the next, the grid of V_{2A} is damped by a horizontal sync pulse through C_2. The degree of damping is controlled by a variable bias adjusted with R_3. The regenerated 3.58-mc signal, continuous except for a short interval during blanking time, is amplified by V_3 and fed to the decoder (Fig. 1) to demodulate the chroma information in the composite color signal.

Video Reconstructed

The decoder chassis (Fig. 6)

separates the composite video signal into its luminance and chrominance components, and applies correction in the demodulation process to yield stabilized I and Q outputs.

Composite video signals from the f-m demodulator and equalizer (Fig. 1) are applied to two filter networks. The low-pass filter (0-3.2 mc) nulls at the subcarrier frequency of 3.58 mc, allowing luminance (brightness) information to pass through while attenuating chrominance information, thus assuring maximum color-subcarrier rejection in the Y channel.

The band-pass filter of 2 to 5 mc passes all of the chrominance information while attenuating l-f video signals. Output of this filter consists of the suppressed subcarrier quadrature-phased color signals I and Q. The combined I and Q information is applied to a pair of diode clamp demodulators, directly in one case, and through a 90-deg phase-shift (at 3.58 mc) network in the other.

The regenerated 3.58-mc signal from the color-lock-unit oscillator, adjusted to 0-deg reference phase by a variable delay line, is also applied to the demodulators. Since the reference signal is subjected to the same instantaneous time-base-displacement errors as the chrominance information and since the signals reaching the Q demodulator are shifted 90 deg from those reaching the I, the two demodulators separate the quadrature components and put out time-base-corrected I and Q signals. Two low pass filters attenuate the unwanted 3.58-mc subcarrier signal while permitting the full narrow-band chrominance information to pass.

The I and Q video signals are now put through individual equalizing delays to match the Y channel delay. Thus color will not be displaced from its brightness component on the monitor screen.

System Limitations

Although the system produces subjectively good color pictures, analysis with precision test equipment shows that there are certain inherent limitations in the methods described. The start-stop oscillator is required to perform two diametrically opposed functions to meet the system's needs. It must be free to follow the frequency and phase of the burst signal which triggers it, and as soon as this reference disappears be stable enough to maintain that frequency and phase for the rest of the horizontal-line time, a period some 25 times as great as the sampling period. It is possible in practice to achieve results which are acceptable; however, inspection shows a slight shift in hue from the right to left-hand side of the picture because of the oscillator's attempt to coast to its natural frequency and the change in head velocity.

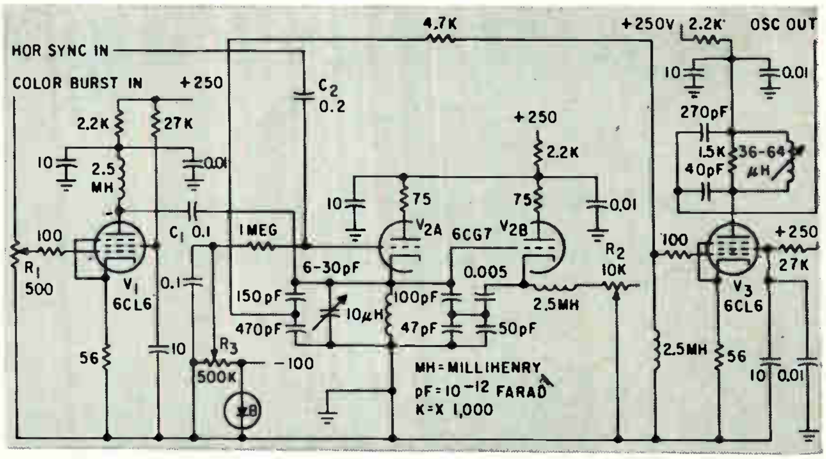


FIG. 5—Start-stop oscillator is gated on by color-burst signal, gated off by sync signal

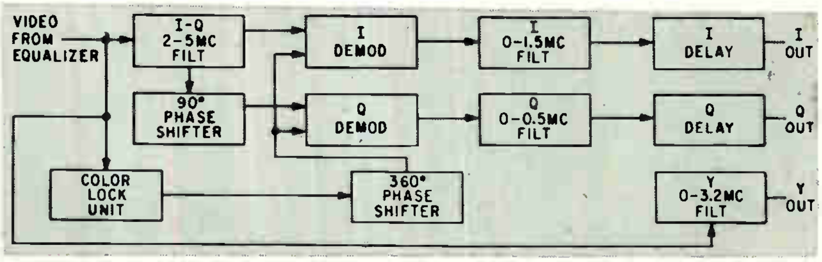


FIG. 6—Decoder circuits break up video into I, Q, and Y signals

Pilot Carrier Technique

The pilot carrier system theoretically shows promise of overcoming this small discrepancy. This system operates on the principle of recording an additional piece of information with the color video signal. If the subcarrier signal (3.58 mc) is divided to some other frequency out of the passband of the video signals and is recorded simultaneously with the video signals (Fig. 7), the divided frequency can be recovered from the tape by a filter network and multiplied back up to 3.58 mc. The 3.58-mc signal recovered from the tape would have the same time-displacement errors that the color information is subjected to. Since the pilot carrier is constantly present, it would represent a cycle-by-cycle correction factor for the color demodulator and therefore eliminate errors introduced by the start-stop oscillator or the head assembly. The present limitation on the use of the pilot-carrier method is the inability to suppress unwanted beats that occur between the pilot carrier and the color video signals. Improvements in system linearity and other refinements should eventually overcome this difficulty.

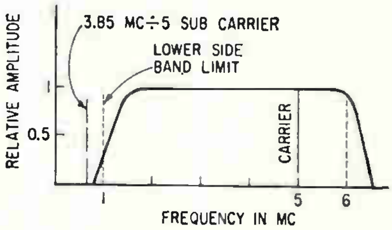


FIG. 7—Frequency graph shows position of divided-down pilot carrier

REFERENCE

(1) Ross H. Snyder, Video Tape Recorder Uses Revolving Heads, ELECTRONICS, Aug. 1957.

Current Pulse Generator

Instrument furnishes current pulses for magnetic-core testing programs. Pulses are adjustable in pulse width, rise time and current magnitude

By **HUGH W. GOSS,** Design Engineer, Test Equipment Engineering, IBM Corp., Poughkeepsie, New York

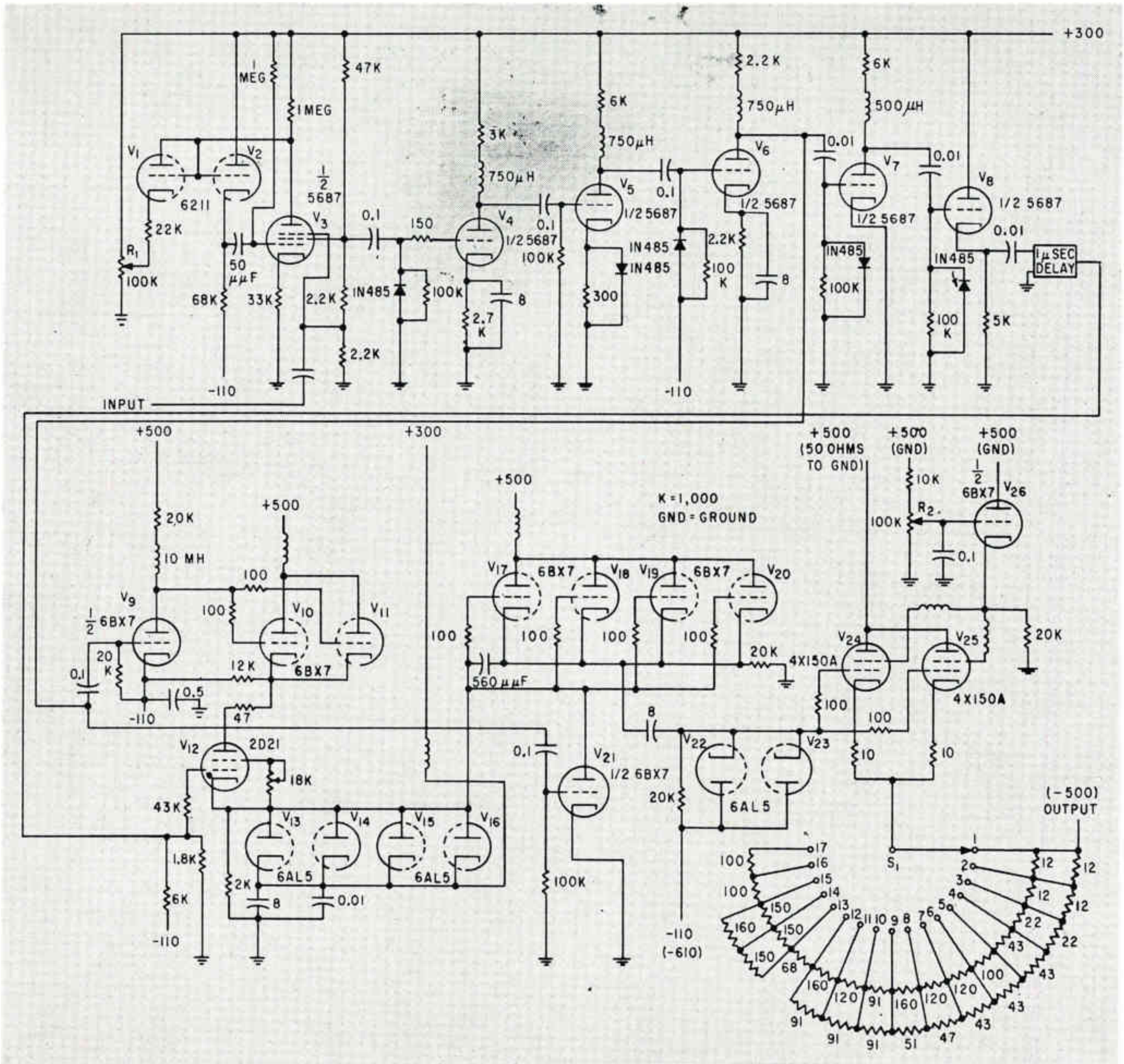
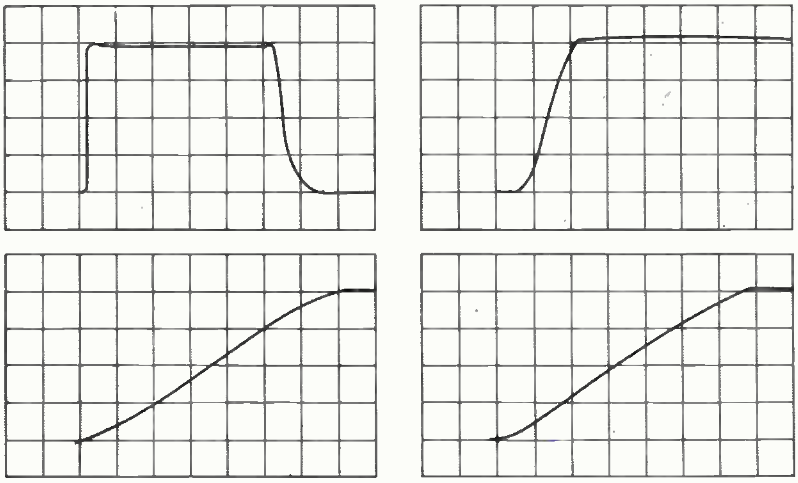


FIG. 1—Current pulse generator requires a trigger input pulse from an external generator

Tests Magnetic Cores

PRODUCTION TESTING of ferrite memory cores consists normally of driving each core with simulated READ and WRITE current pulses, and measuring critical parameters of the core pulse response. Accuracy of the results obtained with this testing depends to a great extent on the accuracy with which the characteristics of the drive pulses can be controlled.

The current pulse generator to be described tests memory cores of various types. These types have a wide range of input requirements. Four such driver circuits are normally required in testing to simulate the partial-read, full-read, partial-write and full-write pulses used in coincident-current memory systems.



Waveshapes indicate the wide variety of pulses available from the generator

Pulse Generation

Figure 1 shows the current driver circuit. This relatively elaborate circuit produces a wide range of output characteristics. The driver is designed for a duty cycle of 20 percent at 2 amp, and for repetition rates up to 15 kc.

Duration of the output pulses is continuously adjustable from 0.5 μsec to 12 μsec without droop. Pulse amplitude is continuously adjustable from 200 ma to 2.5 amp and pulse rise time is linear throughout its adjustment range of 20 milliμsec to 0.5 μsec.

A screen-coupled phantastron (V_3) having a fast recovery characteristic generates the time reference pulse. The operating cycle of the phantastron is controlled by the pulse-width potentiometer, R_1, which varies the control voltage at the plate of V_3.

An external trigger pulse with a 20-v rise of 0.1 to 0.2 μsec is used to initiate circuit operation. The trigger pulse goes to the suppressor grid of V_3, and the output of V_3 is taken from its screen grid.

The output of the pulse generator goes to amplifiers V_4 to V_6. The input of each amplifier is clamped by a diode. Coils in series with plate resistors shape the output pulses of the tubes.

The outputs of amplifier V_6 and inverter stage V_7 condition the cathode followers that control thyratron V_{12}. Plate voltage of V_{12} is furnished by the parallel cathode followers V_{10} and V_{11}, which are controlled by the negative pulse from V_6 that goes to V_9.

Since V_{10} and V_{11} now conduct, plate voltage on thyratron V_{12} is sufficient to permit full conduction when the delayed pulse from V_8 arrives at the grid of V_{12}. This delayed pulse comes through V_7 and V_8, and a 1-μsec delay.

The rise of grid input to V_{12} switches it into full conduction, raising the cathode level about 400 v. The last ten-percent of the rise is clipped by diodes V_{13} to V_{16}. These diodes are parallel-connected to the cathode of V_{12} to assure a flat waveform.

The cathode of V_{12} is also connected to four parallel cathode followers (V_{17} to V_{20}). Triode V_{21} is turned off by the output pulse of V_4; V_{21} goes on at about the same time that the thyratron extinguishes, minimizing the fall time of cathode followers V_{17} to V_{20}.

Unit contains two current pulse generators, one positive and one negative

Output of cathode followers V_{17} to V_{20} is R-C coupled to amplifier V_{24}-V_{25}, which has an adjustable cathode load and an adjustable screen potential. The adjustable cathode load, which is set by switch S_1, and a screen-voltage adjustment (R_2), provide coarse and fine current-amplitude controls.

When used as a positive (READ) driver, the output is taken from terminal 1 of switch S_1. In this mode, a core under test goes between the output terminal and ground, and the plate-supply voltage of V_{24}-V_{25} is 500 v (plus).

When used as a negative (WRITE) driver, terminal 1 of S_1 is connected to -500 v and a 50-ohm load is connected between the plates of V_{24}-V_{25} and ground. A core under test is connected in series with this 50-ohm load. These circuit changes for the negative-driver condition are indicated by parenthesis in Fig. 1.

Output capabilities include repetition rates up to 20 kc, pulse durations from 0.5 μsec to 12μsec (without droop), amplitudes from 200 ma to 3.0 amp, and linear rise times from 20 milliμsec to 0.5 μsec.

Pulse-Coded Fault Alarm

Pulse coding permits remote checking of up to 256 circuit conditions. Single-tone channel of microwave system or d-c transmission may be used

By **JAMES B. BULLOCK,** Moore Associates, Redwood City, California

FAULT ALARM DEVICES are a necessity in multihop microwave systems. At a typical microwave station a fault alarm may remotely indicate faults such as failure of tower lights, failure of utility power, transfer of station facilities from normally used microwave equipment to standby equipment, loss of signal from adjacent station, excessive change in station ambient temperature, failure of battery charger, faulty operation of standby power generator and unauthorized entry on station premises.

Because of the great demand placed on microwave-system modulation bandspace for voice, telegraph, signaling and data transmission, the bandspace available for fault alarm service is at a premium. Multitone schemes in which a different audio tone is used for each fault indication use a lot of bandspace. Some systems code the tones thus reducing the number of tones required.

In the circuit to be described, up to 256 circuit conditions can be monitored over a single tone channel or d-c circuit. Repetitive trains of tone pulses are transmitted by a coder unit to a distant decoder unit equipped with a visual display. Ordinarily, all the pulses in a train are of the same duration except a synchronizing pulse.

When one or more of the pulses in a train is shorter than normal, it is sensed by the remote decoder which actuates a remote visual indicator to show where the fault is occurring.

The coder employs an electronic stepping circuit which sequentially steps from one alarm or data point to another. Normal scanning rate is 20 pulses or scan points per second, but the system can be made operative at scanning rates as low as 5 pulses a second or up to 1,000 pulses a second. The standard units, which are arranged for scanning 8, 16 or 32 points, can be put together in various combinations to scan up to 256 points.

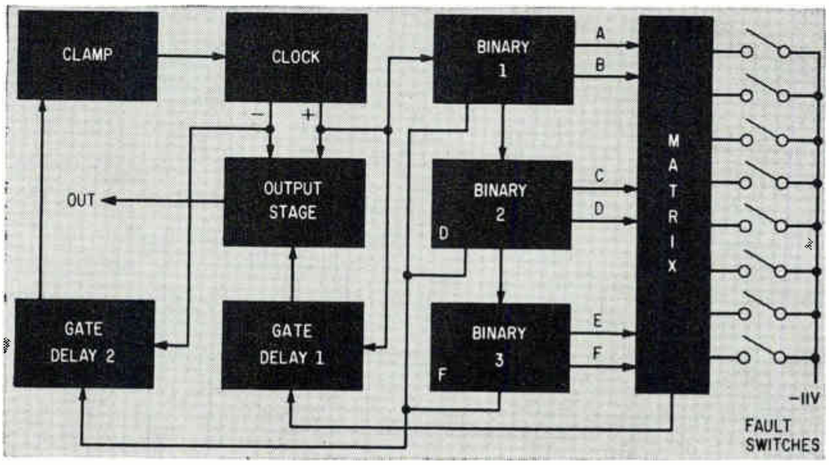


FIG. 1—Eight-function coder narrows appropriate pulse when one or more of the eight fault switches operates

The eight-function coder shown in Fig. 1 generates the repetitive trains of pulses that key a tone generator whose output is transmitted over the microwave system. Under normal conditions (no faults), the pulses are of equal width and are evenly spaced, except for a longer pulse interval (synchronizing pulse) between each train of eight pulses. When a fault occurs, the pulse train becomes coded. Normal-width pulses denote normal conditions; each narrow pulse, which can be identified by its position in the train, indicates a fault condition.

The system stepping rate is determined by the clock, a nonsymmetrical, free-running multivibrator, which triggers the first of three binary stages and feeds an output stage which produces the tone generator keying pulses. The clock also triggers gated delay 1 that narrows applicable pulses when required, as well as gated delay 2 that widens the space between the last pulse of each train and the first pulse of the next train. It is during this long interval that the distant decoder synchronizes itself with the coder.

The three binary stages divide the trigger pulses by 2, 4 and 8. Their six output signals are fed to a matrix which is monitored by the two gated delay circuits. The coding of the binary outputs is different for each of the eight pulses but in all cases three negative and three

in Microwave Systems

positive outputs are applied to the matrix, and appear there as a zero signal under normal conditions.

