

July 1, 1960

# electronics

*Electrical explosion of fine metallic wire may be useful  
for spaceship propulsion and optical radar. Circuits for  
both detonation and instrumentation are described on p 43*

*Ashe*

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# Creative Microwave Technology

Published by MICROWAVE AND POWER TUBE DIVISION, RAYTHEON COMPANY, WALTHAM 54, MASS., Vol. 2, No. 1

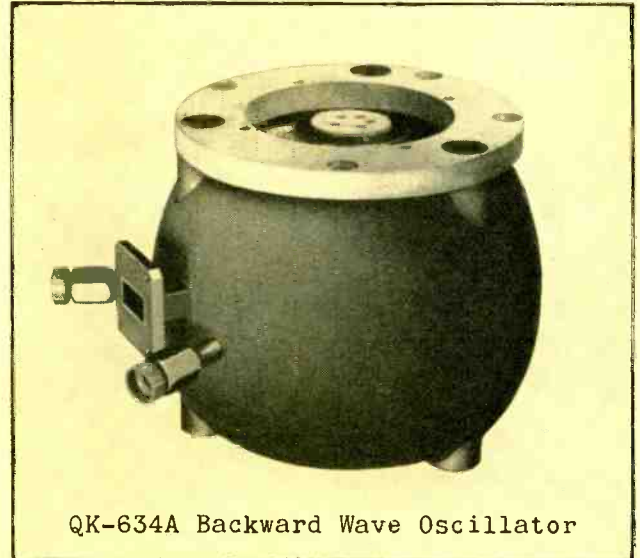
## RAYTHEON "M"-TYPE BACKWARD WAVE OSCILLATORS

Electronically tunable at high power levels  
for a wide range of microwave applications

Where extensive frequency mobility is required, the efficient crossed-field, "M"-type backward wave oscillator is highly versatile. Introduced more than eight years ago, it has been perfected by Raytheon and is now being economically mass produced. Hobbing of the slow-wave structure, a Raytheon-developed technique, assures precision construction necessary for consistently reproducible performance from tube to tube.

Typical of the "M"-type BWO's available from Raytheon is the QK-634A, an X-band tube which features all ceramic-and-metal construction for reliable operation under extreme environmental conditions.

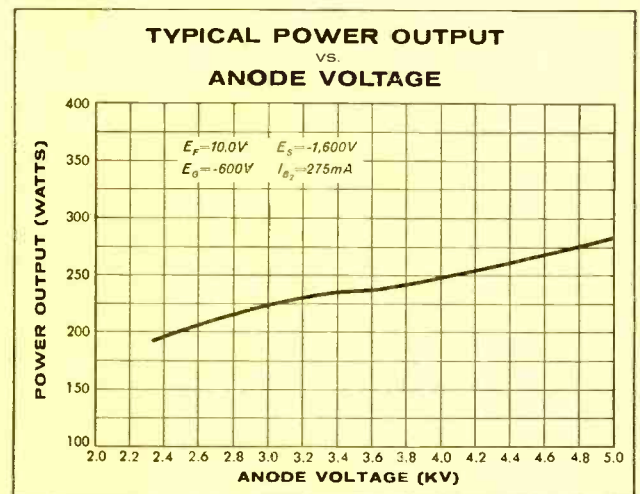
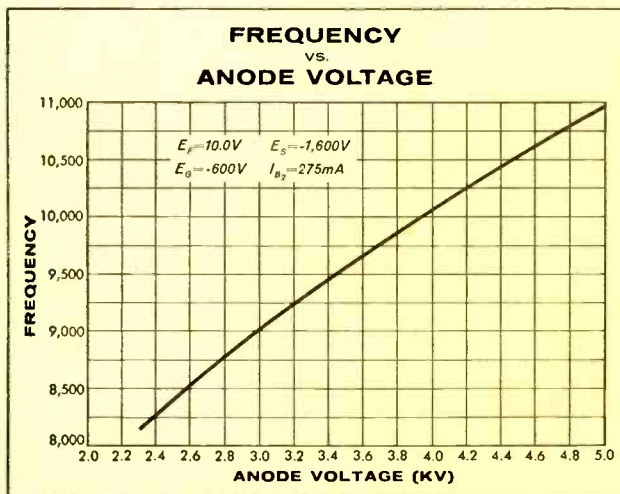
The QK-634A has a nominal power output of 200 to 250 watts and is electronically tunable over its entire frequency range. Precise determination of the radiated spectrum is accomplished by adjusting the voltage applied to either the anode or the sole. Amplitude modulation is also accomplished electronically. Small and compact, the QK-634A can be mounted in any position.



QK-634A Backward Wave Oscillator

### Typical Operating Characteristics--QK-634A

|                          |                              |
|--------------------------|------------------------------|
| Frequency Range .....    | 8,150 to 11,000 Mc           |
| Power Output .....       | 150 watts (min.)             |
|                          | 200 to 250 watts (nom.)      |
| Output Flange .....      | Mates with UG40A/U           |
|                          | modified for clearance holes |
| Tuning Sensitivity ..... | 1.0 Mc/V                     |



Other unclassified BWO's in this series include the QK-625 and QK-659, which cover the 2,500-4,450 Mc band.

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

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# electronics

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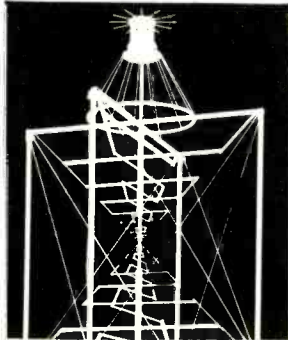
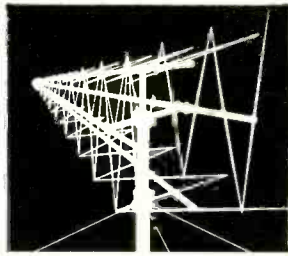
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# BROAD-BAND LOG-PERIODIC ANTENNAS FROM GRANGER ASSOCIATES



Specifications for typical Granger Associates log-periodic antennas  
(Models 720 and 721 shown)