Clock

In addition to triggering the first of the three binary stages, the positive-going output of the clock triggers gated delay 1, a monostable multivibrator whose negative output pulse is one third as long as the total clock period. When the gate of delay 1 is open, the gate narrows the appropriate pulse (or pulses) to indicate a fault condition. The negative output pulse of the clock triggers delay 2 when its gate opens during the eighth pulse.

Synchronization

The end of a cycle is identified by a longer-than-normal interval between pulses. This interval is made longer by clamping the clock so that its positive output side is held at zero for slightly longer than two thirds of the total clock period. The clamping action is provided by gated delay 2, a monostable driven multivibrator, which is triggered by a positive going pulse from the clock at the end of every eighth pulse.

The clock can trigger gated delay 2 only when the gate is open. As shown in Fig. 2, the negative-output clock pulses are applied to gating diode D_1 which ordinarily blocks the signal to the delay multivibrator. During the eighth pulse of a code train, diodes D_2, D_3 and D_4 receive a negative voltage from their associated binary outputs making the cathode of D_1 more negative than its anode. Thus, when the negative clock pulse, fed to D_1, starts going in a positive direction, the trigger gets through to the multivibrator via D_5 which permits triggering only by positive-going pulses. At the end of the delay period, as determined by the multivibrator, the clamp is removed and the intervals between pulses remain of uniform duration until the end of the eighth pulse when the clamping action again takes place.

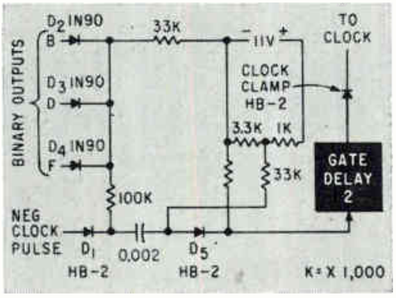


FIG. 2—Gated delay 2 operation makes clock pulse slightly longer to provide synchronizing pulse

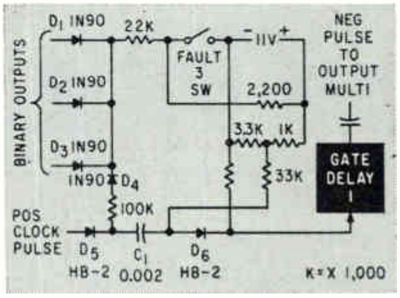


FIG. 3—When fault switch 3 operates, circuit narrows pulse number 3 when the binary input signals are negative

In function 3 (fault sensing switch 3) operation is as shown in Fig. 3; a negative signal is applied to each of the three diodes (D_1, D_2 and D_3) from their associated binary outputs during the 3rd pulse. However, since the diodes oppose passage of the negative signals, the gate remains closed.

When fault sensing switch 3 is closed, a steady negative voltage is applied to the cathodes of diodes D_1, D_2 and D_3. However, since a positive voltage from any binary output will clamp the cathode of D_4 no change will be evident at C_1 until all binary inputs are negative. Thus, with the switch to input 3 closed, a negative pulse will be coupled through D_4 for the time slot when all the binary inputs are negative thereby charging C_1 to a negative potential. When the positive-going wave from the clock applied through D_5 appears, a pulse is coupled through C_1 and D_6 to trigger gated delay 1. Gated delay 1 shortens the output pulse for that function as it restores itself to its normal condition at the end of its delay.

Matrix

Figure 4 is a simplified schematic of a portion of the coder matrix showing only the circuit of fault alarm circuits 3 and 6. During the third pulse of a code train, binary outputs A, D and E are negative. If fault sensing switch S_3 is open, the negative binary output signals will not get through to D_1, because diodes D_2, D_3 and D_4 are not conductive. When S_3 is closed, −11 v is applied to the cathodes of D_2, D_3 and D_4, making their cathodes more negative than their anodes. Hence, they conduct and the negative signal passes through D_1 to the gate of delay 1.

The same is true for the circuit of function 6 during the 6th pulse when binary outputs B, C and F are negative. When switch S_6 is open, the negative signal does not get through D_5 to the delay 1 gate. When S_6 is closed, diodes D_6, D_7 and D_8 conduct and the negative signal gets through D_5.

The anodes of D_2, D_3, D_4, D_6, D_7 and D_8 receive either a −1 or −10 v signal from the binary stages during each pulse. The −1 v signal is considered as a positive signal. When any or all diodes of a trio receive a positive signal, the output of the trio will be considered to be positive instead of negative. Even if the appropriate fault sensing

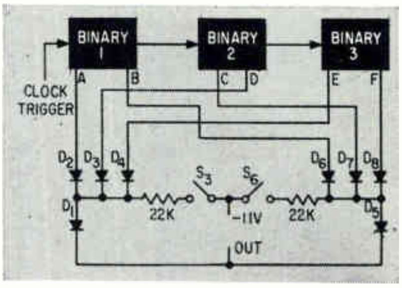


FIG. 4—Portion of coder matrix showing fault alarm circuit associated with fault switches 3 and 6

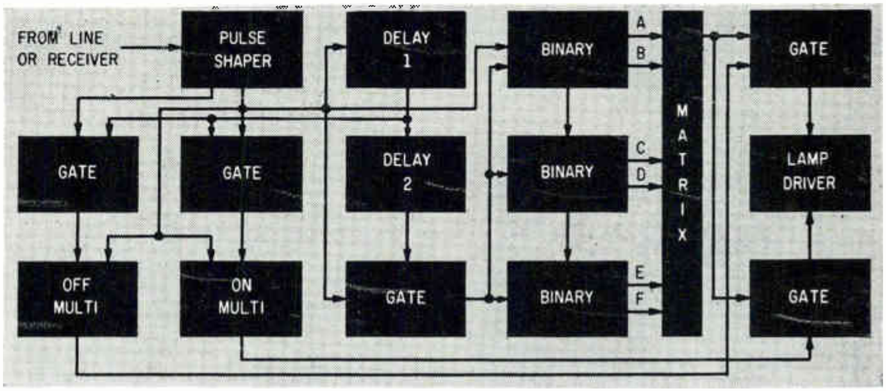


FIG. 5—Eight-function decoder showing only one of the eight lamp driver circuits

switch is closed, the steady bias applied as a result will not affect the gate because of the shunting effect of the positive-fed diode (or diodes). Only when all three are negative, will their effective output voltage be negative, and only when the switch is closed.

Diodes D_2, D_3 and D_4 provide a negative output only during the 3rd pulse and when S_3 is closed. For all other pulses, their output will be relatively positive. The same is true for D_6, D_7 and D_8 during the 6th pulse.

For each function, a quartet of diodes is provided on the matrix, three of which are fed from the binary stages, and one for feeding their output to the gate delay 1 when the associated fault sensing switch is closed.

Decoder

At the receiving end of the circuit, the coded tone pulses are first demodulated to d-c by a tone receiver. The resulting coded d-c pulses are fed to the decoder shown in Fig. 5 which differentiates between normal-width and narrow pulses and recognizes the start of a new pulse train cycle by the longer-than-normal spacing between the last and first pulses of two consecutive trains. If all pulses are of normal width, all of its eight indicator lamps will remain dark. However, for each narrow pulse received, the appropriate warning lamp will glow.

Each of the eight lamps is controlled by an individual driver, a bistable multivibrator, which turns its associated lamp on or off or can be used to control a relay. All drivers are controlled by an off-multivibrator and an on-multivibrator, as selected by the matrix.

Two delay circuits are provided. Delay 1 triggers the on and off multivibrators. Delay 2 automatically resets the binary stages at the start of a new cycle.

The rise time of the incoming pulses is made faster and their heights are made uniform by the pulse shaper, a bistable multivibrator, whose positive-going output signal triggers three binary stages. As in the coder, the six outputs of the binary stages are fed to a matrix.

The on and off multivibrators are reset at the start of the positive-going signal from the pulse shaper. The off multivibrator gate is opened by the negative going signal at the same time that the on multivibrator gate is closed by the positive-going signal.

The positive-going pulse-shaper signal also triggers delay 1 which, when it recovers, causes the off multivibrator to flip the first lamp driver to the off position (lamp or relay de-energized). The on multivibrator is prevented from triggering since its gate is held closed by the long positive pulse from the pulse shaper until after delay 1 has recovered.

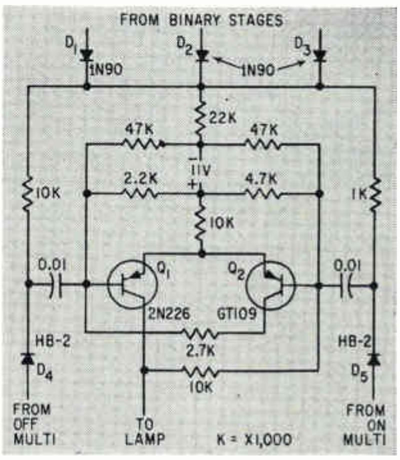


FIG. 6—Lamp driver operates remote indicator

This occurs for each pulse in a train as long as no faults are being reported, in which case all pulses are of equal length.

Fault Conditions

If fault sensing switch 1 at the coder is closed the narrowed 1 pulse will be shorter than the negative-going output pulse from delay 1. This condition allows the on multivibrator gate to open and the off multivibrator gate to close.

Thus, the on multivibrator, which is triggered at the end of the pulse from delay 1, turns on the driver for lamp 1.

The driver stays in the on position until the 1 pulse resumes normal width, which cannot occur until the 1 fault sensing switch at the coder is opened.

The same is true for any of the eight fault functions. The decision as to which lamp driver is to be controlled by a specific pulse is made in the matrix. In the case of the first pulse (function 1) binary outputs *A*, *C* and *E* are all negative.

As shown in Fig. 6, if D_1, D_2 and D_3 receive a negative signal from the binary stages, gating diodes D_4 and D_5 are open and ready to pass trigger signals from the on and off multi-vibrators. If all three diodes are not negative at the same time, they will be at ground potential, and the gating diodes will be closed.

Resynchronization

Synchronization of the coder and decoder is necessary. The two ends require resynchronization after an interruption in the communications link. This is done automatically. Since the spacing between the last and first pulses from the coder is longer than two thirds of the clock period, the reset gate in the binary stages is held open long enough for the differentiated positive-going output of delay 2 to reset the binary stages to agree with the first pulse in the next code train.

The fault-sensing contacts are required to carry only 4 ma and to handle only 10 volts d-c.

Transistor D-C Amplifier For Rugged Use in Field

Measurement of low-amplitude long-period surface waves from small islands in midocean led to the development of this simple, low-cost device

By **WM. G. VAN DORN,** University of California, The Scripps Institution of Oceanography, La Jolla, California

EXTENSIVE OCEANOGRAPHIC operations carried out on Pacific islands over the past six years by the Scripps Institution of Oceanography has led to the development of the battery-operated d-c transistor amplifier shown in Fig. 1. Designed for simplicity and low cost, this small, rugged amplifier is capable of driving a low-impedance recording galvanometer for extended periods in regions where no auxiliary power is available, and where a linearity and stability commensurate with that of other system components (1 to 2 percent) is sufficient. More than 100,000 total hours of continuous use have demonstrated its suitability and dependability in the field.

Design Features

The basic amplifier (Fig. 2) drives an Esterline Angus model AW recording milliammeter to full scale (±0.5 ma) with an input signal of ±75 mv (±15μa) from a Statham model PM5-0.2d unbonded strain-gage pressure transducer. Design specifications and performance data are given in Table I.

The bilateral symmetry of the push-pull circuit using matched 2N65 transistors optimizes linearity and thermal stability. Stability is further enhanced by physically bonding the corresponding left- and right-hand circuit components together by a wrapping of copper wire and encapsulating the fixed components in plastic on a 9-pin miniature tube base.

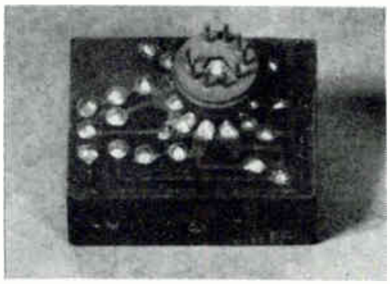


FIG. 1—Fixed components of amplifier are encapsulated in plastic on a 9-pin miniature tube base

Input and output circuit impedances are matched to those of the transducer and recorder, respectively, for maximum power transfer, and the T-pad gain control in the output circuit provides virtually constant amplifier loading at high-enough impedance to give adequate galvanometer response (2 sec) in the recorder. Separate banks of ten 1.3-v mercury cells, rated at 14,000 milliamp hr, provide power for the transducer, the accessory control panel (containing the gain and balancing potentiometers and calibrating network) and the recording milliammeter. Although designed for d-c operation, the a-c amplitude response of this amplifier was tested and found to be flat within 2 db to 50 kc, with negligible harmonic distortion to 30 kc.

Field Service Life

Field records show that the service life of these amplifiers averages about one year of continuous operation, failure usually manifesting itself by a progressively increasing drift to one side or the other as one of the transistors deteriorates. About one-third of the new amplifiers drifted initially after potting or failed to balance at all. This rejection rate was greatly reduced by refrigerating the units during curing of the resin. Although not tried, silicon transistors would probably insure a higher degree of stability than the germanium. This article is based on research carried out by the University of California under contract with the Office of Naval Research.

Table I—Design and Performance Data

Input impedance	5k
Output impedance	1.4k
Thermal stability	
Zero drift	0.4%/deg C
Gain	0.7%/deg C
Input voltage	±75 mv
Input current	±15 μa
Output voltage	±0.75 v
Output current	±0.5 ma
Power gain	±25 db
Linearity	1% of full scale
Supply voltage	12 v d-c
Supply current	3.4 ma

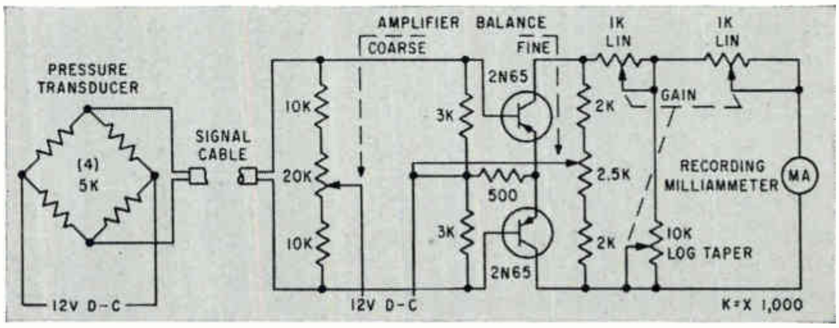


FIG. 2—Basic amplifier circuit. Calibrating network and auxiliary power-supply networks are omitted. Although designed for d-c operation, the a-c amplitude response is flat within 2 db to 50 kc

Steering Circuits Control Reversible Counters

Transistorized reversible decade counter uses static voltage level on bases of steering transistors to determine direction of count

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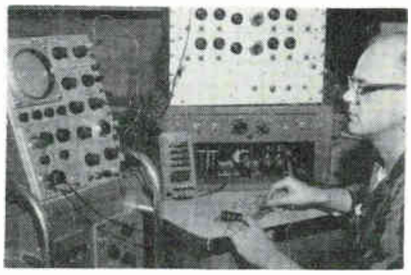
DECADE COUNTERS which count both up an down are useful in control systems that measure temperature, pressure or other variables through combined analog and digital techniques. If the command and feedback of a servo are both expressed digitally, a reversible counter can be used to generate the error signal. Other uses for these counters are decimal arithmetic and in digital control systems.

In the counter, a static voltage level at the bases of steering transistors determines the direction of the count, whether up or down. Coding and feedback techniques minimize the number of components needed in gating and carry circuits when decades are cascaded. Pulses can be counted at rates up to 200,000 a second.

Logical Design

Many logical arrangements can be used to produce a radix-10 counter. Radix is used in the sense of base or root number and a radix-10 counter is the ten's system in general use. Four cascaded binary stages will produce 16 combinations of states (2^4) and this arrangement was chosen on the basis of cost.

Since 16 states or binary numbers are available, and only ten are needed, the excess six states must be nullified. The excess-three binary-coded system was chosen for several reasons. First, the nullification process of excluding the six unwanted states need not involve the first stage. Consequently, one pulse may be counted free before another pulse is passed to the stages in which cancellation feedback is used. Second, the code is represented by binary three to twelve in-



Plug-in decade modules being tested. Mounted in the rack are three readout modules

clusive, such that a unique code, binary two and thirteen, are available to activate the feedback system. Third and last, the code is complementary and uses the nines-complement arithmetic system.

Since complementary bistable memory elements are used, there are two outputs from each stage. One of the outputs will be referred to as the 8 4 2 1 set, and its complement as $\bar{8}\ \bar{4}\ \bar{2}\ \bar{1}$. Table I shows the relationships between the decimal and the binary code used in the counter. The 8 4 2 1 output increases as the $\bar{8}\ \bar{4}\ \bar{2}\ \bar{1}$ output decreases. The output of either set can thus be used to count up or down by changing the interstage coupling. The logic arrangement of the counter is shown in Fig. 1.

The current steering technique used in the interstage coupling requires using the previous binary-zero-to-one collector-transition as an input. When the coupling is derived from the $\bar{8}\ \bar{4}\ \bar{2}\ \bar{1}$ collectors, the 8 4 2 1 binary output increases in count. Conversely, if the interstage carries are derived from the 8 4 2 1 collectors, the 8 4 2 1 binary output decreases in count. When counting, the 8421 binary coded decimal number is increased or decreased. Consequently, the decimal equivalent is counted up or down one count for each input transition.

When counting down, the process

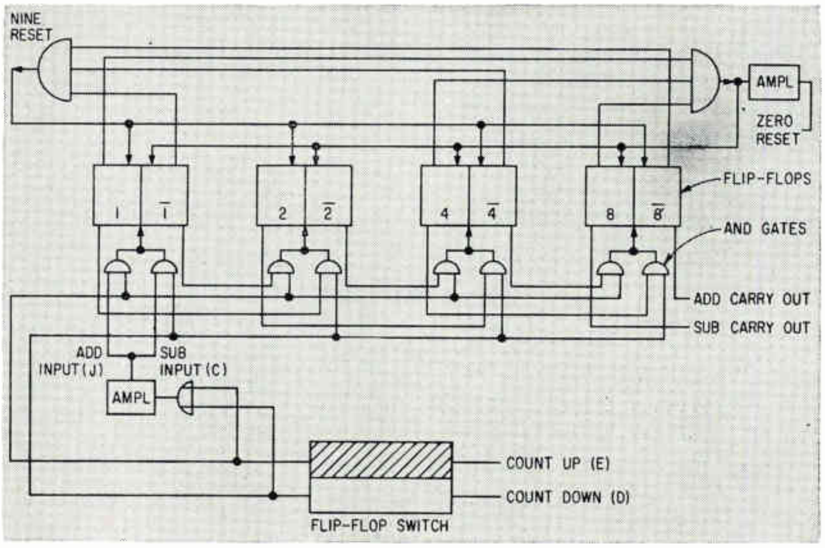


FIG. 1—Reversible counter uses four bistable flip-flops for storage. Logic design is based on nine's-complement arithmetic system

* Now with Radiation Counter Labs, Skokie, Ill.