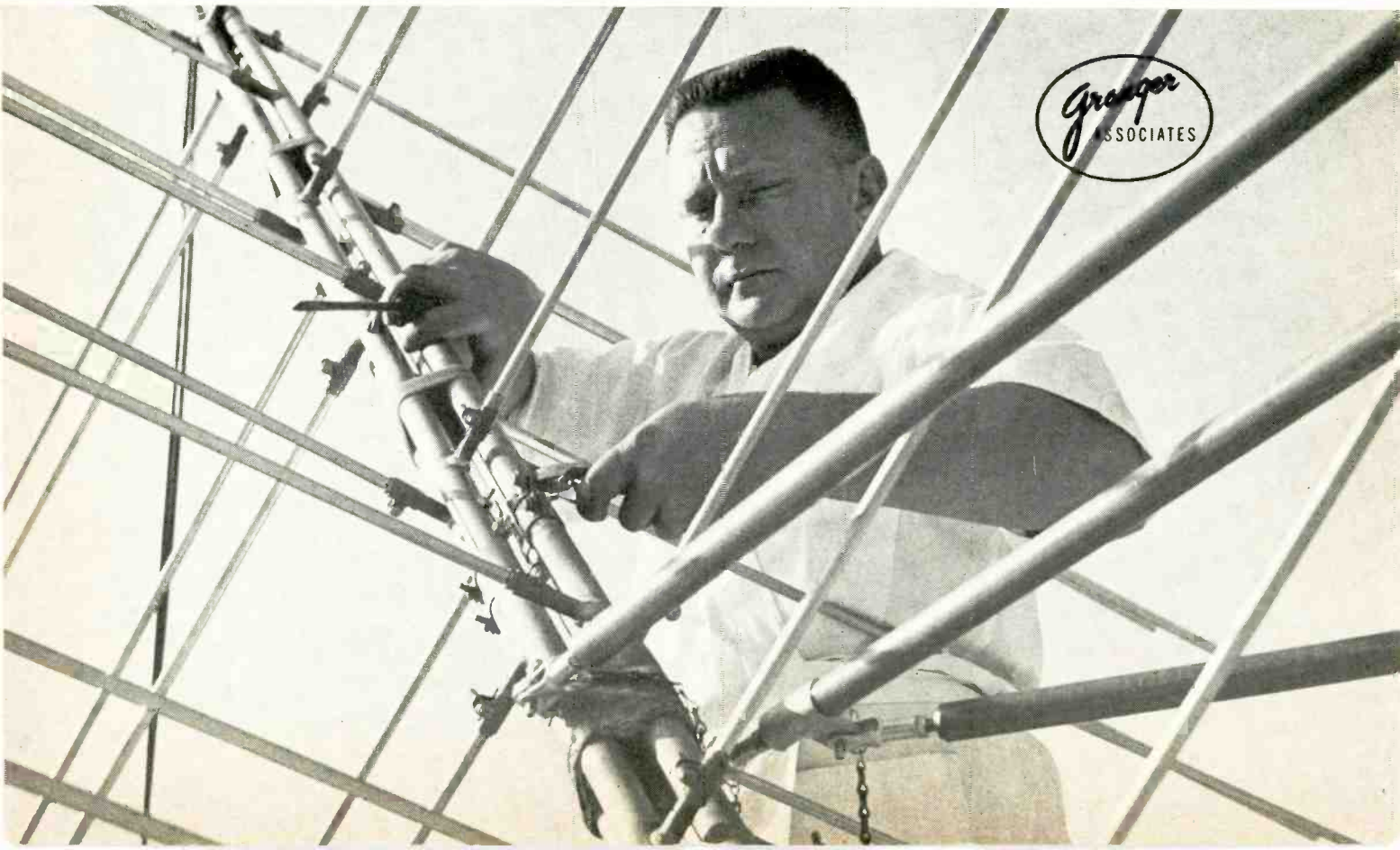
|                         | Model 720<br>(uni-directional)                            | Model 721<br>(omni-azimuthal)         |
|-------------------------|---|---------------------------------------|
| Frequency range         | 50 to 1000 megacycles                                     |                                       |
| Polarization            | Linear, remotely selected vert. or horiz.                 |                                       |
| Pattern Beamwidth       | Typical   |                                       |
| Horizontal Polarization | Azimuth 60 deg.<br>Elevation 60 deg.                      | Azimuth 360 deg.<br>Elevation 55 deg. |
| Vertical Polarization   | Azimuth 60 deg.<br>Elevation 60 deg.                      | Typical discone<br>patterns           |
| VSWR                    | 3.6:1 relative to 50 ohms over the band                   |                                       |
| Environment             | withstands 100 mph wind; 1/2" ice coating                 |                                       |
| Dimensions              | 75" high & wide<br>76" long; mounted<br>on 36" guyed mast | 176" high; 92"<br>wide & deep         |

Note: Model 720 is provided with 360 deg. azimuth drive at 2 rpm with left-stop-right controls and remote position indicator.

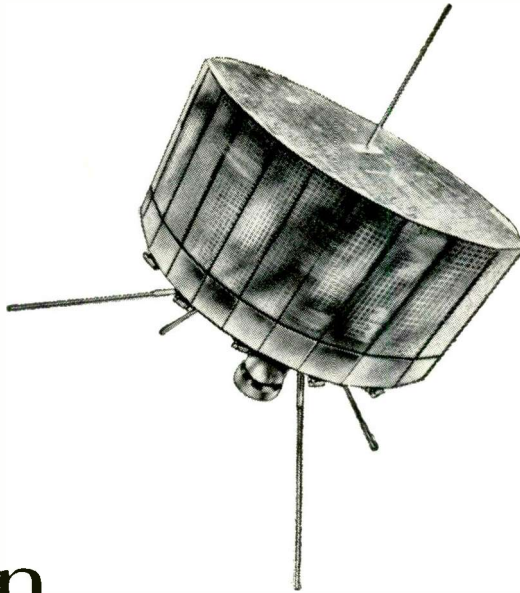
Bandwidth of ten to one or greater independent of frequency—that's why system planners in communications, back scatter, range instrumentation, signal intercept and ECM are excited about log-periodic antennas. Translating this new theory into practical hardware is a specialty of Granger Associates; one of the few organizations that not only understands the concept, but actually builds log-periodics and delivers them to highly satisfied customers. Our accomplishments in this category include omnidirectional designs, high gain pencil beam designs, designs that permit remote selection of polarizations, feeds for reflectors, direction finders, scanning and switched beam arrays. System planners will also find G/A an excellent source for low noise preamplifiers, receiving multi-couplers, wide-band baluns, special purpose transmitters. They will find more: an adroit team of specialists with a unique approach to problem solving that results in dependable equipment—the right kind at the right time.

Granger Associates | 974 Commercial Street | Palo Alto, California | Davenport 1-4175

Circle 2 on reader service card







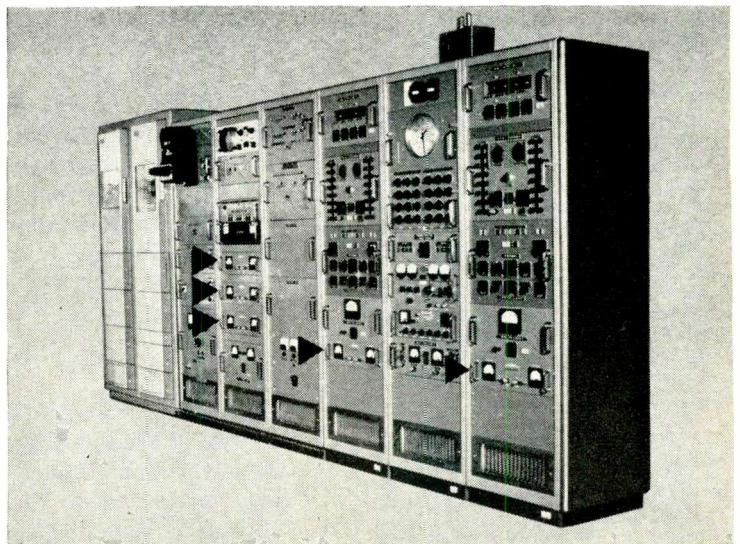
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Technical Direction: U. S. Army Signal Research and  
Development Laboratory

Developed and Built: Astro-Electronic Products Division,  
Radio Corporation of America

LA104

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Published weekly, including the ELECTRONICS BUYERS' GUIDE and REFERENCE Issue in mid-July 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. See panel below for directions regarding subscriptions or change of address.

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**BRANCH OFFICES:** 520 North Michigan Avenue, Chicago 11; 68 Post Street, San Francisco 4; McGraw-Hill House, London E. C. 4; 85 Westendstrasse, Frankfurt/Main; National Press Bldg., Washington 4, D. C.; Six Penn Center Plaza, Philadelphia 3; Four Gateway Center, Pittsburgh 22; 55 Public Square, Cleveland 13; 856 Penobscot Bldg., Detroit 26; 3615 Olive St., St. Louis 8; 350 Park Square Bldg., Boston 16; 1301 Rhodes-Haverty Bldg., Atlanta 3; 1125 West Sixth St., Los Angeles 17; 1740 Broadway, Denver 2; 901 Vaughn Bldg., Dallas 1. **ELECTRONICS** is indexed semiannually, in July and December, and regularly in The Engineering Index.

Subscriptions: Send subscription correspondence and change of address to Fulfillment Manager, Electronics, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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## CROSSTALK

**SEMIANNUAL INDEX.** With this issue we initiate a semiannual index as a new service to our readers. The switch from an annual to a semiannual index has been made feasible through use of a comparatively new offset printing technique.

Process involves Varityping each line of information onto a separate IBM card. The resulting cards (some 9,000 in all) are fed at the rate of 120 a minute through a camera with a micrometer adjustment that automatically sets the vertical spacing between lines. Resulting strip negatives are cut and made up into pages, as you may see starting on p 75.

**SATURN PROJECT.** When the first 180-ft-tall Saturn space vehicle is fired from Cape Canaveral next summer, the tremendous 1.5-million-lb thrust booster stage will have undergone thousands of simulated firings set up on computers at the Redstone Arsenal in Huntsville, Ala. In addition to simulated firings, the eight-engine Saturn booster stage will have undergone 11 static test firings. Eventual goal of the Saturn Project, in 1964, will be flights around the moon and into deep space with payloads up to 25,000 lb.

A few days ago, newsmen witnessed a successful full-duration static firing of all eight booster engines. Covering the Saturn story for **ELECTRONICS** and witnessing the dedication of a new all-solid-state computer, the IBM 7090, was Assistant Editor Lindgren. His story on p 28 takes you to the static firing and gives you a close look at the 7090, whose capabilities of nearly 14 million logical decisions per minute are speeding up the project's development.

**MARKETS.** When the American Marketing Association recently held its 43d national conference in Minneapolis, about 100 representatives of the electronics and missile industries were among those in attendance. Naturally, space equipment sales were a prime discussion topic. It's predicted they will reach \$6 billion in 1975. For predictions on other matters—and what marketing men in our industry are talking about today—see the story on p 32.

**FOR MEN.** If you speak the language of electronics engineers, think you would find it challenging to discuss technical articles with potential authors and also cover the industry's news, like to write occasionally yourself and are not above doing some indoor editing too . . . there may be an opportunity for you on our staff. In New York. Or Chicago. Write the Editor.

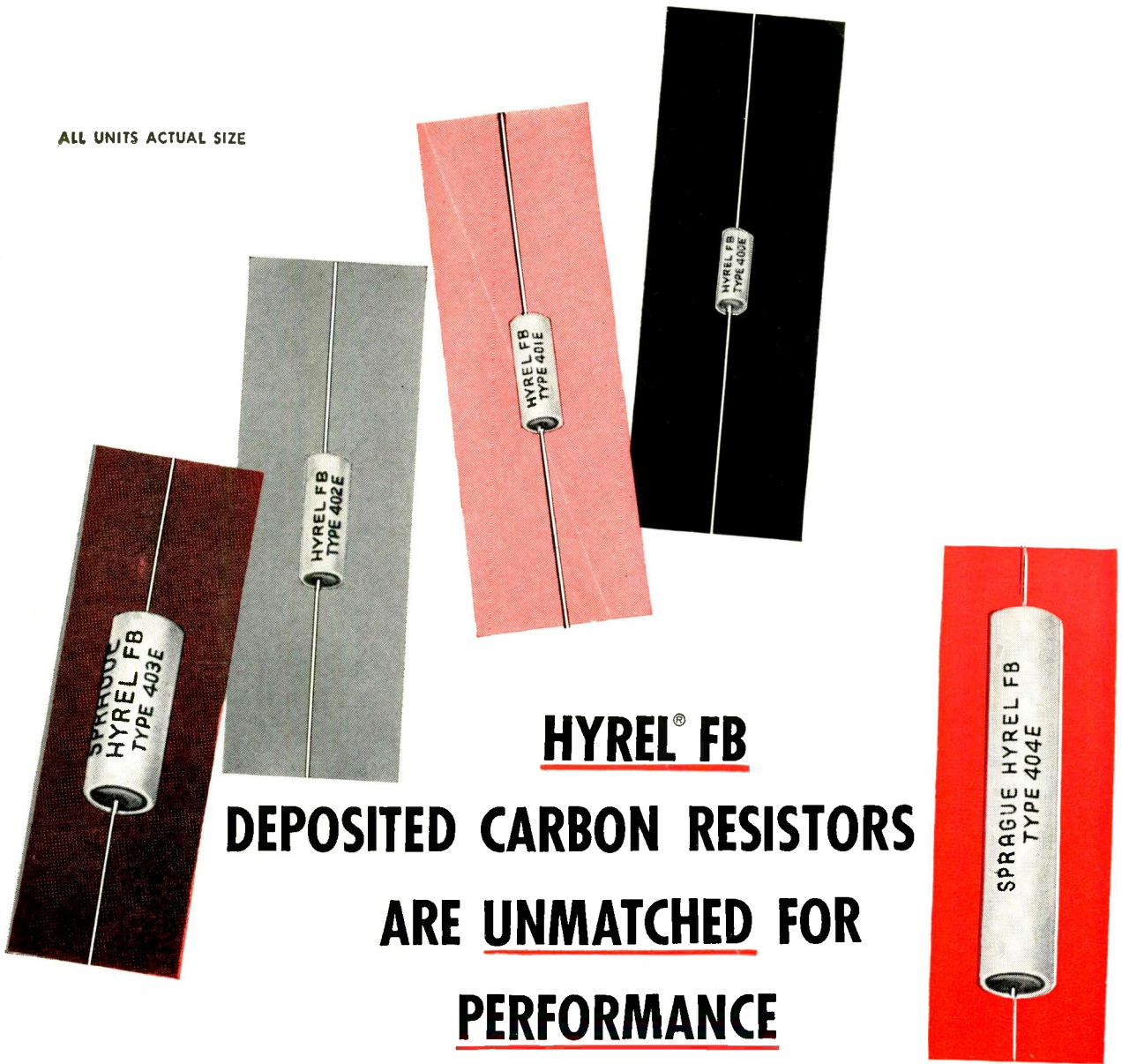
Coming In Our July 8 Issue

**SPACE PROBE.** As the Pioneer V space probe hurtles through the vast reaches of the solar system, contact with our planet is maintained through use of the global Able Space Navigation Network. Designed to control deep space probes up to 70 million miles, the network consists of stations at Singapore, Hawaii, Cape Canaveral and Jodrell Bank, and a central control facility at Los Angeles.

Next week, R. C. Hansen and E. R. Spangler of Space Technology Labs describe how this network provides communication and navigation for space probes. Their informative article outlines the general requirements for space communications and the factors involved in selecting various ground stations. Also, you'll read about the equipment used at the different stations.