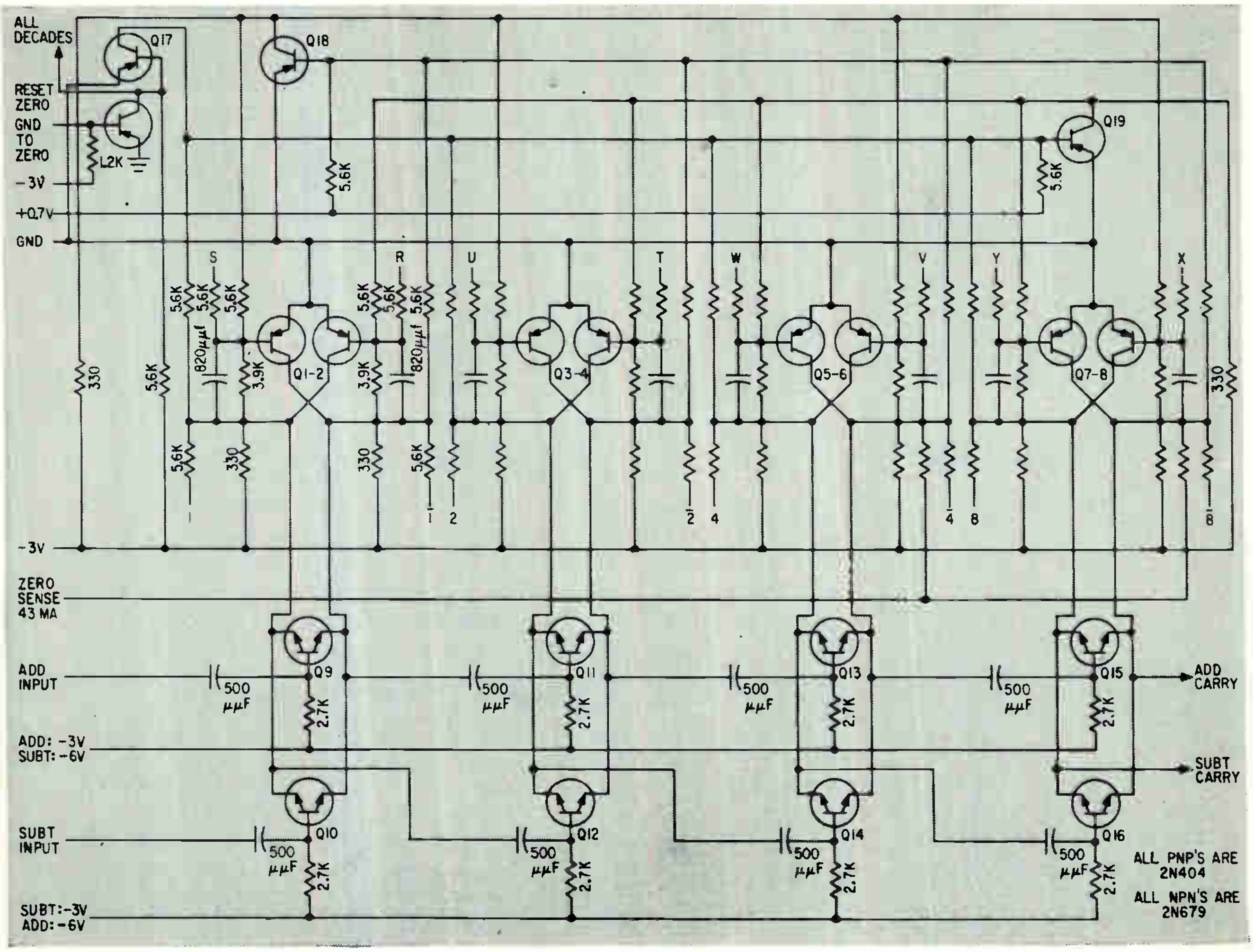


FIG. 2—Steering transistors Q_9 hrough Q_{16} provides economical circuit for counting up or down

continues until decimal zero is reached, 0 0 1 1 at which point the next state being 0 0 1 0 initiates a forced reset to nine, 1 1 0 0. Counting up, when decimal nine is reached, 1 1 0 0, the next state is 1 1 0 1, which initiates a forced reset to decimal zero, 0 0 1 1.

When counting down, it is not necessary to gate the forward forced reset line (9 to 0) since the combination 1 1 0 1 is never produced counting backwards. Similarly, it is not necessary to gate the reverse reset line when counting forward, as the combination 0 0 1 0 is never produced.

Table I—Code System

Decimal System	Binary Coded Decimal Excess Three	Binary Code				Binary Code Complement			
		8	4	2	1	$\bar{8}$	$\bar{4}$	$\bar{2}$	$\bar{1}$
0		0	0	0	0				
1		0	0	0	1				
2		0	0	1	0				
3	0	0	0	1	1	1	1	0	0
4	1	0	1	0	0	1	0	1	1
5	2	0	1	0	1	1	0	1	0
6	3	0	1	1	0	1	0	0	1
7	4	0	1	1	1	1	0	0	0
8	5	1	0	0	0	0	1	1	1
9	6	1	0	0	1	0	1	1	0
10	7	1	0	1	0	0	1	0	1
11	8	1	0	1	1	0	1	0	0
12	9	1	1	0	0	0	0	1	1
13		1	1	0	1				
14									

Circuit Considerations

The circuit, shown in Fig. 2, consists of four R-C coupled, complementary, saturated flip-flops. Symmetrical *npn* transistors, coupled between collectors of the flip-flops are used as trigger current amplifiers and for steering. The zero to one transition from the previous binary stage collector appears as a differentiated pulse at the base of the steering transistor (Q_9 through Q_{16}) by virtue of the coupling capacitor and base resistors. The steering transistors operate as emitter followers; the forward biased junction acts as the emitter-base junction; the junction with a reverse bias acts as the base-collector junction. The positive steered pulse appears at the OFF collector and at the ON base of

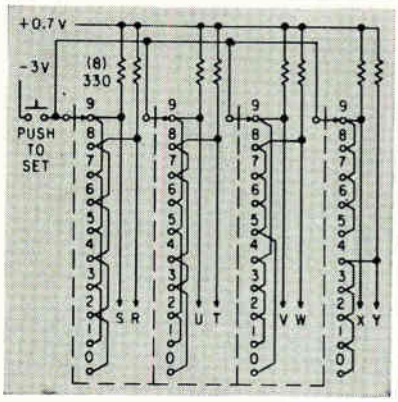


FIG. 3—Ganged switch allows any of ten counter states to be preset. Lines S, R, etc. connect to the circuit of Fig. 2

the flip-flop. An output appears even if the flip-flop is still in the transient condition. The only effect on the flip-flop is to speed up the transition. The *npn* transistors are not specified as bilateral units but at the current levels and speeds encountered their performance is adequate.

By changing the d-c return level of the steering transistor base resistors, the turn-on of the steering transistor can be controlled. Two steering stages are used for each flip-flop, the input of each connected to opposite sides of the previous flip-flop. Gating (count up or count down) is performed by controlling the base-resistor voltage return levels. The ON line is at a negative three volt level while the OFF line is at negative six volts.

Two resistor matrices sense that the count has exceeded the range of binary three through twelve. Their outputs operate either of the two forced-feedback amplifiers, Q_{18} and Q_{19}. Transistor Q_{19} is the forward forced-feedback amplifier which causes a forced zero reset by allowing the $\bar{8}$ $\bar{4}$ 2 1 base resistors to be returned to -3 volts, turning on those stages. Transistor Q_{18} functions as the reverse forced-feedback amplifier, controlling the 8 4 $\bar{2}$ $\bar{1}$ base resistor return level.

A separate isolation amplifier Q_{17} is provided for zero reset, 0 0 1 1, so that all counters can be connected to a common reset line controlled by one transistor amplifier. This base line must be at +0.7 v when counting.

Any positive input transition of 2 to 3 volts in amplitude, with a rise time of less than 1.0 microsecond or a pulse duration greater than 0.25 microsecond allows the counter to operate well above 100 kc.

Separate signal inputs and carry outputs for add and subtract are provided and are connected from the output of the previous decade to the input when cascading counters. This eliminates switching the carry outputs in each cascaded decade counter and allows isolated inputs for the first decade. First stage inputs may be connected together if only one input pulse source is used. When two separate inputs are used, they may be connected to provide control of the count up and count down lines directly. This is indicated in Fig. 1.

A pulse discriminator has been built which allows the counter to operate with random count up and count down inputs simultaneously without loss of information.

The number stored in the binaries may be changed to the nines complement by pulsing either control line to ground with a positive, 3-volt, 2-microsecond pulse. This enables the use of nines complement arithmetic when the counters are used in computers.

Eight resistor-isolated base lines, *S, R, U, T, W, V, Y, X*, shown in Fig. 3, are available for direct preset from any of the ten existing code combinations. These resistors, normally returned to a positive 0.7 v, are momentarily returned to the negative 3-volt level during reset. A four-pole ten-position switch, eight resistors, and a single pole pushbutton switch are required.

Eight inputs 8 4 2 1 and $\bar{8}$ $\bar{4}$ $\bar{2}$ $\bar{1}$ each at 0.5 milliampere minimum are required for the indicator circuit of Fig. 4. The counter supplies these currents directly. Internal amplifiers provide the power to drive the resistor matrix which in turn drives voltage amplifiers controlling the Nixie tube.

The bias method allows the use of an unregulated power supply for the Nixie voltages, which may vary as much as ±20 percent. Reliable operation at high temperatures is maintained by reverse base-emitter bias during turn-off of the amplifiers.

The first binary stage was included in the feedback circuit to provide simple zero set. However, it need not be involved for higher counting speeds. Counters using regenerative type reset circuits and mesa or microalloy transistors are capable of reliable megacycle reversible counting.

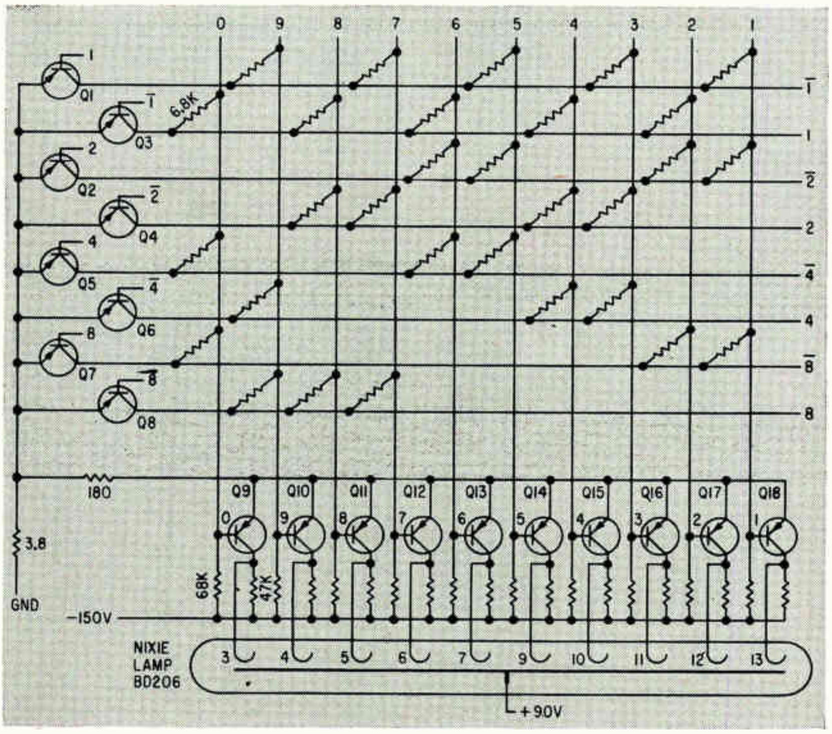
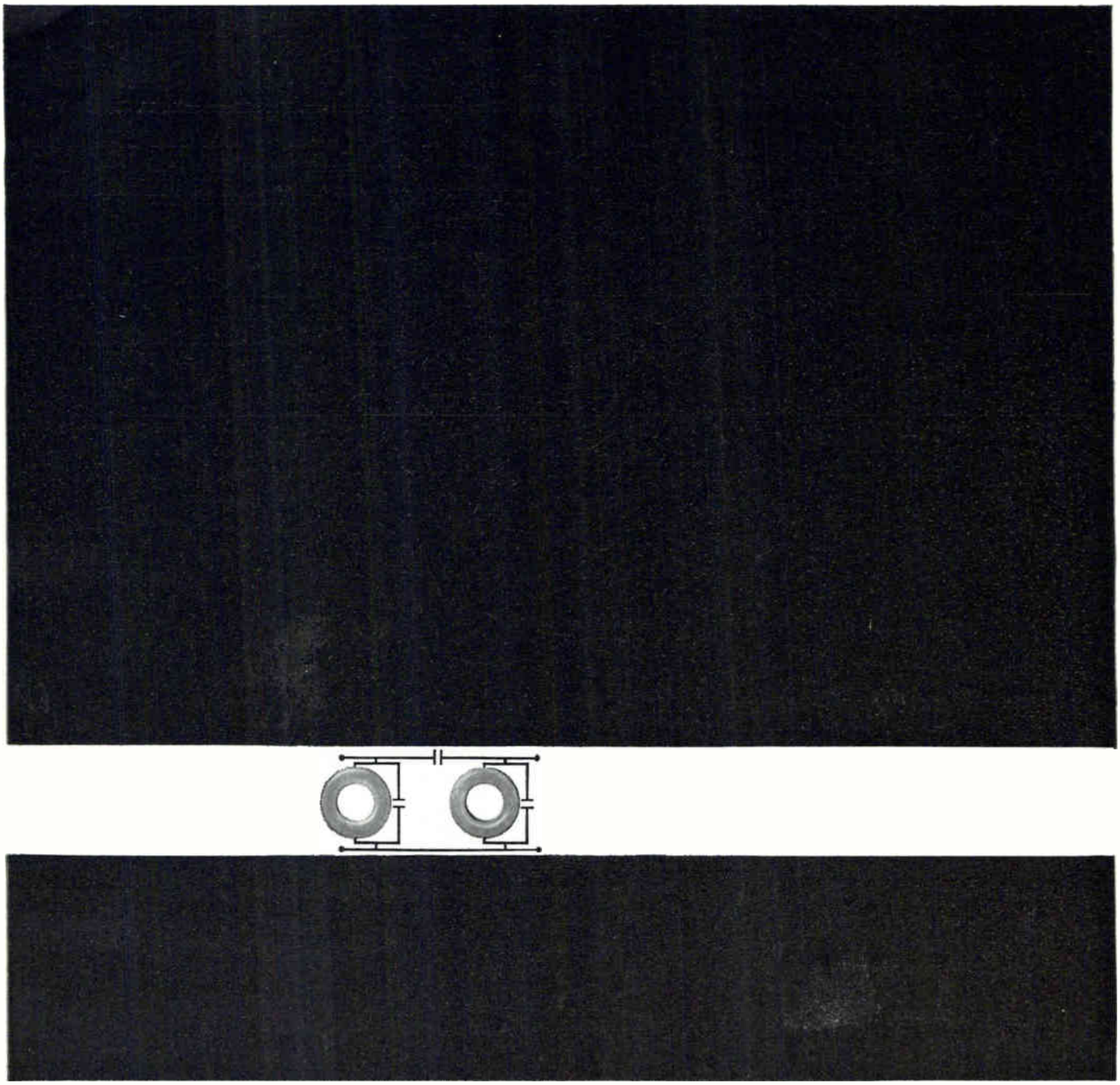


FIG. 4—Readout circuit has high gain, allows 20-percent variation in Nixie lamp supply voltage



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Filter designers! First 160-mu moly-permalloy powder cores pack high performance into smaller space

Filter and inductor designers specify our 160-mu moly-permalloy powder cores for low frequency applications. Where space is precious, such as in carrier equipment and telemetering filters, the high permeability of these 160-mu cores eases the squeeze.

In many cases, 160-mu cores offer designers the choice of a smaller core. In others, because inductance is 28 percent higher than that of 125-mu cores, at least 10 percent fewer turns are needed to yield a given inductance.

If Q is the major factor, 160-mu cores permit the use of heavier wire with a resultant decrease in d-c resistance.

Like all of our moly-permalloy powder cores, the 160's come with a *guaranteed* inductance. We can ship eight sizes from stock, with a choice of three finishes—standard enamel, guaranteed 1,000-volt breakdown finish, or high temperature finish. Further information awaits your inquiry. *Magnetics Inc., Dept. E-78, Butler, Pa.*

MAGNETICS inc.

R-F Cable Hardware

By MORTON POMERANTZ,
Senior Project Engineer, U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J.

TABLE I concludes the cross index of military r-f cables and connectors (ELECTRONICS, p 42, Dec. 25, 1959). Series N, C and BNC may be used up to frequencies of 10 kmc; LC and LT, to 5 kmc; Twin and SM, below 1 kmc. The 60-cycle rms ratings are: N and C, 1,500 volts; BNC and Twin, 500 volts; LC and LT 5,000 volts (LT for higher power); SM, 100 volts.

Table I—Connectors, Procurement Specifications, Mating Cables and Fittings

Connector Nomenclature	Fitting[a]	Series	Procurement Specification	Use With 50-Ohm Cable RG- /U	Use With Other Cable RG- /U	Mating Plug UG- /U	Mating Jack UG- /U	Mating Receptacle UG- /U
UG-18D/U	PS	N	MS91231	212, 222, 143A	6A		20D, 159C	58A
UG-20D/U	JS	N	MS91233	212, 222, 143A	6A	18D		
UG-21E/U	PS	N	MS91236	213, 214, 225	216		23E, 160D	58A
UG-23E/U	JS	N	MS91237	213, 214, 225	216	21E		
UG-88D/U	PS	BNC	MS35168	58C, 223			89C, 261C	1094, 625B
UG-89C/U	JS	BNC	MS35169	58C, 223		88D, 913A		
UG-154A/U	PS	LC	REB49152	219				352B
UG-156A/U	PS	LC	REB49154	220, 221				
UG-157B/U	ASFF	LC	REB49155	220, 221		156A		
UG-159C/U	JSB	N	RE49D489	212, 222, 143A	6A	18D		
UG-160D/U	JSB	N	RE49D489	213, 214, 225	216	21E		
UG-167E/U	PS	N	RE49D215	218				
UG-204( )/U[b]	PS	N	ES-C-178871	217				
UG-260C/U	PS	BNC	MS35170		59B, 62A		261C	1094, 625B
UG-261C/U	JSB	BNC	MS35171		59B, 62A	260C		
UG-352B/U	RS	LC	REB49160	218, 219		1258, 154A		
UG-421A/U[c]	PS	TWIN	REB49326		22B		423A	422
UG-423A/U	JP	TWIN	REB49341		22B	421A		
UG-483/U	JS	N	REB49086	81		186		
UG-486/U	PS	N	REB49088	81			483	58A
UG-532A/U	PS	LT	REB49161	211				
UG-533B/U	ASFF	LT	REB49162	211		532A		
UG-536B/U	PS	N	REB49090	58C, 223			556B	58A
UG-556B/U	JS	N	REB49378	58C, 223		536B		
UG-570A/U	JSB	C	MS35317	213, 214, 225	216	573B		
UG-572A/U	JS	C	MS35318	213, 214, 225	216	573B		
UG-573B/U	PS	C	MS35315	213, 214, 225	216		570A, 572A	569A, 705
UG-603A/U	PS	N	REB49211		59B, 62A			58A
UG-626B/U	PS	C	MS35280	212, 222, 143A	6A		630A, 633A	569A, 705
UG-627B/U	PS	C	MS35286		59B, 62A		631A	
UG-630A/U	JSB	C	MS35284	212, 222, 143A	6A	626B		
UG-631A/U	JSB	C	MS35279		59B, 62A	627B		
UG-633A/U	JS	C	MS35328	212, 222, 143A	6A	626B		
UG-692/U	PS	SM	MS35115		59B, 62A		923	697, 696, 694
UG-699/U	PS	SM	MS35122	58C, 223			700	697, 696, 694
UG-700/U	JSB	SM	MS35123	58C, 223		699		
UG-704A/U	JSB	C	MS90227	58C, 223		709B		
UG-707( )/U[b]	PS	C	ES-C-178872	217				569A, 705
UG-708B/U	PS	C	MS90247	218				569A, 705
UG-709B/U	PS	C	MS90214	58C, 223			704A	569A, 705
UG-710B/U	PRA	C	MS90237	213, 214, 225	216		570A, 572A	569A, 705
UG-711B/U	PS	C	MS90244	211				569A, 705
UG-909A/U	JSB	BNC	MS35169	58C, 223		88D, 913A		
UG-913A/U	PRA	BNC	MS35367	58C, 223			89C, 909A	1094, 625B
UG-923/U	JSB	SM	MS35124		59B, 62A	692		
UG-936B/U	JSB	N	REB49092	215	12A	941B		
UG-937A/U[d]	JSB	C	MS35317 & MS90277	215	12A	573B	943B, 945B	
UG-940B/U	JS	N	MS90292	215	12A	941B		
UG-941B/U	PS	N	MS90293	215	12A		936B, 940B	58A
UG-943B/U	PS	C	REB49195	215	12A		937A	569A, 705
UG-945B/U[e]	PRA	C	MS90237 & MS90277	215	12A		937A	569A, 705
UG-1006( )/U	PS	N		224				
UG-1179/U	PS	LC	SC-C-24456		85A			352B
UG-1189/U	PS	LC	SC-C-32978	189				352B
UG-1258/U	PS	LC	SC-C-26753	218				352B

(a) Key: PS-plug, straight; PRA-plug, right angle; JSB-jack, straight, bulkhead; JPSF-jack, panel, square flange; ASFF-adapter, straight, female-to-female; RS-receptacle, straight (b) Recent modification, not coordinated (c) 95 ohms (d) UG-57A/U with armor clamp (e) UG-710B/U with armor clamp

Microwave Component News
from SYLVANIA

22 TYPES OF FERRITE DEVICES NOW IN FULL PRODUCTION AT SYLVANIA

COMPETITIVELY PRICED

Tee Circulator—FD-TC531—typical of Sylvania's tee circulator and isolator line is this model, which operates at 24 KMC, weighs only three ounces and is 1½" x 1½" x ¾". It is less expensive than conventional phase shift circulators. The line covers from 5.4 to 26 KMC.

Waveguide Isolator—FD-5213A—this miniature X-band isolator is representative of Sylvania's success in miniaturizing these important components. Units from 2.6 to 26 KMC are available.

Coaxial Isolator—FD-151P—representative of Sylvania's coaxial line, it gives octave coverage. The units in this line exhibit unequalled electrical performance and cover the range from 1 through 11 KMC.

Expanded facilities now make it possible for Sylvania to offer 22 different ferrite devices as full production items at competitive prices. These production units represent over one-third of the types now in Sylvania's growing line of ferrite devices.

Modifications of Sylvania ferrite devices can be provided within three weeks. In addition, new types developed to meet your special requirements can be delivered in as little as 60 days, and we can be in full production on these new items within 60 days after design approval.

All ferrite devices in the line are made to Sylvania's recognized high standards and have these characteristics:

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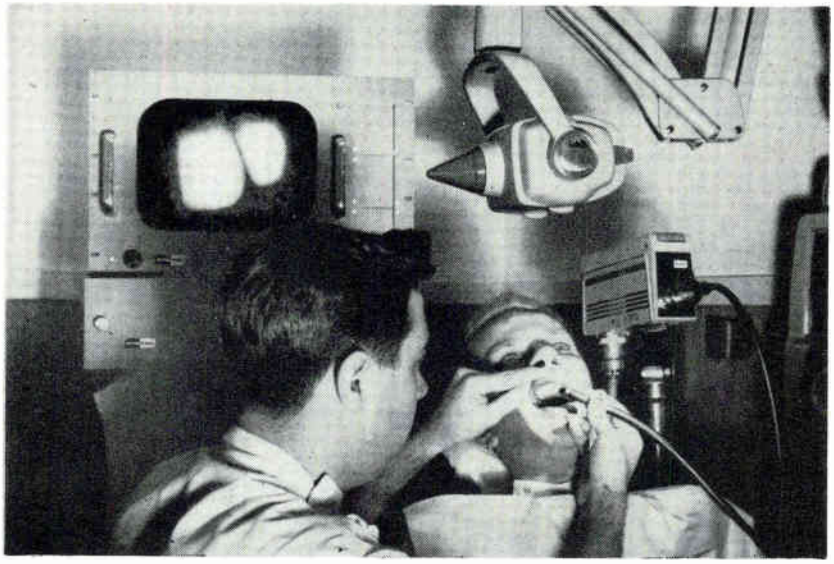


Magnified image of teeth on tv monitor provides dental training aid and assists in diagnosis

LABORATORY experiments indicate the feasibility of applying closed-circuit tv to dental diagnosis and treatment. The prototype system permits dentists to view any part of a patient's mouth, highly magnified, on a tv screen.

The equipment, an optical fiber probe linked to a closed-circuit tv system, may eventually be adapted for medical probes to explore inside the human body.

The dental monitor was recently demonstrated at the U. S. Navy Dental School, Bethesda, Md. It was developed under a feasibility study sponsored by the Office of Naval Research by Avco's Research and Advanced Development division.

The study program was aimed at providing a group-monitoring system for oral operative procedures. Clinical dentistry has been hindered by inability of examiners to explore the oral cavity for simultaneous inspection by others. Tv cameras are now used in limited intraoral dental applications but can view only part of the mouth. They present a difficult lighting problem, and because of their size they are uncomfortable for the patient and on obstruction for the dentist.

The dental probe consists of a bundle of up to 10,000 optical fibers bound in a cable with a lens arrangement at the probing end. The bundle permits separation of sensor of tv camera from the main camera body. The sensor can be introduced into the mouth, permitting a distortion-free, magnified image.

Fiber Optics

Fiber optics involves conduction of light along a transparent dielectric fiber because of multiple internal reflections. Diffraction takes place in the small diameter fiber, which acts like a waveguide.

A fiber consists of flint-type glass clad with another type of glass having a smaller index of refraction. Individual clad fibers have an outside diameter of 0.002 in. with a maximum length of about one meter, providing about 20 percent transmission. In about a year, clad fibers may have been developed with an outside diameter of only 0.001 in.

Each fiber isolates a microscopic element of the image surface. The element of an image focused on one end of the bundle are transmitted to the opposite end and picked up by a tv camera. The picture, made up of thousands of light segments, is presented on the screen with the tooth or portion of it magnified up to 35 times. Selected portions of the mouth or individual teeth can be displayed during actual operative procedures for inspection by other dentists or students.

Fiber Cable

The cable is matched so that opposite ends of a fiber occupy the same geometric position. Intermediate positions of fibers in the cable do not alter the image within broad limits. These characteristics provide generous mechanical flexibility without image distortion. Bending radius for a fiber is twenty times its diameter.

The present device provides bundle sizes from about 1 x 1 in. to 1 x 1 mm cross section. The pickup end of the bundle incorporates a low-power field lens system that images the object at about ½-in. working distance, onto the termination face of the fiber bundle. This end also incorporates a right angle isosceles prism that allows viewing at 90 deg. The camera end has an optical system that projects the image at the end of the fiber bundle onto the photo cathode surface of the vidicon receiver in the camera.

Resolution of a fiber bundle is dependent on individual fiber size as well as optical magnification. For 1-to-1 magnification at the pickup end, the limit of resolution referred to the object is 0.002 in.

The probe field lens system is adjustable for different magnifications ranging from about 2-to-1 magnification to 2-to-1 reduction.

Other Uses

Successful use of the system to explore inside body cavities could illuminate areas not now accessible. They could be displayed in color for inspection by several specialists for immediate consultation and diagnosis.

MHD Generators Offer High Efficiencies

MAGNETOHYDRODYNAMICS, getting considerable attention in relation to space propulsion and re-entry

FEDERAL SIGN and SIGNAL counts on Tung-Sol transistors to power three-in-one sound device

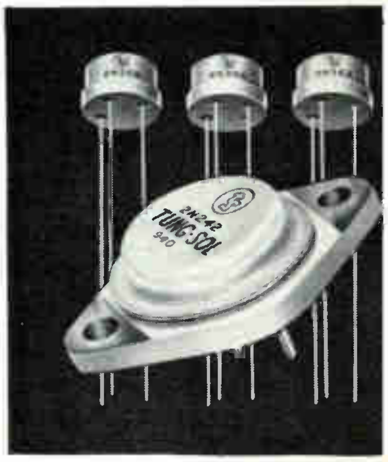
Federal Sign and Signal Corporation has combined a highly directional electronic siren, a mobile public address system and a car radio amplifier into one compact unit. This unique creation, the Interceptor, arms police patrol cars, fire engines, ambulances and civil defense vehicles with a three-pronged weapon to cope with life-and-death emergency.

The Interceptor counts on Tung-Sol power transistors to deliver the necessary three-purpose power with round-the-clock reliability. Federal, in fact, describes the large complement of Tung-Sol 2N242 and 2N382 germanium transistors as "the heart of the unit".

The 2N242 and 2N382 feature tight parameter control, sure-safe hermetic sealing and efficient thermal design . . . qualities which assure peak performance and long life.

Like every other Tung-Sol component, these semiconductors are the products of carefully disciplined factory processes and rough-and-tough life testing aimed at bringing you the best in componentry.

Federal Sign and Signal Corp., the largest manufacturer of sound-producing devices, represents another of the discriminating companies benefiting from Tung-Sol components. Tung-Sol can serve you, too, with premium units for any industrial or military requirements. Get in touch with our applications engineers. They'll be glad to evaluate your circuitry and recommend the components to fit your design. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193.



TUNG-SOL®

problems, may find more down-to-earth applications. A research project is underway to study application of magnetohydrodynamics (MHD) to generation of electric power. A small experimental device using the principle is already successfully producing 10 kw.

Ten power companies represented by American Electric Power Service have joined with Avco in the program. Feasibility and economic advantages of MHD have been under study for about a year.

After another year, the program should indicate expected practicability.

Advantages and Limitations

Aim of the research is replacement of most of the conventional turbine generator. The rotating armature, passing through a magnet field to produce electricity, will be replaced by a super-heated gas. MHD will eliminate much heavy, costly equipment, including part of the boiler, piping, turbine, condenser and boiler feed pumps.

Preliminary investigations indicate that the MHD generator can be 25 percent more efficient than existing systems, while being considerably simpler. Capital costs of an MHD plant will be competitive with costs of a conventional plant.

Moreover, conventional power plants have undergone many years of development with further significant improvements unlikely. The new system, more efficient at the outset, has a long future of refinement and development ahead.

Basic difficulty with the generator is heat, which creates structural problems. To yield electrical power, the gas in the generator must be at high temperature—above 4,000 F. Materials exist that have satisfactorily handled comparable temperatures, but not under the conditions of the MHD system.

Temperatures are well within the range of known gas dynamics problems, the highest temperature in this study being about 5,300 F. MHD does not present the extreme temperature problems involved in nuclear fusion reactors.

One of the two types of MHD generators being considered is a coal-burning, open-cycle plant. It is conceptually similar to conventional gas turbine-steam turbine combinations, with the MHD generator replacing the gas turbine. The plant is scaled to deliver 450,000 kw, with the MHD generator producing more than three-fourths of net total power directly and providing heat for the steam-turbine subsystem.

Coal is added to preheated air and burned to obtain very high furnace temperatures. Furnace gases, seeded with 0.1 percent potassium to increase conductivity, pass through the MHD generator where a large amount of heat energy is converted directly into electrical power. Remaining heat energy produces electricity in a conventional steam cycle.

The MHD generator should be mechanically simple and reliable and can be built to relatively low tolerances at low cost. Biggest problems will be heat and chemical reactions between coal combustion products and structural materials in other components.

Estimates indicate that a heat rate of 6,200 Btu/kwhr (53 percent thermal efficiency) could be obtained. Best conventional power plants are 40 percent efficient.

Nuclear-Fueled Plant

It is difficult to obtain nuclear reactor temperatures as high as furnace temperatures, but there are compensating factors. The nuclear-fueled system can use inert gas—helium or argon, with 1 percent cesium seeding. These combinations provide better conductivity and greatly reduce chemical reactions with structural materials.

With conductivity improved, the system can operate at lower temperatures. A ratio of 5,800 Btu/kwhr is possible. Heat rate is reduced 42 percent over the best nuclear power system now in development.

The nuclear MHD system assumes that a nuclear reactor capable of operation at high temperatures will be available in the foreseeable future. Recent developments indicate that such an assumption is not unwarranted.

The nuclear-cycle MHD system is also proportioned to deliver 450,000 kw. The MHD generator is the same size and has the same field strength as in the coal system.

Recent Advances in Ceramic Capacitors

SIZE REDUCTION of capacitors, previously employing mica, paper and other conventional dielectrics, has been made possible by the introduction of ceramic dielectrics.

The dielectric constant of paper and film dielectrics is only 4 to 5 while that of a good ceramic dielectric is about 1,200. This 240 to 1 ratio comparison becomes even more remarkable when considering available ceramic dielectric materials with constants of about 6,000.

Handicaps

The use of the excellent electrical characteristics of ceramics has been somewhat handicapped because of certain limiting physical properties: poor formability and inherent brittleness.

Progress in ceramic capacitors for the higher capacitance values has been severely limited because ceramic materials are difficult to form and are inherently brittle. The brittle nature of ceramics and consequently the extreme fragility of thin ceramic sections, imposes certain limitations in the processing of thin ceramic sections. Ceramic disc capacitors of 5 mils thickness are now produced in large quantities. Thickness of less than 5 mils however becomes difficult to handle in a practical way. Even 5 and 6 mil sheets must necessarily be limited as to the size and number that can be stacked due to fragility.

Thin Film

New techniques were evolved to arrive at higher capacitive values. The obstacle of fragility was first overcome, at the Hi-Q Division of Aerovox, Olean, N. Y., by forming a thin film of ceramic dielectric on a substrate, which is one of the electrodes and also serves as a support for the fragile film. With this support, extremely thin films can be processed conveniently and high capacities obtained. The thickness of the film employed determines the voltage rating.

The CERAFIL capacitor consists of a single rod element or a multiple of this rod element depending on the capacity value required.

A capacitor rod element is about 1/32 in. in dia with a length determined by the length of the unit desired. The construction consists of a thin film of ceramic dielectric over a previously metallized ceramic rod substrate which acts as one of the electrodes and at the same time serves as a support for the fragile film. The outer surface of the dielectric film is also metallized forming the second electrode. The bundled rods form a cylindrical shaped honeycomb structure, the surface-to-volume ratio of which increases with diminishing rod diameter. The rod diameter selected is the smallest to be within practical methods of processing.

Standard CERAFIL capacitors range in size from 0.090 in. dia by 0.320 in long for the 0.001 μf unit, to 0.310 in. in dia by 0.750 in. long for the 0.1 μf unit. These remarkably ultra-miniature units are designed primarily for airborne and spaceborne electronics, transistorized circuit applications in hearing aids and other critical requirements where space and weight are at an absolute premium.

The CERAFIL construction, however becomes less efficient above the 0.1 μf range and new techniques had to be evolved to arrive at higher capacity values.

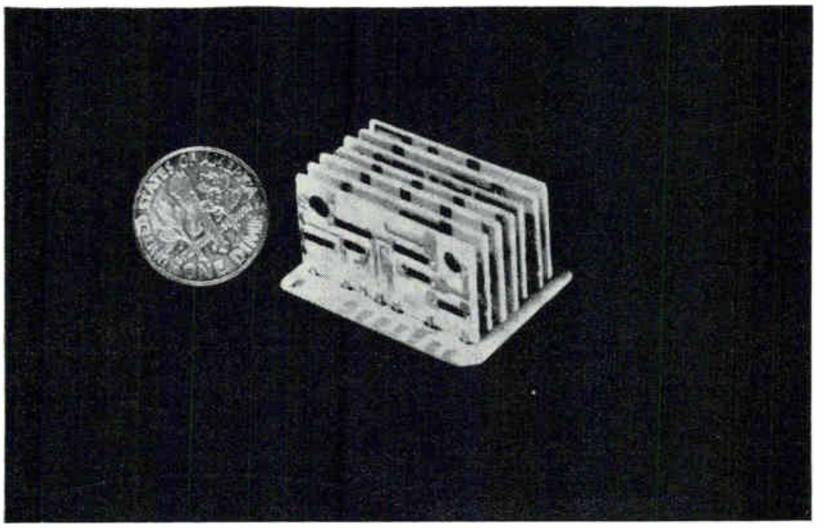
Rolled Sheets

The ability of paper and film dielectrics to be formulated into thin sheets of films capable of being rolled or wound into a section has been the primary reason for their high capacity-to-volume ratio despite their low dielectric constant. It becomes apparant then, that a miniaturized ceramic capacitor with a high capacitance rating could be produced if a thin sheet of ceramic dielectric is rolled.

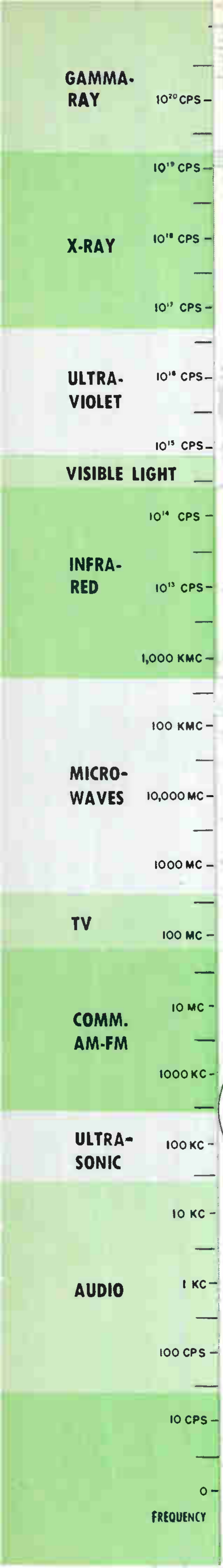
Research at Aerovox, under the direction of Antonio Rodriquez, has resulted in a rolled ceramic capacitor that occupies the high capacity range along with paper and plastic film capacitors, but much smaller in size.