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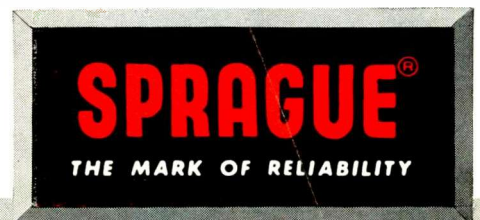


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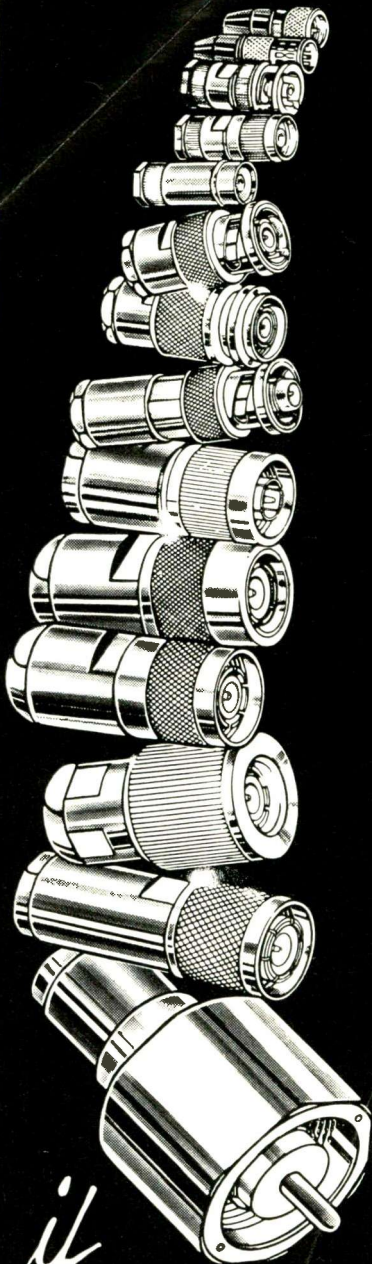


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## COMMENT

### Electronics in Japan

(Ref. "Electronics in Japan," p 53, May 27) . . . it is amazing how the author collected such a wealth of fundamental information in such a relatively short time. Needless to state that his impressions are very useful to us, foreign workers in this country, as they corroborate on many points our own ideas.

F. COETERIER

MATSUSHITA ELECTRONICS CORP.  
OSAKA, JAPAN

Congratulations on the excellent article "Electronics in Japan." It is an outstanding piece of work. How did the author accomplish so much? . . .

JAMES F. SEARS

GENERAL ELECTRIC  
SANTA BARBARA, CALIF.

### Metric System

American engineers and physicists who think in terms of inch, foot, pound, gallon, mile, grain, bushel, rod and yard require conversion tables or conversion factors when they wish to express a unit in the metric system.

Modern physics makes use of the metric system all over the world (even in England and in the United States), a system which was legalized by an Act of Congress in 1886 but which has not taken root in American technical practice. The American Geophysical Union issued a circular letter on this subject, and published a "Progress Report of the Committee for the Study of the Metric System in the United States" on Nov. 1, 1959 (*Transactions, American Geophysical Union*, 40, 3) in which it was stated that 94 percent of 1,080 interviewed scientists declared themselves in favor of the urgent introduction of the metric system in the U.S. The opposition of a 6-percent minority is attributable to two causes: ignorance of the metric system; and indolence or aversion to establishing a way of thinking in terms of the metric system. . .

GEZA L. VAJDA

HALEX INC.  
EL SEGUNDO, CALIF.

Reader Vajda sent along a metric conversion table showing the relationships among metric units of length (1 meter = 1,000 mm = 1,000,000 micron =  $10^{10}$  Angstrom units). We subscribe strongly to the idea that the scientific community should use a common set of measures; but we can only record accepted practice and encourage improvements in practice. American Standards Association, National Bureau of Standards, and the Institute of Radio Engineers—these are the organizations that will have to sweep away the archaic usages.

### L-F Antenna Design

In reading our paper "Antenna Design for Maximum L-F Radiation" (p 84, June 3), we note the following errors and omissions in text:

On p 84, column 2, par 2, "illustrated in Fig. 1B" should read "illustrated in Fig 1A." The equation at the bottom of column 2 on that page should read

$$Q = \frac{f_o}{2R_{loop}} \left| \frac{dX}{df} \right|_{f_o} = \frac{f_o}{R_{loop}} \left| \frac{dX_a}{df} \right|_f$$

In column 3, par 1, "net reactance  $X = Q$ " should read "net reactance  $X = 0$ ."

On p 85, column 2, the equation at the end of the paragraph following equation (7) should read  $dX'_a/df = \alpha BK_A/hf^{n-1}$ .

The value of Table I was greatly reduced when, during editing, deletion of bandwidth and center frequency was made. The efficiency values are typical for the scale model driven at 1.5 Mc with the bandwidth set at 100 Kc; and for the 150-ft antenna driven at 150 Kc with the bandwidth adjusted to 10 Kc. Under these conditions, the efficiency values are 0.15 percent, 0.53 percent, and so forth up to 0.92 percent.

We would like to thank you for the splendid presentation of the material. . .

GEORGE J. MONSER  
AMERICAN ELECTRONIC LABORATORIES  
LANSDALE, PENNA.





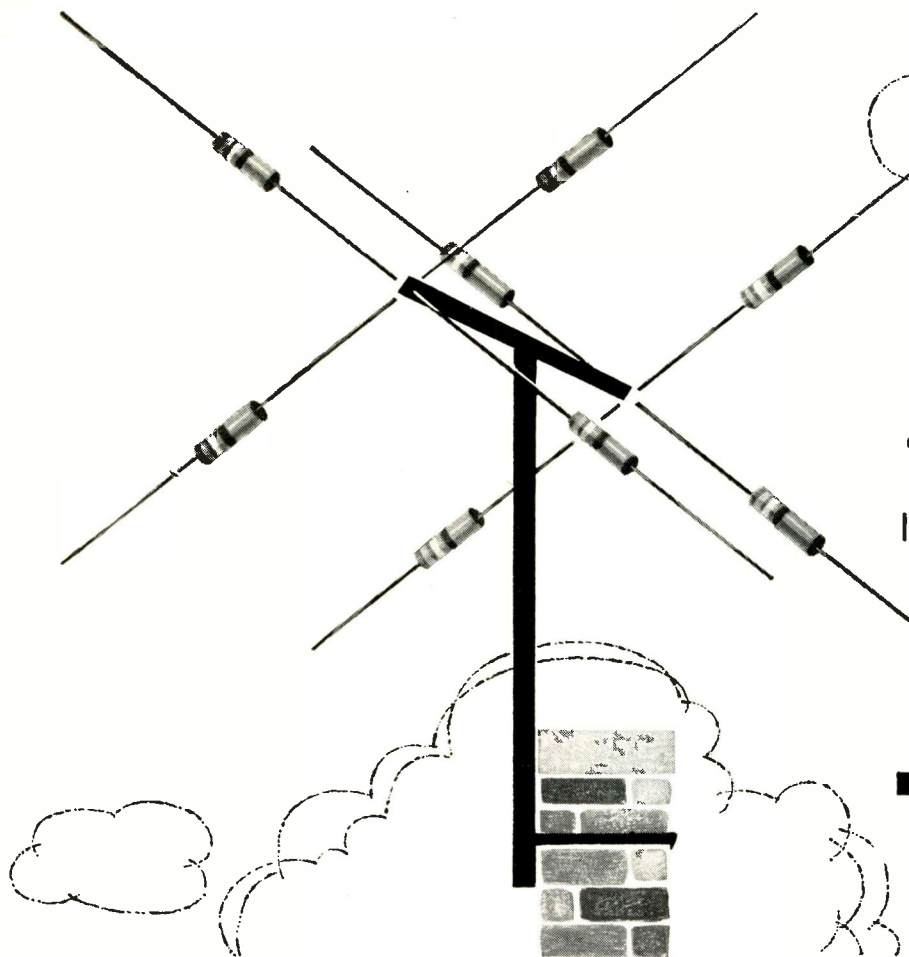
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## NEW TYPES EXTEND MINI-STAB INDUCTANCE RANGE TO 10,000 MICROHENRIES!