The CEROL capacitor is produced

Ceramic-Based Micro Package



A complete adder circuit, designed for a ballistic missile computer, is here shown in exact size. At present, according to Aerovox Corp., it appears that a good, realistically designed microminiature package should incorporate ceramic based materials of a size not greater than 1¼ in by 1 in, nor smaller than ½ in by 1 in. A base thickness of 0.020 in to 0.035 in is reasonable. This approach incorporates resistance and capacitance linear elements and diode and transistor nonlinear elements



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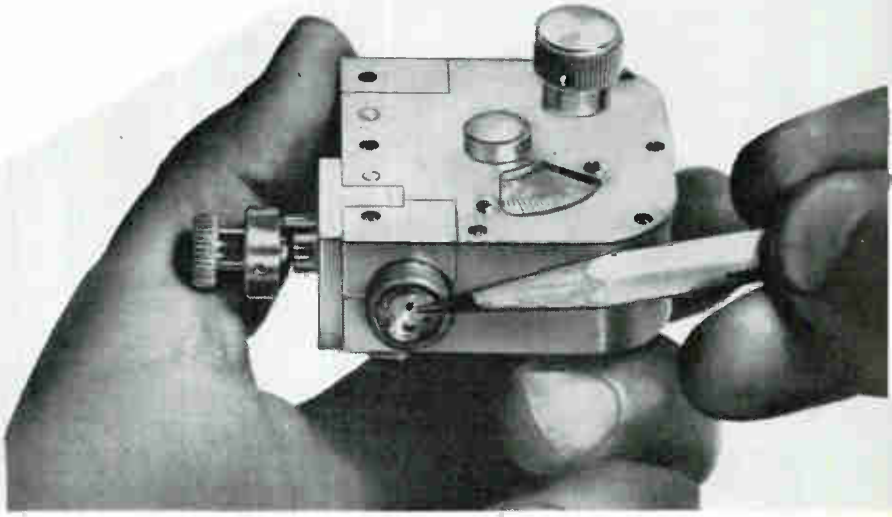
- *Slotted Sections.*
- *Precision Variable Attenuators.*
- *Standard Gain Horns.*
- *E/H Tuners.*

Other components shown below.

Slotted section, shown here, actual size.



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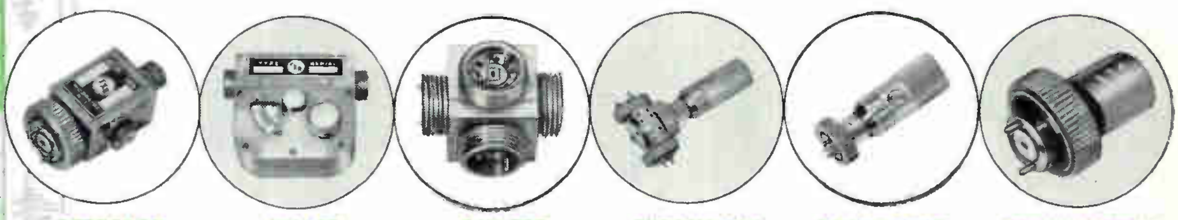

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by a method of processing which permits the rolling of an extremely thin ceramic dielectric film upon which a precious metal is deposited. The rolled ceramic film is then fired. Upon completion of the firing process, the capacitor becomes a compact and monolithic structure that is capable of withstanding severe environmental conditions. Standard units range in size from 0.2 in. dia. by 0.650 in. long for a 0.1 μf unit, to 0.4 in. dia by 1.4 in. for the 2 μf unit. Dimensions are maximum and in all cases conservative. These capacitors are rated for operation at 100-v d-c at temperatures between −55 C to 85 C and at 50 v up to 125 C. Higher voltages will be available upon request. Power factor is 2 percent maximum at 1 kc. Capacitance variation with temperature is 15 to 25 percent over −55 C to 125 C. These capacitors meet spec MIL-C-11015B.

Other Applications

The Hi-Q Division of Aerovox plans to apply the CEROL technique to other ceramic materials and to cover a much broader application. These techniques open up new avenues to circuit design, and enable the designer to take full advantage of the high dielectric constant of ceramics.

With an ever increasing number of applications below 100-v d-c, the company is working to design ceramic dielectrics with a thickness in the order of one mil. An increase in the volumetric efficiency by threefold is expected in the very near future.

Plug-In Capacitors For Printed Circuits

MORE CAPACITANCE in less space is promised by use of plug-in type tantalum capacitors for printed circuits.

Single-Ended

The new capacitors, designated as the TES type, are claimed to be the first single-ended tantalum foil capacitors to be offered commercially. Designed primarily for use in printed circuits in missiles and high-speed aircraft the new capacitors have been used in an electronic stall control system for commercial

Welds of the leads of the plug-in capacitors are completely encapsulated in an epoxy compound. This minimizes possibility of weld failures in assembly, for solder connections can be made close to the encapsulating compound without causing damage

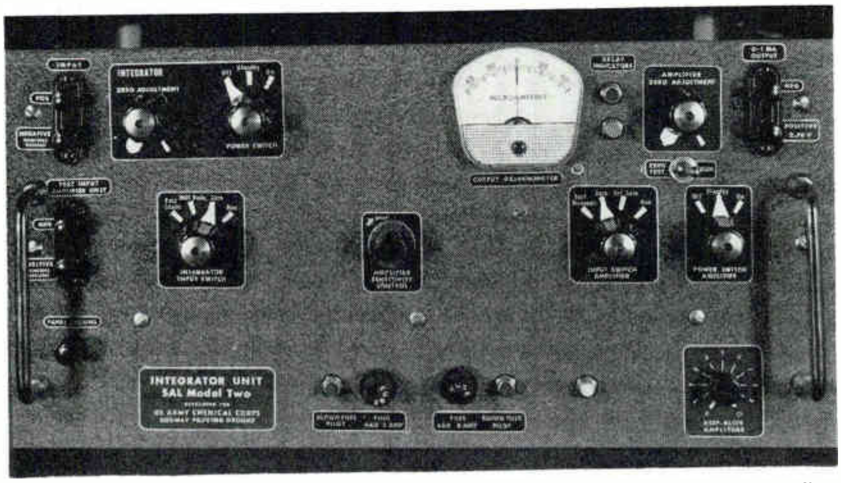
and private aircraft. Non-polar units are useful here because of voltage reversals under some flight conditions. The capacitors are similar in performance to Tansitor axial-type TEF capacitors which meet all the requirements of MIL-C-3965B, except that both leads emerge from one end. This is a key to their compact nature, according to their manufacturer, because a seal is required on one end, with consequent savings in overall length.

Ratings

The capacitors contain a noncorrosive, wet electrolyte and are rated at −55 to 85 C. They are capable of operation at surge temperatures up to 125 C for several hundred hours with some derating in voltage. TES-type capacitors are available with ratings of 3 to 150 v, well over the usual 80-v limit of sintered pellet type tantalum capacitors. They are manufactured by Tansitor Electronics, Inc., Bennington, Vermont. Because welds on the leads of the new plug-in type capacitors are completely encapsulated, soldering can be done very close to the encapsulating compound without damaging the welds. Significant savings in space are thus possible.

Photography Makes Custom Labels

By GEORGE M. KOHLER, Stanford Aerosol Laboratories, Palo Alto, Calif.



One-of-a-kind labels for prototype instrument panel are made from photographically-sensitized aluminum sheets

LABELS BEYOND the scope of standard decals and metal stampings are often required for instrument prototypes, test sets and custom-built equipment. Photographically-sensitized metal sheets can be made into reasonably-priced, attractive labels with special symbols and colors. The surface can be hardened for environmental resistance.

Copy is prepared by standard drafting methods, to any desired scale. Black india ink on white paper or transparent acetate and LeRoy lettering gives good contrast. Trans-adhesive lettering (Monsen, Artype, Zip-A-Tone) gives good results if ink work on acetate is protected from the adhesive by a thin layer of transparent material (Krylon). After use, copy can be saved for future use by stick-up procedures.

The photographic negative should be free of such defects as pinholes. If copy is on transparent acetate, the negative can be contact printed (Fig. 1). Opaque copy is photographed to size with lithographers' film. High contrast negative materials (Kodalith or Reprolith) are ideal. Flaws are spotted out with opaque or india ink, after developments.

Metal prints will be black letters on a shiny metal background. For

Portion of composite negative used to produce all the labels

shiny letters, a postive transparency is made and printed as in Fig. 2. Very clear transparent copy can be used instead of the positive. Best results are obtained from a parallel-beam printer.

The metal plate is printed from the negative, positive transparency or original copy (Fig. 3). Intimate contact assures sharp images. Exposure time in standard contact printing boxes is generally 10 to 40 seconds.

After exposure, the plate is momentarily dipped in water and developed in a standard developer (such as Kodak D-19) for 5 to 7 minutes at room temperature. The plates are rinsed, fixed in hypo for 1 to 2 minutes and washed for 1 minute.

The resulting sepia lines (on metal white background) are converted to jet black by soaking for 5 minutes in a gold chloride-thiocyanate toner (Metalphoto CT-100 or Ansco 231), followed by a water rinse. The white metal can be colored by chemicals supplied by the plate manufacturer (Metalphoto Corp., Cleveland, Ohio). Interesting color combinations can be obtained by masking local areas with stop out varnish, impervious masking tape or waxes before applying the chemicals.

Hardening the Plate

Boiling the finished plate for 30 minutes in distilled water sets the image within a thin layer of anodized aluminum. The coating resists abrasion and misuse.

Individual labels are cut from the plate with shears or a well-adjusted guillotine paper cutter. Odd-shaped cuts are made with a jeweler's saw. Holes should be punched, not drilled, and burrs removed with a fine file. Wrinkled labels can be

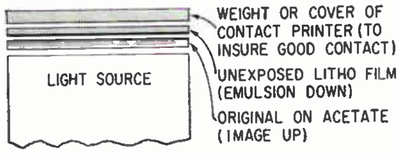


FIG. 1—Arrangement of transparent copy and film to make contact negative

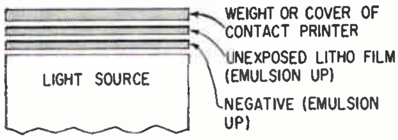


FIG. 2—Arrangement for making positive transparency

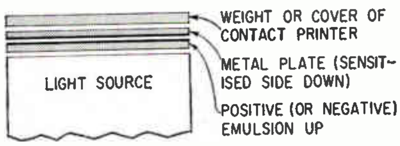
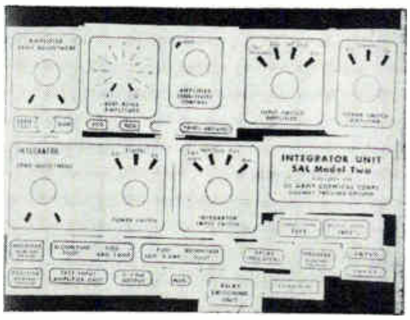


FIG. 3—Arrangement for printing metal plate

straightened by bending.

Labels are cemented to panels. Several celluloid and polystyrene cements work well, but the author has obtained good results with Minnesota Mining and Manufacturing Co. adhesive EC-847. This is coated over the back of the plate and dried thoroughly before the plate is cut. After cutting, the adhesive is reactivated by brushing on methyl-ethyl-ketone (ventilate work area).



Positive transparency made from composite negative

A few seconds later, the label is pressed into place and held for a moment to insure firm adhesion. Excess adhesive is removed with a soft rag. Pressure is applied until the adhesive is hard, about 45 minutes maximum. On flat surfaces, the label is weighted; on curved surfaces a wide rubber band cut from an inner tube is stretched over the label.

Sheets are made in thicknesses from 0.012 to 0.064 inch. Entire panels with labelling, diagrams, instructions and drilling or punching layouts can be printed on a large sheet. The sheet can be cemented to a heavy backing. The process can also be used to produce small lots of special dial plates, graph sheets, compass cards, etc. It is especially suited to marine equipment as the aluminum oxide surface resists salt spray.

Automatically Adjusts Spotwelder's Voltage

WELDING CONTROL developed by The Budd Co., Philadelphia, Pa., automatically adjusts voltage to compensate for variations in resistance spotwelding conditions. The control unit holds voltage across the weld constant, offsetting the effects of variations in such conditions as line voltage, applied force, electrode wear, surface finish and shunting effects.

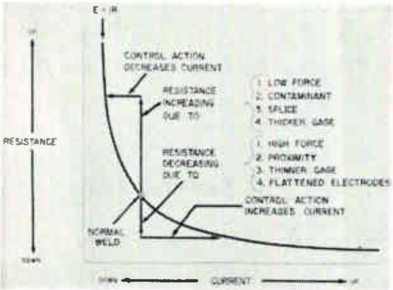
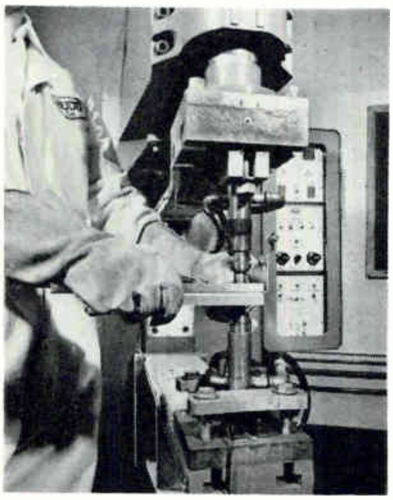


FIG. 1—Graph shows basic method of compensating for variations in welding conditions

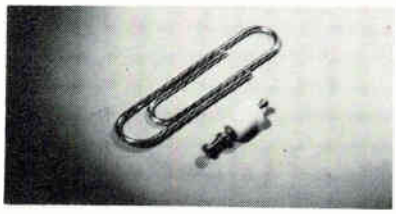


Closeup shows feedback control pickup leads on upper and lower electrodes of spotwelder

Correct fusion temperature is maintained in each weld, the firm reports, by relating the voltage across a given weld area to the ultimate temperature that will occur in the weld. Actual voltage at the electrodes is compared, by feedback and computing methods, with a command voltage. The command voltage is programmed according to metal type, metal thickness and weld strength desired. The action of the control is outlined in Fig. 1.

The control unit, called Monautronic V-2, can be used for any metal that can be resistance-welded, including exotic metals, tungsten and vinyl-clad steel. A unit compatible with existing aluminum welding machines used in the electronics industry will also be made available.

On The Market



Teflon Terminal
longer body

SEALECTRO CORP., 139 Hoyt St., Mamaroneck, N. Y. Type RFT-SM-2 TUR-C4 Press-Fit Teflon terminal is designed for installation in chassis up to 0.125 in. thick. It retains the advantages of Press-Fit one-piece construction that eliminates nuts, washers, and other hardware, together with the insulating characteristics of Teflon.

CIRCLE 301 ON READER SERVICE CARD

Power Amplifier
delivers 20 w

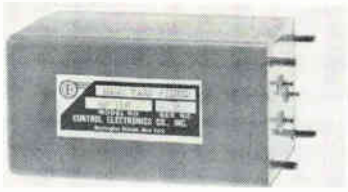
TECHNITROL ENGINEERING CO., 1952 E. Allegheny Ave., Philadelphia 34, Pa. Model ATMS-2001 power amplifier provides a full 20 w of power output over its complete frequency range of 30 cps to 150 kc with only 0.5 db attenuation. It is designed to deliver 20 w from an input signal of only 10 mw. Input impedance is approximately 10 K and the input circuit is provided with a step attenuator to control the amplitude of the input signal. Harmonic distortion is less than 1.5 percent and output impedance is a balanced or unbalanced resistive load of 135 ohms.

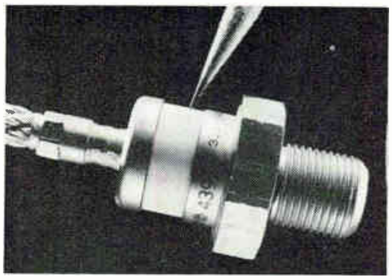
CIRCLE 302 ON READER SERVICE CARD

Audio Filters
modular line

CONTROL ELECTRONICS CO., INC., 10 Stepar Place, Huntington Station, L. I., N. Y. A modular line of audio filters for multichannel band separation use has been made with center frequencies of 1.05, 3.78, 10.6, 21.6, 36.7 and 52.6 kc. Input and output impedances are 2 K ohms, and insertion loss less than 2 db. Size: 2¼ by 2⅜ by 4 in. high.

CIRCLE 303 ON READER SERVICE CARD





Silicon Rectifier
high-voltage

WESTINGHOUSE ELECTRIC CORP., P. O. Box 2088, Pittsburgh 30, Pa. Type 439 silicon power rectifier is for high-current, h-v applications. Units can provide up to 240 amperes of forward current per cell with maximum piv ratings up to 600 v. Maximum reverse leakage current is 50 ma at the rated piv. Features include: operation at high ambient temperatures—up to 190 C at the junction; solid copper base for ruggedness; and small size—with maximum cell length of 3 in.