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### Miniaturization PLUS Stability

In Jeffers MINI-STAB inductors, *miniaturization* is achieved through more efficient use of coil winding space. *Stability* is made possible through the use of an open magnetic circuit as obtained with a conventional powdered iron coil form.

TYPICAL CHARACTERISTICS OF INDUCTOR DESIGNS BASED ON 1000 UH VALUE

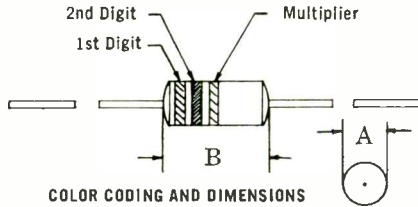
| INDUCTOR CHARACTERISTICS                            | JEFFERS<br>MINI-STAB DESIGN | CONVENTIONAL DESIGNS |                  |
|---|-----------------------------|----------------------|------------------|
|   |                             | MINIATURIZED*        | NON-MINIATURIZED |
| Miniaturization<br>(wt. in grams)                   | 1.0                         | 0.5 to 2             | 2 to 10          |
| Stability of Inductance<br>with temp. -55 to +125°C | ±2%                         | ±10%                 | ±2%              |
| with applied current<br>(zero to 90 MA)             | -1%                         | -30%                 | NIL              |
| with applied voltage<br>(test or signal)            | GOOD                        | POOR                 | GOOD             |

\*Utilizing closed magnetic circuits such as toroids, cup-cores, etc.

A comparison of typical MINI-STAB performance with that of conventional miniaturized and non-miniaturized inductors appears above. Inductor designs of the closed magnetic circuit type such as toroids, cup cores, etc. tend to be inherently unstable.



# THIS IS THE EXPANDED MINI-STAB LINE



| TYPE | A±.015 | B±.015 | LEADS                   |
|------|--------|--------|-------------------------|
| 1    | .190   | .440   | AWG. #22 1½ Min. Length |
| 2    | .220   | .600   | AWG. #21 1½ Min. Length |
| 3    | .240   | .740   | AWG. #20 1½ Min. Length |

## MINI-STAB TYPE 1

| PART NUMBER | TYPE | INDUCTANCE (Microhenries) | MEAS. FREQ. (MC) | Q MIN. | SRF MIN. (MC) | D.C. RES. MAX. at 25°C (OHMS) | CURRENT* RATING (MA) | COLOR-CODING |     |     |
|-------------|------|---------------------------|------------------|--------|---------------|-------------------------------|----------------------|--------------|-----|-----|
|             |      |                           |                  |        |               |                               |                      | 1st          | 2nd | 3rd |
| 1311-1      | 1    | 18 ± 10%                  | 2.5              | 50     | 25            | 1.8                           | 315                  | BRN          | GRY | BLK |
| 1311-2      | 1    | 22 ± 10%                  | 2.5              | 50     | 24            | 2.0                           | 300                  | RED          | RED | BLK |
| 1311-3      | 1    | 27 ± 10%                  | 2.5              | 50     | 20            | 2.8                           | 255                  | RED          | VLT | BLK |
| 1321-1      | 1    | 33 ± 10%                  | 2.5              | 50     | 19            | 2.5                           | 270                  | ORG          | ORG | BLK |
| 1321-2      | 1    | 39 ± 10%                  | 2.5              | 50     | 18            | 3.0                           | 245                  | ORG          | WHT | BLK |
| 1321-3      | 1    | 47 ± 10%                  | 2.5              | 50     | 17            | 3.5                           | 225                  | YEL          | VLT | BLK |
| 1321-4      | 1    | 56 ± 10%                  | 2.5              | 50     | 15            | 4.2                           | 205                  | GRN          | BLU | BLK |
| 1321-5      | 1    | 68 ± 10%                  | 2.5              | 50     | 14            | 5.0                           | 190                  | BLU          | GRY | BLK |
| 1321-6      | 1    | 82 ± 10%                  | 2.5              | 50     | 12            | 5.5                           | 180                  | GRY          | RED | BLK |
| 1321-7      | 1    | 100 ± 10%                 | 2.5              | 50     | 11            | 6.0                           | 170                  | BRN          | BLK | BRN |
| 1321-8      | 1    | 120 ± 10%                 | 0.79             | 50     | 9.0           | 7.0                           | 160                  | BRN          | RED | BRN |
| 1321-9      | 1    | 150 ± 10%                 | 0.79             | 50     | 8.6           | 8.0                           | 150                  | BRN          | GRN | BRN |
| 1321-10     | 1    | 180 ± 10%                 | 0.79             | 50     | 8.0           | 9.0                           | 140                  | BRN          | GRY | BRN |
| 1321-11     | 1    | 220 ± 10%                 | 0.79             | 50     | 6.6           | 10.0                          | 130                  | RED          | VLT | BRN |
| 1331-1      | 1    | 270 ± 10%                 | 0.79             | 45     | 4.0           | 6.8                           | 165                  | RED          | RED | BRN |
| 1331-2      | 1    | 330 ± 10%                 | 0.79             | 45     | 3.6           | 7.4                           | 155                  | ORG          | ORG | BRN |
| 1331-3      | 1    | 390 ± 10%                 | 0.79             | 45     | 3.4           | 10.6                          | 130                  | ORG          | WHT | BRN |
| 1331-4      | 1    | 470 ± 10%                 | 0.79             | 45     | 3.1           | 11.5                          | 125                  | YEL          | VLT | BRN |
| 1331-5      | 1    | 560 ± 10%                 | 0.79             | 55     | 2.9           | 15.2                          | 110                  | GRN          | BLU | BRN |
| 1331-6      | 1    | 680 ± 10%                 | 0.79             | 50     | 2.6           | 17.0                          | 105                  | BLU          | GRY | BRN |
| 1331-7      | 1    | 820 ± 10%                 | 0.79             | 50     | 2.4           | 19.0                          | 100                  | GRY          | RED | BRN |
| 1331-8      | 1    | 1000 ± 10%                | 0.79             | 45     | 2.2           | 21.3                          | 90                   | BRN          | BLK | RED |

## NEWEST MINI-STAB TYPES 2 AND 3

|        |   |             |     |    |     |      |     |     |     |     |
|--------|---|-------------|-----|----|-----|------|-----|-----|-----|-----|
| 1312-1 | 2 | 1200 ± 10%  | .25 | 60 | 2.2 | 21.0 | 110 | BRN | RED | RED |
| 1312-2 | 2 | 1500 ± 10%  | .25 | 60 | 2.1 | 24.0 | 105 | BRN | GRN | RED |
| 1312-3 | 2 | 1800 ± 10%  | .25 | 65 | 1.9 | 27.0 | 100 | BRN | GRY | RED |
| 1312-4 | 2 | 2200 ± 10%  | .25 | 70 | 1.7 | 30.0 | 95  | RED | RED | RED |
| 1312-5 | 2 | 2700 ± 10%  | .25 | 70 | 1.6 | 33.0 | 90  | RED | VLT | RED |
| 1312-6 | 2 | 3300 ± 10%  | .25 | 70 | 1.4 | 37.0 | 85  | ORG | ORG | RED |
| 1313-1 | 3 | 3900 ± 10%  | .25 | 75 | 1.5 | 44.0 | 90  | ORG | WHT | RED |
| 1313-2 | 3 | 4700 ± 10%  | .25 | 80 | 1.4 | 49.0 | 85  | YEL | VLT | RED |
| 1313-3 | 3 | 5600 ± 10%  | .25 | 80 | 1.2 | 54.0 | 80  | GRN | BLU | RED |
| 1313-4 | 3 | 6800 ± 10%  | .25 | 80 | 1.1 | 60.0 | 75  | BLU | GRY | RED |
| 1313-5 | 3 | 8200 ± 10%  | .25 | 80 | 1.0 | 67.0 | 70  | GRY | RED | RED |
| 1313-6 | 3 | 10000 ± 10% | .25 | 80 | 0.9 | 75.0 | 70  | BRN | BLK | ORG |

\*Based on a 25° C Maximum Temperature Rise.

MINI-STAB inductors are capable of meeting the requirements of MIL-C-15305, Grade 1, Class B, as outlined in Jeffers Product Specification SK-393. Details are available on request.



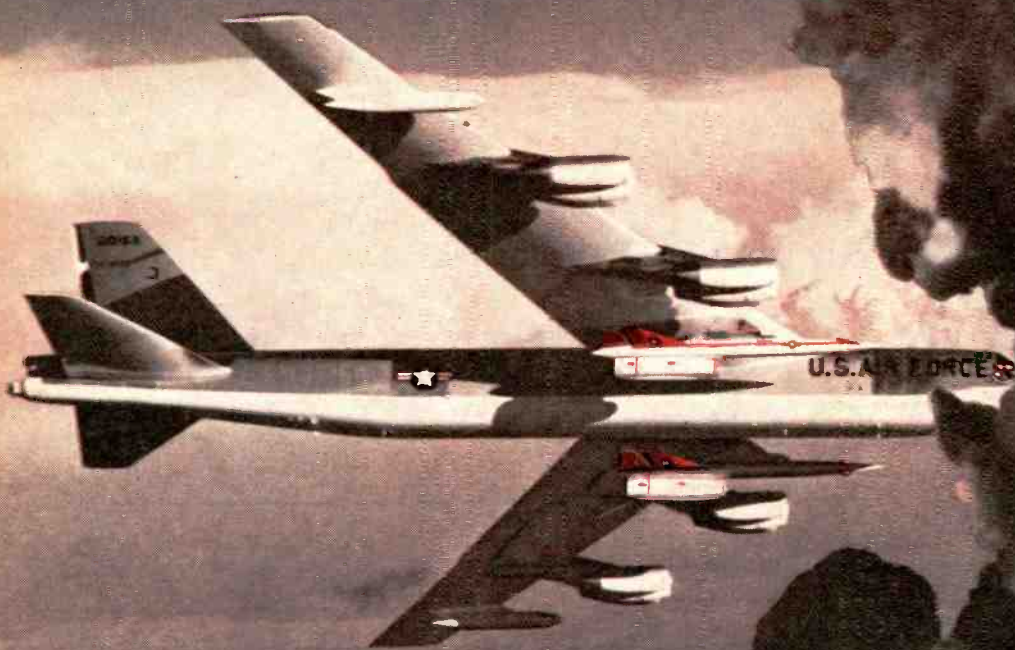
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# ELECTRONICS NEWSLETTER

## Pickaback Satellite Measures Sun's Radiation

SECOND TRANSIT experimental vehicle, which went into orbit last Wednesday, brings the Navy a step nearer an operational satellite navigation system. Last week's unique shot put two payloads into orbit on one rocket launcher. Attached pickaback to the 223-lb Transit II was a 42-lb solar radiation measurement satellite which was kicked off ahead of the larger satellite at an altitude of about 500 miles.

Navigation satellite payload was developed by Johns Hopkins University's Applied Physics Lab and built mostly by APL and the Naval Ordnance installations at China Lake, Calif., and Dahlgren, Va. The radiation-measurement satellite was developed at the Naval Research Laboratory.

Transit's payload included two ultra-stable oscillators in insulating flasks, each capable of transmitting continuously on two frequencies over a silver-painted spiral-band antenna system. An infrared scanner measures the satellite's rotation; a digital electronic clock serves as a timing standard, and a special receiver designed by Canada's Defense Research Telecommunications Establishment measures cosmic noise above the ionosphere.

Two command systems can change the satellite's position in accord with signals received from the ground. The satellite's telemetry system sends temperature and other data back to earth. Both solar cells and storage batteries power the electronic gear.

The NRL radiation-measuring satellite telemetry system includes a 108-Mc transmitter.

## Compactrons Combine Tube Functions

NEW DEPARTURE in tube design sees three and four valving functions included in one envelope in General Electric's Compactron, with consequent space saving.

GE this week demonstrated a radio set equivalent to a 5-tube superhet, made with two Compactrons.

One contains a power diode (equivalent to a 35W4 rectifier), a power amplifier (50C5) and a diode-triode (12AV6); the other houses a pentagrid converter (12BE6) and a pentode (12BA6). The receiver measures 2½ in. by 2½ in. by 10½ in. wide, the width being dictated by the loud-speaker size.

The company estimates that a tv receiver can be made with 10 Compactrons (compared with 15 tubes and 3 diodes, or 24 transistors and 11 diodes), and a 6-tube hi-fi amplifier could be made with 4 Compactrons.

The new valving devices are bigger than miniature tubes; they measure 1½ in. in diameter, vary in seated height from 1 in. to 2¾ in. Heaters for the individual valves are connected in series within the Compactron, so that only two heater pins are needed. Internal connections are made as in conventional tubes. The Compactron has a duodenary (12-pin) base, with a blank pin on either side of the plate connection for increased high-voltage arc rating.

## Vapor-Growth Speeds Transistor Manufacture

ATOMIC BRICKLAYING technique called vapor-growth by developer International Business Machines may make semiconductor fabrication more of a production-line process. The vapor-growth process can be used to produce semiconductor components to serve multiple functions.

The vapor-growth technique uses high-temperature iodide vapor which picks up semiconductor material from a block placed in a channel through which the vapor passes. The vapor, with semiconductor material held in gaseous suspension, moves down the channel to a cooler zone where the metals deposit out on substrate pellets.

A complex multifunction device can be built up layer by layer in repeated runs through the vapor channels. Impurity introduced by the iodide vapor is negligible, about 1 part in 100 million. IBM says that diodes—including variable-capacitance and tunnel types—and transistors have been vapor-grown successfully.

Both homogeneous and heterogeneous semiconductor crystals can be formed. Germanium of either polarity can be deposited on germanium and silicon of either polarity can be deposited on silicon. Germanium can be deposited on gallium arsenide or gallium phosphide and gallium arsenide can be deposited on germanium. Silicon can be deposited on gallium arsenide and gallium phosphide.

Germanium-gallium arsenide junctions have resulted in tunnel diodes having wider voltage swing than germanium units and lower series resistance than gallium arsenide units.