CIRCLE 304 ON READER SERVICE CARD

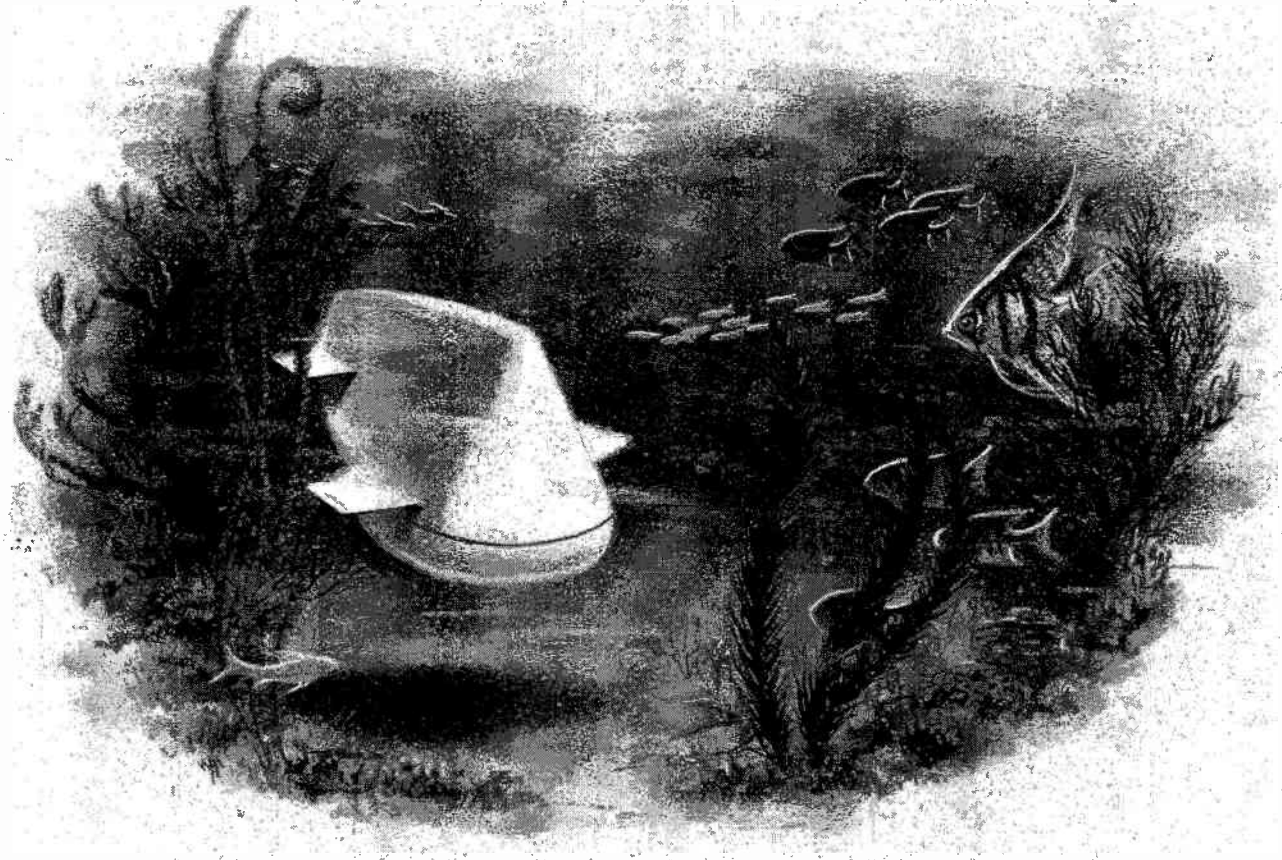
Frame Grid Tubes
very high gain

AMPEREX ELECTRONICS CORP., 230 Duffy Ave., Hicksville, L. I., N. Y. The 6EH7/EF183 is a frame grid remote cutoff pentode, and the 6EJ7/EF184 a sharp cutoff type—both designed for use as an i-f amplifier in tv receivers. Their high transconductance - low capacities, and low feedback capacity, enables the construction of simplified broad band amplifiers with high stability. The higher gain per stage in many instances reduces the number of tubes required in the tv i-f strip.

CIRCLE 305 ON READER SERVICE CARD

Tape Recorder
two-hr cartridge

TELECTRO INDUSTRIES CORP., Long Island City, N. Y. Model TR555 one-hand loading cartridge recorder is especially suited for airplanes, automobiles, boats and other mobile units where vibration is a factor. It uses a 4-track ¼ in. tape. Recorder measures 11½ in. wide, 10 in. deep and 6½ in. high, and weighs 15 lb. A remote control instrument adds to its convenience. The con-



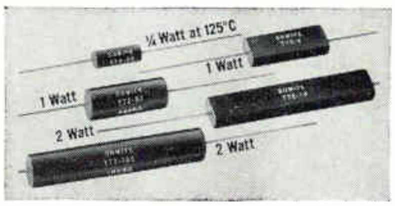
trol permits pushbutton start, stop, selection or playback of any one of the four tracks on the $\frac{1}{4}$ in. tape, which automatically and sequentially records and reproduces two hours of information. Control unit weighs 2 lb and is $5\frac{3}{4}$ in. by 4 in. by $4\frac{3}{4}$ in.

CIRCLE 306 ON READER SERVICE CARD

Neon Noise Sources for 1,120-26,500 mc

KAY ELECTRIC CO., 14 Maple Ave., Pine Brook, N. J., announces a new group of neon noise sources. Designed to operate in the range from 1,120 mc to 26,500 mc, the new neon tubes provide 18 db of excess noise, and are physically interchangeable, in most cases, with present models of the microwave Mega-Nodes, using the Argon tube. Power supplies designed to operate these neon sources are available from stock.

CIRCLE 307 ON READER SERVICE CARD



Resistors metal film

OHMITE MFG. CO., 3655 W. Howard St., Skokie, Ill., has expanded its line of metal film resistors. Line now provides: a new smaller size measuring $\frac{5}{8}$ in. by $\frac{15}{64}$ in. diameter and rated $\frac{1}{4}$ w at 125 C; new 2 w units in both semi- and full-cylindrical shape affording a range to $2\frac{1}{2}$ megohms; and more sizes to meet

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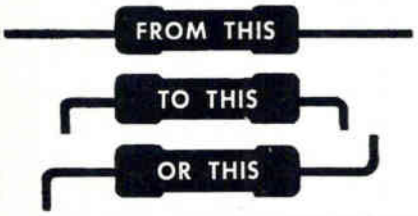

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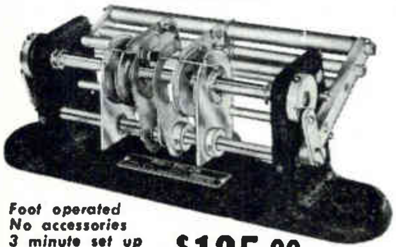

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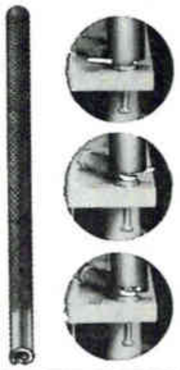

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FREQUENCY	60 CPS	Either 1 KC or 10 KC
FULL SCALE RANGES	±1%, ±5%, ±10, ±20%	±5%, ±10%, ±20%
IMPEDANCE LIMITS:		
Resistance	5 ohms to 5 megohms	5 ohms to 5 megohms
Capacitance	500 mmfd. to 500 mfd.	50 mmfd. to 10 mfd.
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OTHER MODELS AVAILABLE

MODEL	BRIDGE VOLTS	FULL SCALE RANGES
1000	2.5V-1000 CPS	±1, 5, 10%
1025	2V-1 KC, 25 KC	±5, 10, 20%
400	2.5V-400 CPS	±1, 10, 20%
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60-L	.6V-60 CPS	±1, 5, 10, 20%

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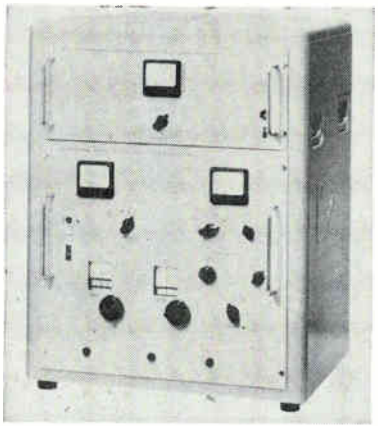
CIRCLE 308 ON READER SERVICE CARD

Oscilloscope Camera easy-to-use

HEWLETT-PACKARD Co., 275 Page Mill Road, Palo Alto, Calif. Model 196A records full-sized oscilloscope patterns without distortion on Polaroid Land film. It uses a standard camera bellows to eliminate light leakage. Its object to image size ratio is 1 to 0.9 to show a full 10 cm graticule width. Lens adjustments may be made without removing the camera from the scope. Model 196A simplifies multiple exposure procedures since a convenient knob moves the lens through 11 detented positions while the camera back remains fixed. The stationary camera back also simplifies tab pulling. Price is $425.

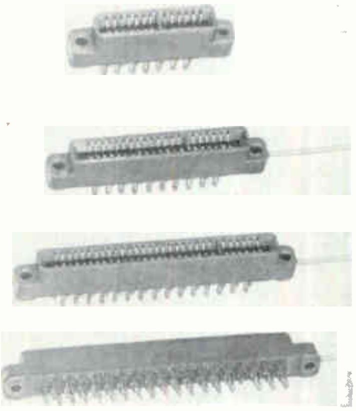
CIRCLE 309 ON READER SERVICE CARD



Synthesizer low frequency

ROHDE & SCHWARZ SALES CO. (U. S. A.), INC., 111 Lexington Ave., Passaic, N. J. Type XUB l-f synthesizer can either be used alone or in combination with the type XUA. Together, they cover the frequency range from 30 cps to 30 mc, with the XUB acting as vernier in crystal-locked steps of 10 cps and a continuously variable oscillator for the interval of 10 cps with a scale graduation of 10 millicycles per division. They cover the range with the accuracy of the master crystal (10^{-8}) $\pm$ 5 millicycles. Used alone, the XUB is a l-f synthesizer ranging from d-c to 100, 1,000 and 10,000 cps in 3 ranges with crystal locked steps of 1; 10; and 100 cps and maximum error of 0.5; 5; and 50 millicycles.

CIRCLE 310 ON READER SERVICE CARD



P-C Connector card-edge type

ELCO CORP., M St. below Erie Ave., Philadelphia 24, Pa. Series 6003 is designed for use in miniaturized electronic equipment with 0.078 contact spacing. Closest tolerances are guaranteed for board slot size, location and contact spacing. The connector employs tuning-fork style contacts, fabricated of beryllium copper, gold plated over silver plate. Phosphor bronze gold plated over silver plate contacts can be supplied on special order. Contacts can be supplied with wire hole termination. The design of either style contact is such that nearly-constant pressure is exerted on any p-c board within NEMA thickness limits.

CIRCLE 311 ON READER SERVICE CARD

Ceramic Parts beryllium oxide

COORS PORCELAIN CO., 600 Ninth St., Golden, Col., is now producing dense ceramic parts with beryllium oxide compositions. These new com-

CIRCLE 109 ON READER SERVICE CARD

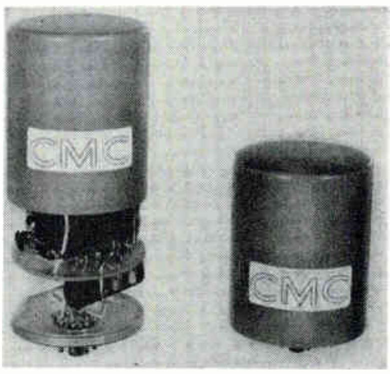
positions retain their strength characteristics at elevated temperatures, exhibit excellent heat transfer properties and have low dielectric constant and loss factors.

CIRCLE 312 ON READER SERVICE CARD

Amplifier peak limiting

COLLINS RADIO CO., P. O. Box 1891, Dallas 21, Texas. The 26U-1 peak limiting amplifier is designed to achieve maximum modulation with minimum distortion. It limits audio passages to prevent overmodulation, distortion and adjacent channel interference while at the same time it allows low level passages to be broadcast in their true range. Transmission range of the station's signal and the overall efficiency of the transmitter are increased through the limiting action which permits a higher average modulation level. A self-balancing circuit eliminates the need of tube selection or delicate balancing procedures. The 26U-1 is capable of 30 db compression.

CIRCLE 313 ON READER SERVICE CARD



Current Standard temperature stable

CONTROL METHODS CO., Foxhollow Road, Rhinebeck, N. Y. This current standard is designed to replace dry cell batteries and standardizing mechanisms or procedures from industrial or laboratory instrument systems. It compensates variations in supply voltage to better than 0.001 percent per v. Temperature variations are compensated to better than ± 0.05 percent over a 70 to 140 F range. Versions are available for potentiometers of various manufacturers.

CIRCLE 314 ON READER SERVICE CARD

Weld Control
transistorized

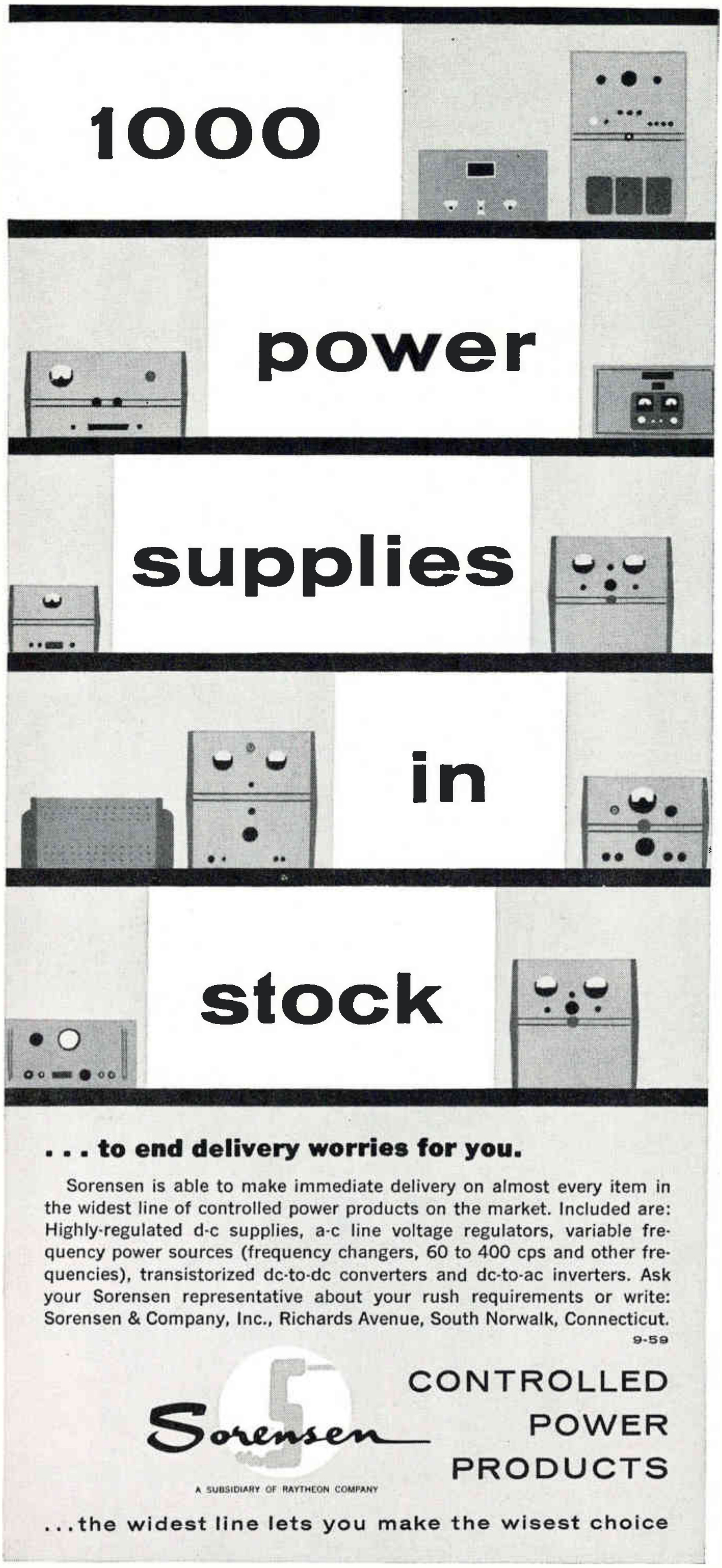
The Budd Co., 2450 Hunting Park Ave., Philadelphia 32, Pa. The Monautronic V-2 weld control utilizes the feedback principle to produce spot-welds of high quality. It overcomes such obstacles to weld quality as line voltage fluctuation electrode wear, variations in electrode tip force, surface finish and shunting. It features automatic lockout, automatic sequencing, modular construction, safety interlock and tamperproof case.

CIRCLE 315 ON READER SERVICE CARD

Capacitors
high temperature

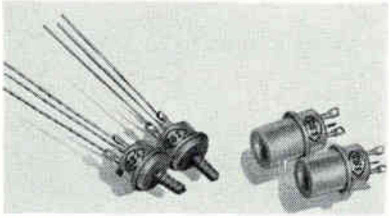
King Electronics, Inc., 915 Meridian Ave., South Pasadena, Calif. The K2R and K2T series capacitors

CIRCLE 111 ON READER SERVICE CARD



have the following features: 150 C temperature stable; microminiature size, to 0.100 by 0.100 by 0.100; 200 wvdc; dielectric strength tested 800 v; 10 $\mu\mu$f to 18,000 $\mu\mu$f 5 percent-10 percent-20 percent.

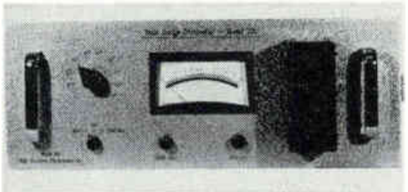
CIRCLE 316 ON READER SERVICE CARD



Power Transistors complementary pairs

CBS ELECTRONICS, 900 Chelmsford St., Lowell, Mass., announces a line of complementary *npn-pnp* power transistors in industrial packages. In complementary amplifier circuits, these eight pairs offer economy, miniaturization and improved frequency response. Negative feedback can be more easily applied. The transistors are mounted in TO-10 and TO-13 packages and are supplied with solder lugs or flying leads. They feature voltages up to 100 v and exceed MIL-T-19500A for audio, control, voltage regulation, servo and computer applications. All types in the line have a maximum collector current of 3 amperes, a minimum large-signal current gain of 30 (for a collector current of 0.5 ampere), and a maximum thermal resistance of 3C/W.

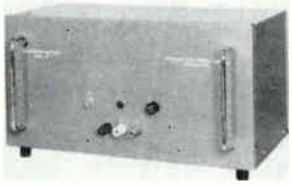
CIRCLE 317 ON READER SERVICE CARD



Ohmmeter wide range

MID-EASTERN ELECTRONICS, INC., 32 Commerce St., Springfield, N. J. Model 701 is especially suited to the accurate measurement of semiconductors because of the extremely low test potential applied to the specimen being tested. At one ohm the power dissipated in the sample is 0.036 mw, and at 500 K only 0.0004 μw. Range is 50 milliohms to 5,000 megohms, with center scale ranges of 0.5, 5, 50, 500, 5K, 50K, 500K, 5M, 50M, and 500M ohms. Accuracy is approximately ±3.0 percent of scale length. The voltage applied to the sample is 30 mv at infinity; 15 mv at center scale; and 7.5 mv at quarter scale.

CIRCLE 318 ON READER SERVICE CARD



Electronic Battery transistorized

AMERICAN ELECTRONIC LABORATORIES, INC., 121 N. Seventh St., Philadelphia 6, Pa. Model 175 electronic battery is designed to replace a storage battery or storage battery and floater combination in those applications where the ultra stability, regulation and output characteristics necessitated the use of wet cell batteries. It will deliver 5 amperes at 6 v with line regulation of 0.01 percent for changes from 105 to 125 v and load regulation is 0.05 percent from no load to full load. Output noise and ripple is less than 1 mv rms and recovery time for either line or load transients is 0.001 sec.

CIRCLE 319 ON READER SERVICE CARD

Testing Facility current transformer

KNOPP INC., 1307-66th St., Oakland 8, Calif. Type CCT-1 is especially engineered for use in the aviation and missile industry. It is a complete testing facility for obtaining ratio error and phase angle of 400-

cycle instrument current transformers having primary ranges from 0.5 to 600 amperes and a secondary rating of 5 amperes. Overall accuracies in the order of 0.01 percent and 0.5 minute are attained.