A full adder has been constructed as an *npnp* sandwich having a common three-terminal emitter and two separate collectors each on its own *p-n* mesa.

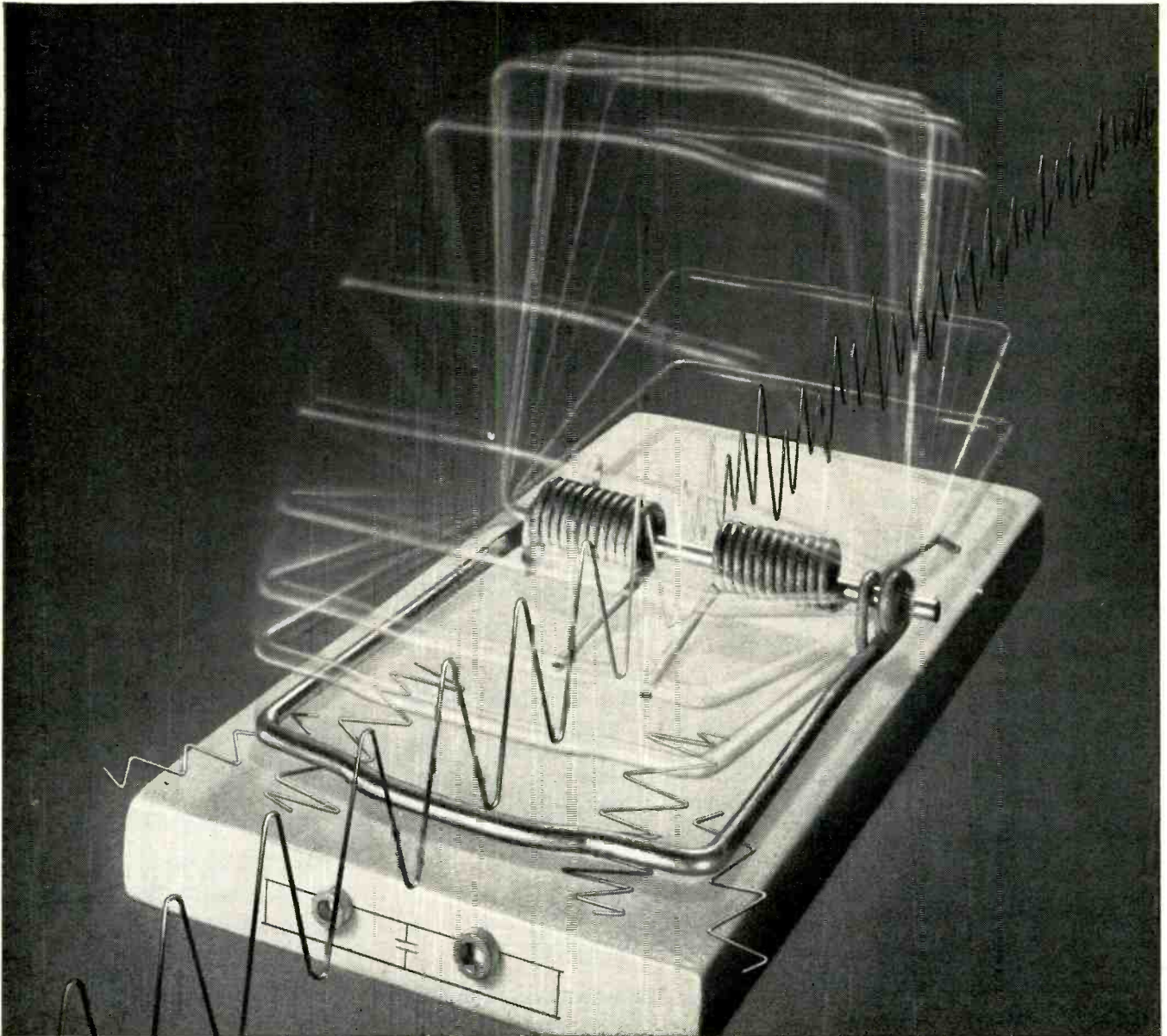
## Steel-Strip Cores Ease Transformer Design

NEW FABRICATION TECHNIQUE for transformer cores, developed by Sylvania, was disclosed last week in New York. Transformers produced with the novel cores, dubbed Flexicores by the General Telephone & Electronics subsidiary, range from 2 to 30 percent lighter than conventional E-I or C transformers, can be produced in a wider variety of configurations, firm says.

Flexicores are produced from grain-oriented strip steel cut from continuous rolls. The strips are bent into staggered U-shapes and formed into nests of laminations. Each core is made up of two nests with the staggered edges interleaved for minimum resistance in the magnetic circuit; the final shape is a hollow square or rectangle.

Use of nested cores permits the magnetic lines of force to flow with the grain of the steel continuously, instead of across the grain as in parts of an E-I core. This in effect cuts the size of the core for a given value of flux. Also the fringe flux at the junctions of the core halves is less than in E-I cores, since the flux path is not changing direction at that point; hum is therefore reduced.





## ***How to build a better (audio signal) trap!***

**Magnetics Inc. permalloy powder cores give filter designers new attenuation and stability standards—and miniaturization to boot!**

The art of trapping unwanted frequencies has been advanced during the past year with a succession of improvements in molybdenum permalloy powder cores by Magnetics Inc. Most audio filter designers now work with smaller cores, more stable cores and cores whose attenuation characteristics are ultra-sharp. Do you?

Do you, for example, specify our 160-mu cores when space is a problem? With this higher inductance, you need at least 10 percent fewer turns for a given inductance than with the 125-mu core. What's more, you can use heavier wire, and thus cut down d-c resistance.

What about temperature stability? Our linear cores are used with polystyrene capacitors, cutting costs in half compared to temperature stabilized moly-permalloy cores with silvered mica capacitors. Yet frequency stability over a wide swing in ambient temperatures is increased!