CIRCLE 320 ON READER SERVICE CARD

Silicon Solar Cells high-efficiency

TEXAS INSTRUMENTS INC., P. O. Box 312, Dallas, Texas. Silicon solar cells are available in a rectangular configuration, measuring 1 by 2 by 0.05 cm, both in single units and shingle arrays. Units possess a high degree of mechanical ruggedness and when formed into shingle arrays are guaranteed to resist a minimum static load of 16oz per contact without rupture. The TIN2009, one of the series of diffused-junction units, provides a typical efficiency of 9 percent and a spectral emissivity of 0.7 at 4 microns wavelength illumination, 0.4 at 11 microns. Cells are capable of 22.5 mw output at 56.5 ma and 0.4 v per cell when operated under sunlight levels as found in near space.

CIRCLE 321 ON READER SERVICE CARD

Transformers plate and filament

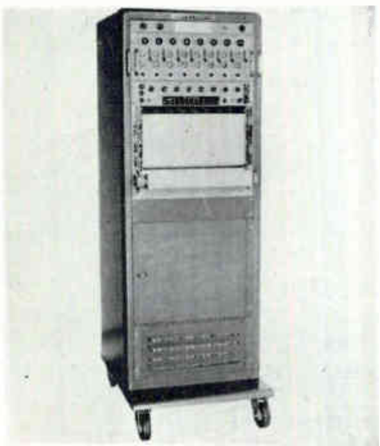
SORENSEN & CO., Richards Ave., South Norwalk, Conn., has available three models of voltage-regulated plate and filament transformers especially designed for critical electron-tube power supplies. Regulation of d-c plate voltage measured at input to filter is ±3.0 percent, against line variations of 100 to 130 v a-c. The units also provide 5.0 and 6.3 v a-c filament voltages, regulated to ±3.0 percent. The new transformers can replace conventional, unregulated plate and filament transformers with output capabilities up to 380 v d-c at 250 ma.

CIRCLE 322 ON READER SERVICE CARD

Silicon Mixer Diode
low noise

MICROWAVE ASSOCIATES, INC., Burlington, Mass. the 1N21F silicon microwave mixer diode is for superheterodyne receiver use at frequencies from 100-4,000 mc. The 1N21F calculated overall receiver noise figure is 6.0 db maximum measured with a 1.5 db 30 mc i-f amplifier. Vswr is 1.3 (max.) and i-f impedance limits are 350-450 ohms. The diode has immediate applications in low noise mixers following parametric preamplifier stages, vhf/uhf scatter communications and navigational receivers, and permits design of all solid-state r-f receivers for very low noise signal reception at these frequencies.

CIRCLE 323 ON READER SERVICE CARD



Recording System
direct writing

SANBORN CO., 175 Wyman St., Waltham 54, Mass. Model 958-1500 is a high gain, general purpose oscillographic recording system. It provides 8 identical recording channels for floating or grounded inputs and

CIRCLE 117 ON READER SERVICE CARD

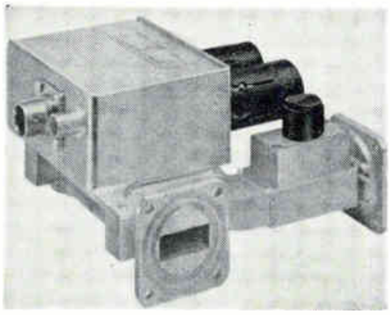
a recording sensitivity of $10\mu v$ to 0.1 v per chart division. The all-transistorized electronics of the system is mounted behind a single 7-in. high panel.

CIRCLE 324 ON READER SERVICE CARD

Oscillator Packages
miniature

MONITOR PRODUCTS CO., 815 Fremont, South Pasadena, Calif., announces a complete line of new transistorized oscillator packages. Miniature sized, the frequency range is 400 cps to over 100 mc. The units have been designed to meet extreme environmental conditions.

CIRCLE 325 ON READER SERVICE CARD



Mixer-Preamplifier
matched assembly

LEL, INC., 380 Oak St., Copiague, L. I., N. Y. The MMX-2 matched microwave preamplifier unit covers the 8.5 to 9.6 kmc range, has a minimum gain of 25 db, a maximum noise figure of 7.5 db, and a 50 ohm i-f output at 30 or 60 mc. It is available with or without an integral variable attenuator in the local oscillator arm. MMX-2 is a mechanically and electrically integrated unit which will provide optimum receiver performance and enable the user to avoid the electrical problems which often arise from the use of an unmatched assembly.

CIRCLE 326 ON READER SERVICE CARD

Bandpass Filters
small size

APPLIED RESEARCH INC., 76 South Bayles Ave., Port Washington, N. Y. Model HFF(C) family of bandpass filters operate in the range 300 to 1,000 mc. Units are designed for military environmental conditions. They operate from a 50-ohm and into a 50-ohm impedance and have a skirt selectivity ratio of less than 3 to 1. Typical of the filters is a unit for operation at 332 mc with 3 db bandwidth of 24 mc. With this center frequency, weight of the filter is 20 oz. Dimensions of the case are $5\frac{1}{8}$ in. long by $1\frac{11}{16}$ in. wide by $3\frac{1}{4}$ in. high.

CIRCLE 327 ON READER SERVICE CARD

Metal Specimens
single crystal

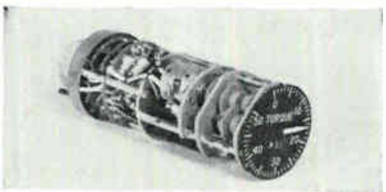
FLOW CORP., 85 Mystic St., Arlington 74, Mass. A large number of randomly-oriented single crystal specimens in aluminum, cadmium, copper, lead, nickel, silver, tin and zinc are now available as off-the-shelf items in many standard sizes and shapes. Company can also supply a variety of special specimens.

CIRCLE 328 ON READER SERVICE CARD

Black Glass
beads and cases

CORNING GLASS WORKS, Corning, N. Y., has developed black glass that is impervious to light for enclosure of silicon semiconductor devices. Designated Code 9361, it is offered in the form of beads and cases for sealing to standard 0.017 Dumet lead wires. The glass filters out virtually all wavelengths of the ultraviolet, visible and near infrared spectrum. Silicon semiconductor crystals are sensitive to such radiation.

CIRCLE 329 ON READER SERVICE CARD

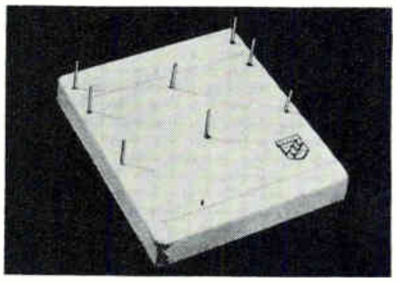


Servo Indicator
transistorized

SERVO DEVELOPMENT CORP., 567 Main St., Westbury, N. Y. Designed

to operate where high input impedances are required, the model 20-200-4 aircraft servo indicator has an input impedance of 100,000 ohms to 1 megohm. Completely contained in a MS-33639 2-in. diameter by 5-in. long hermetically sealed case, the indicator will operate in an ambient temperature range of – 55 to + 70 C. It has a sensitivity of 0.1 percent, a gain of 10,000 and a slewing time of approximately 4 sec for full scale.

CIRCLE 330 ON READER SERVICE CARD



Delay Line
high reliability

ESC Corp., 534 Bergen Blvd., Palisades Park, N. J., announces model 15-52 delay line for high reliability computer applications. Designed for printed wiring assembly techniques, it has raised bearing surfaces to prevent moisture trapping. The unit has a delay time of 0.5 μsec tapped at 0.1 μsec intervals; impedance is 100 ohms; rise time is 0.1 μsec. Dimensions are 0.375 in. by 2 in. by 2.28 in.

CIRCLE 331 ON READER SERVICE CARD

Hand Winder
heavy duty

Geo. Stevens Mfg. Co., Inc., Pulaski Road at Peterson, Chicago 46, Ill., has available a versatile heavy duty hand winder designed for lab and production use permitting winding speeds of 300, 400, 800 and 1,800 rpm at full $\frac{1}{2}$ h-p torque rating. Model 510-AM winds wire gages as heavy as No. 10 Awg on spools up to 8 in. diameter as well as extremely fine wires at speed selected by conveniently located shift lever. Maximum coil o-d is 12 in., maximum loading distance between headstock and tailstock 12 in. and output end of spindle $\frac{3}{4}$ in., keyed slot.

CIRCLE 332 ON READER SERVICE CARD

Literature of the Week

VOLTMETER. Southwestern Industrial Electronics Co., 10201 Westheimer, Houston 27, Texas. An illustrated bulletin covers features of the model R-2 voltmeter, and specifies its applications—such as measuring the regulation of power supplies, the resolution of potentiometers, and the linearity of amplifiers.

CIRCLE 375 ON READER SERVICE CARD

ELECTRIC MOTORS. Hysyn Electromotive, subsidiary of Telecomputing Corp., 915 N. Citrus Ave., Los Angeles 38, Calif. An illustrated brochure describes extreme precision hysteresis synchronous electric motors.

CIRCLE 376 ON READER SERVICE CARD

R-F CABLES AND CONNECTORS. Western International Co., 45 Vesey St., New York 7, N. Y., has available a 28-page reference manual listing r-f cables and connectors.

CIRCLE 377 ON READER SERVICE CARD

REMOTE CONTROL SYSTEM. Texas Instruments Inc., 13500 N. Central Expressway, Dallas, Texas. A recent issue of *Application Notes* describes a remote-control system that gives good performance with inexpensive transistors. The system components, a transmitter and a receiver, are described separately and suggestions for adjusting the system for optimum performance are presented.

CIRCLE 378 ON READER SERVICE CARD

INFRA-RAY GAGE. Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J. A 4-page folder details equipment and operating principles of a new non-contact radiation-operated gage which measures and records the width of hot strip traveling at speeds as fast as 2,000 fpm.

CIRCLE 379 ON READER SERVICE CARD

MICROPHOTOMETER. Applied Research Laboratories, Inc., P. O. Box 1710, Glendale 5, Calif. A 4-page bulletin describes the Spectroline Scanner, a new projection comparator - microphotometer for spectrographic analysis.

CIRCLE 380 ON READER SERVICE CARD

POWER SUPPLIES. Electronic Measurements Co., Inc., Eatontown, N. J. Bulletin 422 is a 12-page short-form catalog of Regatron power supplies and calibrators.

CIRCLE 381 ON READER SERVICE CARD

SOLDERING SUPPLIES. Johnson Mfg. Co., Inc., Mt. Vernon, Iowa. Catalog C-1 contains complete descriptions of fluxes, solders and supplies for all soldering applications.

CIRCLE 382 ON READER SERVICE CARD

IMPEDANCE BRIDGES. Electro Measurements, Inc., 7524 S. W. Macadam Ave., Portland 19, Ore. Catalog sheet C-16 gives details on the 250 series portable universal impedance bridges.

CIRCLE 383 ON READER SERVICE CARD

ROTARY SOLENOIDS. Pacsol, Division, Illinois Tool Works, 3155 El Segundo Blvd., Hawthorne, Calif. A new brochure on rotary solenoid products and systems is now available.

CIRCLE 384 ON READER SERVICE CARD

DPDT CHOPPERS. Airpax Electronics Inc., Cambridge, Md. Synchronous modulator-demodulator functions are performed in single dpdt choppers described in bulletin C-43.

CIRCLE 385 ON READER SERVICE CARD

QUARTZ CRYSTAL MEASUREMENTS. Rohde & Schwarz, 111 Lexington Ave., Passaic, N. J. Reprints of a paper entitled "Measuring Instruments For Determination Of Electrical Characteristics Of Quartz Over The Range From 0 to 300 Mc" can be obtained by qualified persons by letterhead request.

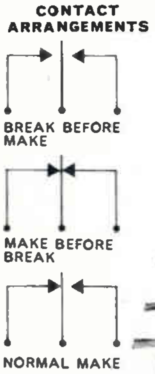
PHOTOTRANSISTORS. General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y. An 8-page brochure G-190 describes a complete line of *pnp* germanium alloy junction phototransistors which combine high speed response and high sensitivity.

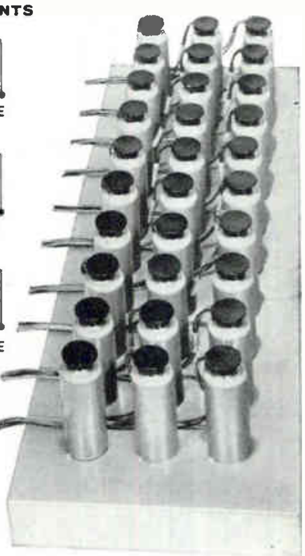
CIRCLE 386 ON READER SERVICE CARD

μ/ volt signals
μ/seconds operating
at 0-200 cps

THE
JAMES "Micro-Scan" RELAY

FOR COMPUTOR, MULTIPLEXING AND INSTRUMENT APPLICATIONS





- DPDT AND SPDT MODELS
- CONTACT RATING—0 to 10 VOLTS AT 1 MA.
- OPERATING TIME—LESS THAN 750 MICROSECONDS
- DRIVING SYSTEM—
  0-200 CPS SYNCHRONOUS AND ASYNCHRONOUS
  LESS THAN 500 MILLIWATTS
  POLARIZED
  CENTER TAPPED COIL
- THERMAL NOISE—LESS THAN ONE MICROVOLT
- INSULATION—EXCEEDS 10^{10} OHMS
- POSITIONING—NON CRITICAL
- VIBRATION AND SHOCK RESISTANT

The Micro-Scan Relay is available in a wide range of standard models. James solicits your engineering inquiries toward the application of this new concept in relays into your system design.

Write Direct for Full Engineering Specifications

Dept. E-1

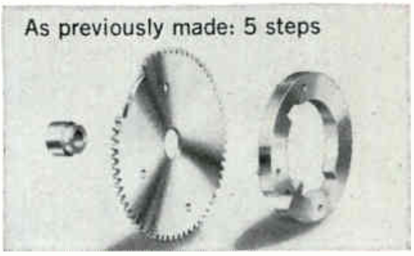
JAMES VIBRAPOWR COMPANY
4050 N. Rockwell St., Chicago, Ill., COrnelia 7-6333

CIRCLE 236 ON READER SERVICE CARD

APPLIANCE TIMER GEAR MADE IN ONE STEP INSTEAD OF 5

Shown actual size

with tiny GRC zinc die casting



This mutilated gear, cam and bushing combination for an electrical appliance timer formerly required two stampings, a screw machined part and two assemblies. Die cast by GRC in one automatic operation reduced costs 66%, and made a superior product. Closer tolerances and greater uniformity were achieved by casting in one piece. Units were ready to use as cast, with no secondary operations, no scrap loss. Another demonstration of the production economies and wide design latitude Gries' exclusive methods have made possible. Only the GRC Method gives such complete design freedom for small precision parts.

NO MINIMUM SIZE!
Maximum Sizes: 1¾" long, ½ oz.

Write today for fact filled bulletin.
Send prints for quotations.

GRIES REPRODUCER CORP.
World's Foremost Producer of Small Die Castings
151 Beechwood Ave., New Rochelle, N. Y., NEw Rochelle 3-8600

GRIES

CIRCLE 203 ON READER SERVICE CARD

new GEN-PRO®
TAPER PIN TERMINAL BOARDS

TPB-20-S

New single row Taper Pin Terminal Board available in 10 or 20 feed-thru type taper receptacles, single and double feed-thru connections. Ideal for computer and data processing programming, multi-channel communications systems, etc.

EASY TO MOUNT AND STACK

Barriers across both faces increase creepage path; elongated holes facilitate mounting; nesting projection and recess aid stacking. Brass receptacles provide low contact resistance. 14 lbs. min. pull out with standard solderless taper pins. Molding compound is MAI-60 (Glass Alkyd) of MIL-M-14E.

Gen-Pro boards have passed Navy 2,000 ft. lb. high shock requirements as specified by MIL-S-901B.

WRITE NOW FOR FURTHER DETAILS

GENERAL PRODUCTS CORPORATION
Over 25 Years of Quality Molding
UNION SPRINGS, NEW YORK TWX No. 169

CIRCLE 123 ON READER SERVICE CARD

IEEI Enters New Quarters

INDUSTRIAL ELECTRONIC ENGINEERS INC., which engineers and manufactures fully automatic systems and in-line digital displays, announces the move to a new location in North Hollywood, Calif. The expanded facilities contain 10,000 sq ft, completely air conditioned.

The new plant houses executive offices, sales display room, engineering and drafting departments, as well as production facilities. Also included in the structure is an electronic laboratory, model shop and a complete photographic studio.

Industrial Electronic Engineers Inc. has been in business since 1945 and distributes its products nationally and internationally through representatives in principal cities. The company manufactures a complete line of rear-projection-type readout devices. Its engineering work embraces the development and manufacture of fully automatic systems and controls such as automatic warehousing equipment.

IEEI is engaged primarily in the commercial field. Recent months, however, have seen introduction of the company's in-line digital displays into ground support equipment of the missile industry.

Name Hughes Division G-M

WILLARD A. HUGHES has been appointed general manager of the Microwave Division, Kearfott Co. Inc., Van Nuys, Calif., manufacturer of precision microwave components and test equipment. He has served the division for a number of years as chief engineer and, most recently, as assistant general manager.

In his new capacity, Hughes has appointed D. F. Metcalf as chief engineer; N. P. Weinhouse as manager of the engineering technical office; and W. R. Biderman as quality control manager for the Microwave Division.

Realigns

INFRARED INDUSTRIES, INC., Waltham, Mass., announces the formation of two new divisions—the Photoconductor Division and the Controls Division—to facilitate development, production and marketing in these specific areas.

E. Douglas Reddan, president of the company, also announced the following personnel changes:

William E. Standring, Jr., formerly plant manager, to general manager of the Photoconductor Division; Stuart D. Grandfield, from contracts manager to sales manager of the Photoconductor Division; and Gunther Kleeberg, from assistant technical director to general manager of the Controls Division.

Promote Bunnell To Sales Manager

MORT V. BUNNELL was recently named sales manager of the Avnet Corp., west coast firm supplying electrical connectors and other parts to aircraft, missile, electronic and allied industries.

Prior to joining Avnet as assistant manager of engineering and sales in 1958, Bunnell had served as district sales manager of AMP, Inc., and earlier as applications engineer with the west coast Scintilla division of Bendix Aviation Corp.

Epsco Appoints Two To Board

WALLACE E. RIANDA and David Bakalar were recently appointed to the board of directors of Epsco, Inc., Cambridge, Mass.

Rianda is an Epsco vice-president and general manager of Epsco-West, Anaheim, Calif.

Bakalar is president of Transitron Electronics Co., Wakefield, Mass. Transitron was founded in

1952 by David and Leo Bakalar and in the ensuing years has grown to a company whose worth is estimated at $150 million.

Radio Receptor Fills Key Posts

RADIO RECEPTOR CO., subsidiary of General Instrument Corp. and largest unit in the corporate Defense and Engineering Products Group, has announced three key appointments and promotions.

Ralph Mendel, a vice president of Radio Receptor, previously with the company's Engineering Products Division, has been named general manager of its new Advanced Development Laboratory at Westbury, N. Y.

Arnold M. Wolf, formerly vice president for manufacturing and engineering at Lewyt Corp., has joined Radio Receptor as vice president of its Engineering Products Division at Brooklyn, N. Y.

Seymour D. Gurian, who has served with Radio Receptor for 10 years in senior sales and engineering posts, has been named vice president in charge of military marketing.

Appoint Griffin Divisional Mgr.

JOSEPH H. GRIFFIN is appointed divisional manager of the Seminole Division of Airpax Electronics Inc., Fort Lauderdale, Fla. His duties will encompass supervision of all phases of plant operation including engineering, production and product planning.

Griffin joined Airpax in March of 1959 as special sales representative to the Missile Center at Cape Canaveral. Prior to this he was president of the Avionics Corp. of America, an organization which he founded in 1947.

News of Reps

Flow Corp., Arlington, Mass., manufacturer of random signal measuring instruments, announces the appointment of three new engineering sales reps. **Broger Instrument Sales Co.** of Brookline, Mass., has been assigned the New England territory. **Martin Electronic Marketing Association, Inc.** of New York City will cover eastern Pennsylvania, New Jersey and the greater New York area. **Burt C. Porter Co.** of Seattle, Wash., will handle sales in Washington, Oregon, Idaho, Montana and Alaska.

Marty Bettan Sales of Flushing, N. Y., is named sales rep for Ward Products Co., Amsterdam, N. Y., to cover the metropolitan New York area. Ward manufactures a complete line of automobile radio antennas as well as antennas for the communications industry.

U. S. Transistor Corp., Syosset, L. I., N. Y., has appointed sales reps in a number of cities. These include the following:

William B. Seaton Associates, New York City; **Fred Wamble Sales Co.,** Montgomery, Ala.; **Burt Anderson & Associates,** Chicago, Ill.; **J. W. Marsh Co.,** Los Angeles, Calif.; **Frederick L. Ohmer,** Dayton, Ohio; **C. E. Snow Co.,** Philadelphia, Pa.; **Cirolia Leblanc Sales Corp.,** Waltham, Mass.; **Walter J. Brauer & Associates,** Cleveland, Ohio; **John W. Richardt Co.,** Pine Brook, N. J.; **F. C. Somers & Co.,** Kansas City, Mo.; **Harry Estersohn,** Philadelphia, Pa., and **Oliver C. Wolf,** Onondaga, N. Y.

Engineering Services Co. of Indialantic, Fla., has been selected to represent Telemeter Magnetics, Inc., Los Angeles, Calif., in the state of Florida.

COMMENT

Medical Electronics

Just a note to commend you for recognizing that medical electronics is an important and stimulating field of engineering. We have a small group at the University that is making this field a profession. All of us in the group appreciate hearing—through your excellent magazine—of new developments in the field.

K. E. BIGNALL
UNIVERSITY OF MICHIGAN
ANN ARBOR, MICH.

It's a stimulating field for us to explore. We've had a spate of articles on the interrelations of medicine and electronics recently, and we're naturally following the subject with continued interest.

Thyristors

The article by Messrs. von Urff and Ahrons ("How to Generate Accurate Sawtooth and Pulse Waves," p 64, Dec. 11 '59) was well presented. However, it seems to me that the big, important thing is glossed over too lightly. Apparently this thyristor of theirs can be easily pulsed *off* with a base control signal. Here is a point that should be made more strongly.

FRANK C. ALEXANDER JR.
SWARTHMORE, PA.

The theory and background of the device were covered in "The Thyristor, a High-Speed Switching Transistor," IRE Tranactions on Electron Devices, Jan. '58; and in "Solid-State Thyratrons Available Today," Electronics, p 50, Mar. 6 '59. The former article was referenced in the text; both articles were mentioned in the Bibliography at the end of the article. And the sixth paragraph of the article begins "When a positive pulse is applied to the base, the transistor turns off. . ."

Ultrasonics in Medicine

In the issue of ELECTRONICS for Dec. 11 '59, there is an article entitled "Medical Ultrasonics: What's New" (p 28). In the first paragraph of the subsection entitled "Ultrasonic Neurosurgery" . . . your writer has said:

"Focused high-energy ultrasonic beams have been used to produce circumscribed destruction of deep-seated ganglia (a benign growth) in the brains of animals."

. . . The ganglia of the brain are not benign growths, but closely packed collections of ganglion cells, which is the old neurological term for neurones or nerve cells. The closely packed cells of a particular ganglion are often those with a similar function, but not necessarily so. It is believed that in some human disorders such as Parkinson's syndrome, the seat of the trouble is in the basal ganglia (so called because they are near the base, or deep part, of the brain).

Destruction of these "deep-seated ganglia" has been carried out by surgical methods for several years, and the application of ultrasound to this problem is simply an instrumental extension of existing therapeutic ideas.

On the other hand, there are benign growths elsewhere in the body (particularly on the wrist, back of hand or foot, sometimes behind the knee) which are known as ganglia simply because they are knotted clumps of fibrous or cystic tissue; but they have nothing whatever to do with the brain. I imagine your writer looked up *ganglia* in the dictionary and found *a benign growth*, so he stuck the wrong meaning in the sentence.

Ultrasound might possibly be used one day in the treatment of growths within the brain, but this has not been attempted to date; and in any event there are no brain growths known as ganglia. . .

ROGER M. MORRELL, M.D.
MONTREAL NEUROLOGICAL INSTITUTE
MONTREAL, QUE.

Take the parenthesis out and the sentence is perfectly correct. What actually happened is that the man who wrote the article assumed that everyone knew what ganglia were; our copy desk felt less confident and looked it up. Reader Morrell's guess is pretty close.

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DISENCHANTED ENGINEERS

If your present employer has failed to utilize your full potential, why not permit us to explore the parameters for your personal qualifications with the many dynamic young companies in aviation, electronics, missiles and rockets. We now have in excess of 4,000 openings in the $8,000 to $40,000 bracket, all of which are fee paid. Why wait? Send resume in duplicate at once indicating geographical preferences and salary requirements.

FIDELITY PERSONNEL
1530 Chestnut Street, Philadelphia 2, Pa.
Established 1943

Manufacturing Vice President

. . . With excellent record of accomplishment in directing large Eastern multi-plant operation in Radio, Television and Electronic Components, desires similar or administrative position in Electronics industry on West Coast. Available for interview Los Angeles or vicinity early January.

P-3321, Electronics
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

TELECOMMUNICATIONS ENGINEER

Major eastern railroad now actively engaged in every area of communications is seeking experienced communications engineer who desires:

Practical application of his training and experience in an essential industry.
Salary range $9,000 year and benefits with definite growth potential leading to management positions.

Candidate should have 3 to 5 years experience in communications field.
Send confidential resume to

MR. R. R. HICKS
Director of Personnel Services
N. Y. CENTRAL SYSTEM
New York 17, N. Y.

To Employers Who Advertise for Men:

The letters you receive in answer to your advertisements are submitted by each of the applicants with the hope of securing the position offered.

When there are many applicants it frequently happens that the only letters acknowledged are those of promising candidates. Others do not receive the slightest indication that their letters have even been received, much less given any consideration. These men often become discouraged, will not respond to future advertisements and sometimes even question if they are bona fide.

We can guarantee that *Every Advertisement Printed Is Duly Authorized.* Now won't you help keep our readers interested in this advertising by acknowledging every application received, even if you only return the letters of unsuccessful applicants to them marked, say, "Position filled, thank you." If you don't care to reveal your identity, mail them in plain envelopes.

We suggest this in a spirit of helpful co-operation between employers and the men replying to Positions Vacant advertisements.

Classified Advertising Division
McGRAW-HILL PUBLISHING COMPANY
"Put Yourself in the Place of the Other Fellow"

ELECTRONIC ENGINEER

Opening in growing concern located in university town in southwest. 2 to 8 years experience in circuit design, telemetering, transistor circuitry, or data handling required. Pleasant working and living conditions.

DORSETT LABORATORIES, INC
P. O. Box 862 Norman, Oklahoma

EMPLOYMENT PROBLEM?

When you are in need of specialized men for specialized jobs, contact them through an employment ad in this publication.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES
EQUIPMENT - USED or RESALE

DISPLAYED RATE

The advertising rate is $24.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. An ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page. EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.40 a line, minimum 3 lines. To figure advance payment count 5 average words as a line. BOX NUMBERS count as one line additional in undisplayed ads.

RADIO RESEARCH INSTRUMENT CO.

550 FIFTH AVE. NEW YORK
JUDSON 6-4691

1 MEGAWATT PULSER

MIT Radiation Lab Model 9 pulser. Desc. in "Rad. Lab. Series" Vol. 5, pps. 152-160. Supplies 1 megawatt output using 6C21 tubes. Complete modulator 115v 60 cycle input enclosed in single cabinet. Also 22000v power supply for magnetron in second cabinet. As new condition. In stock for immediate delivery.

AN/APS-10 3 CM. X BAND RADAR

Complete RF head including transmitter, receiver, modulator. Uses 2J42 magnetron. Fully described in MIT Rad. Lab. Series Vol. 1, pps. 616-625 and Vol. II, pps. 171-185, $375.00. Complete X band radar system also avail. incl. 360-deg. antenna, PPI, syn. pwr supply. Similar to $17,000 weather radar now in use by airlines. $750 complete.

10 CM. WEATHER RADAR SYSTEM

US Navy Raytheon 275 KW peak output S band. Rotating yoke Plan position Indicator. Magnetron supplied for any S band frequency specified, incl. Weather Band, 4, 20 and 80 mile range, 360 degree azimuth scan. Sensitive revr using 2K28/707B and 1N21B. Supplied brand new complete with instruction books and installation drawings. Can be supplied to operate from 32VDC or 115 volts. Price $950. Ideal for weather work. Has picked up clouds at 50 miles. Weight 488 lbs.

ANTENNA PEDESTAL SCR 584—MP 61B

Full azimuth and elevation sweeps, 360 degrees in azimuth, 210 degrees in elevation. Accurate to 1 mil. over system. Complete for full tracking. Complete description in McGraw Hill Radiation Laboratory Series, Volume 1, page 284 and page 209, and Volume 26, page 233.

AUTOMATIC TRACKING RADAR

SCR 584 is in like new condition, ready to go, and in stock for immediately delivery. Ideal for research and development, airway control, GCA, missile tracking, balloon tracking, weather forecasting, antiaircraft defense, tactical air support. Write us. Fully Desc. MIT Rad. Lab. Series, Vol. 1, pps. 207-210, 238, 284-286.

CIRCLE 460 ON READER SERVICE CARD

GENERATORS

High frequency, 400 cycles, also available in variable voltage and variable frequency at any voltage and phase desired. Driven by constant speed motors or variable speed motors, A.C. or D.C. Control panels also available. Large stock on hand. Write for catalogue and prices.

Reliable Electric Motor Repair Co.
19 California Avenue, Paterson, N. J.

CIRCLE 461 ON READER SERVICE CARD

PROFESSIONAL SERVICES

ALBERT PREISMAN
Consulting Engineer
Television, Pulse Techniques, Video Amplifiers, Patent technical consultation.
616 St. Andrews Lane, Silver Spring, Maryland

READERS MAY CONTACT

the consultants whose cards appear on this page with the confidence justified by the offering of these special services NATIONALLY.

If there is anything you want

that other readers can supply

OR . . . something you don't want—

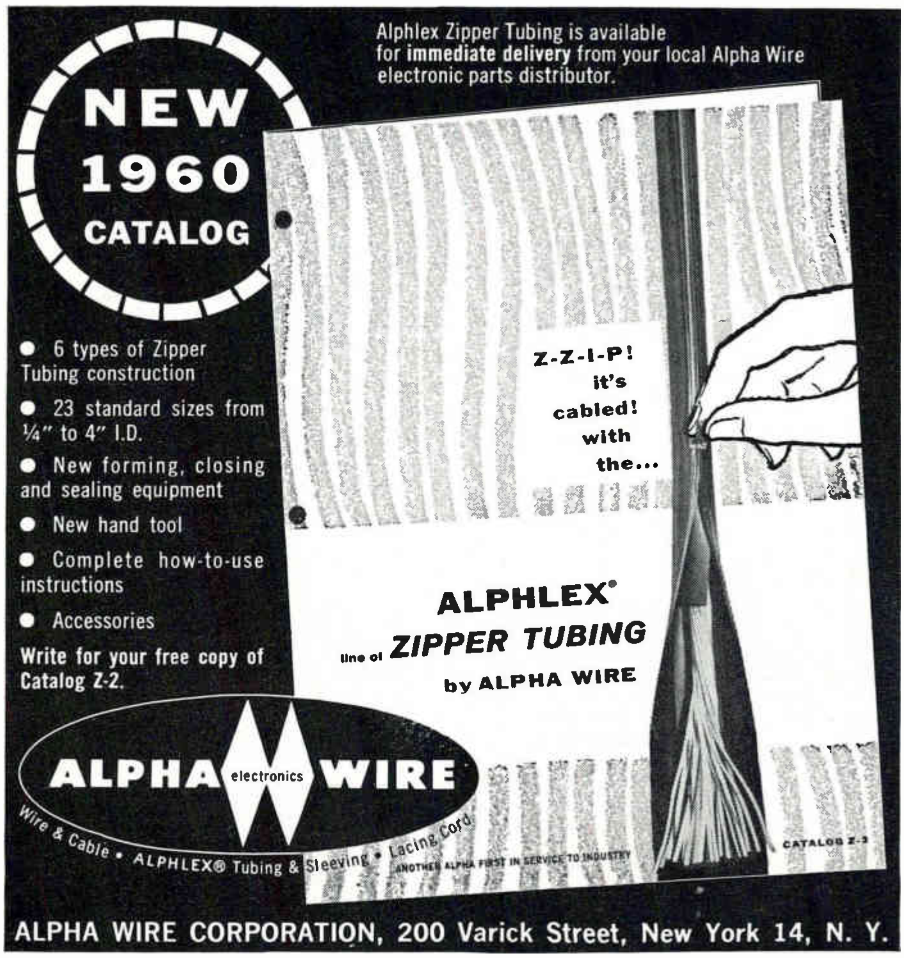
that other readers can use—

Advertise it in the

SEARCHLIGHT SECTION

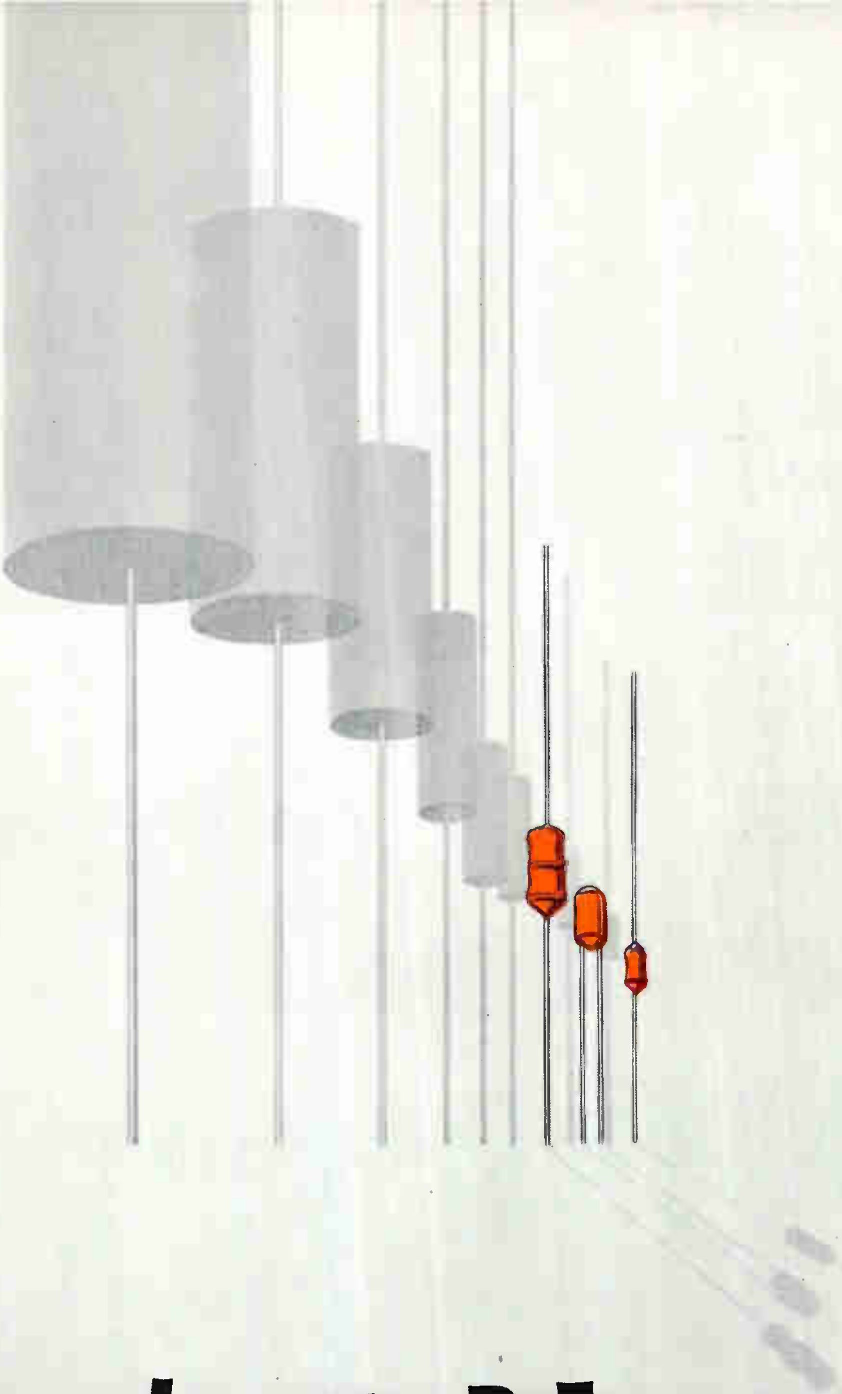
INDEX TO ADVERTISERS

● See advertisement in the June, 1959 Mid-Month ELECTRONICS BUYERS' GUIDE for complete line of products or services.



● See advertisement in the June, 1959 Mid-Month ELECTRONICS BUYERS' GUIDE for complete line of products or services.

This Index and our Reader Service Numbers are published as a service. Every precaution is taken to make them accurate, but ELECTRONICS assumes no responsibilities for errors or omissions.



The INCREDIBLE SHRINKING RESISTOR...

Daven has always been the leader in the miniaturization of precision wire wound resistors. Now, due to further advances in resistor manufacture, Daven is able to offer higher resistance values in smaller sizes than ever before. Typical miniature units, with their new maximum values, are tabulated here.

For guided missiles, airborne radar, telemetering, and for any application where extremely small size and dependability are of prime importance, specify Daven miniature wire wounds.

TYPE	DIAM	LENGTH	MAX WATTS	MAX OHMS
1250	1/4	1/2	.33	1 Megohm
1274	3/16	3/8	.25	250 K
1284	1/4	27/64	.25	1 Megohm

THE DAVEN CO. LIVINGSTON, NEW JERSEY

TODAY, MORE THAN EVER, THE DAVEN Ⓓ STANDS FOR DEPENDABILITY!