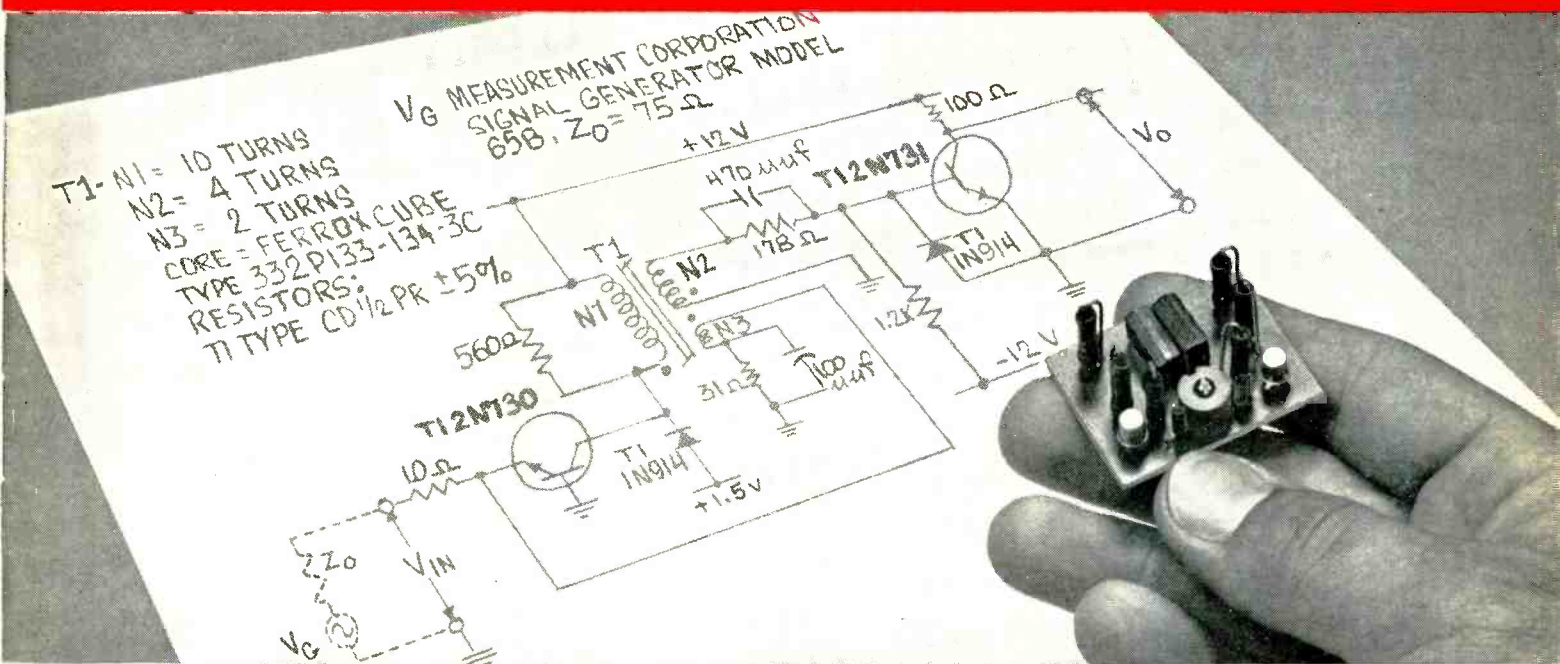
And what do you specify when you must rigidly define channel cut-offs, with sharp, permanent attenuation at channel crossovers? Our moly-permalloy cores have virtually no resistive component, so there is almost no core loss. The resultant high Q means sharp attenuation of blocked frequencies in high and low band pass ranges.

Why not write for complete information? Like all of our components, molybdenum permalloy powder cores are *performance-guaranteed* to standards unsurpassed in the industry. *Magnetics Inc., Dept. E-82, Butler, Pa.*

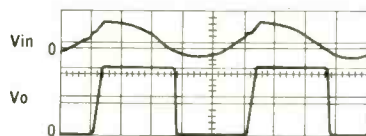
**MAGNETICS inc.**  
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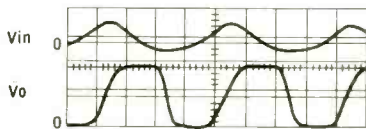
# HOW TO GENERATE 100-ma PULSES AT 10 mc



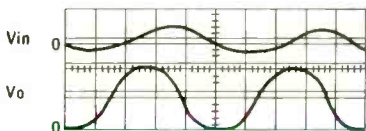
## ... WITH TI 2N730 and 2N731 SILICON MESA TRANSISTORS



**1 Megacycle**  
 VERT. —5v/cm  
 HORIZ. —2 μsec/cm  
 T<sub>A</sub> —25°C



**5 Megacycles**  
 VERT. —5v/cm  
 HORIZ. —50 μsec/cm  
 T<sub>A</sub> —25°C



**10 Megacycles**  
 VERT. —5v/cm  
 HORIZ. —20 μsec/cm  
 T<sub>A</sub> —25°C



See how these performance-proved characteristics apply to your high-current, high-speed switching circuits...

*High-current loads* — Switch 100 ma at 10-mc rates using TI 2N730 and 2N731 transistors (see applications circuit) • *Fast switching* — Note 20 millimicrosecond rise and fall times on

the waveforms illustrated • *Size and weight* — Save both size and weight with the subminiature TO-18 packaging of the TI 2N730 and 2N731 'mesas' • *Dissipation* — Get a full 500 mw (T<sub>A</sub> = 25°C) or 1.5w (T<sub>C</sub> = 25°C) with beta spreads of 20-60 (2N730) and 40-120 (2N731) • *Reliability* — TI Quality Assurance guarantees you performance to specifications • *Applications* — Use the TI 2N730 and 2N731 guaranteed performance in your digital computer clock pulse generators and similar high-load, high-speed, high-reliability circuits. Check these specifications:

| electrical characteristics at 25°C ambient (unless otherwise noted) |  |                          | 2N730                     |     | 2N731 |     | unit |     |  |
|---|--|--------------------------|---------------------------|-----|-------|-----|------|-----|--|
| PARAMETER   | TEST CONDITIONS                                  | min                      | max                       | min | max   |     |      |     |  |
| I <sub>CB0</sub>  | Collector Reverse Current                        | V <sub>CB</sub> = 30v    | I <sub>E</sub> = 0        | —   | 1.0   | —   | 1.0  | μa  | Collector-Base Voltage . . . . . 60v                             |
| I <sub>CB0</sub>  | Collector Reverse Current at 150°C               | V <sub>CB</sub> = 30v    | I <sub>E</sub> = 0        | —   | 100   | —   | 100  | μa  | Collector-Emitter Voltage . . . . . 40v                          |
| BV <sub>CB0</sub>   | Collector-Base Breakdown Voltage                 | I <sub>C</sub> = 100μa   | I <sub>E</sub> = 0        | 60  | —     | 60  | —    | v   | Emitter-Base Voltage . . . . . 5v                                |
| BV <sub>CER</sub>   | Collector-Emitter Breakdown Voltage              | I <sub>CER</sub> = 100ma | R <sub>BE</sub> = 10 ohms | 40  | —     | 40  | —    | v   | Total Device Dissipation . . . . . 0.5w                          |
| BV <sub>EBO</sub>   | Emitter-Base Breakdown Voltage                   | I <sub>E</sub> = 100 μa  | I <sub>C</sub> = 0        | 5   | —     | 5   | —    | v   | Total Device Dissipation at Case Temperature 25°C . . . . . 1.5w |
| h <sub>FE</sub>   | DC Forward Current Transfer Ratio                | I <sub>C</sub> = 150ma   | V <sub>CE</sub> = 10v     | 20  | 60    | 40  | 120  |     | Storage Temperature Range . . . . . -65°C to +175°C              |
| V <sub>BE(sat)</sub>  | Base-Emitter Voltage                             | I <sub>C</sub> = 150ma   | I <sub>B</sub> = 15ma     | —   | 1.3   | —   | 1.3  | v   |  |
| V <sub>CE(sat)</sub>  | Collector-Emitter Saturation Voltage             | I <sub>C</sub> = 150ma   | I <sub>B</sub> = 15ma     | —   | 1.5   | —   | 1.5  | v   |  |
| h <sub>fe</sub>   | AC Common Emitter Forward Current Transfer Ratio | I <sub>C</sub> = 50ma    | V <sub>CE</sub> = 10v     | 2.0 | —     | 2.5 |      |     |  |
| C <sub>ob</sub>   | Common-Base Output Capacitance                   | I <sub>E</sub> = 0       | V <sub>CB</sub> = 10v     | —   | —     | —   | —    |     |  |
|   |  | f = 1mc                  |                           | —   | 35    | —   | 35   | μuf |  |

\*Pulse conditions: Length = 300μs, duty cycle < 2%

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DC to 1 KMC, Usable to 2 KMC

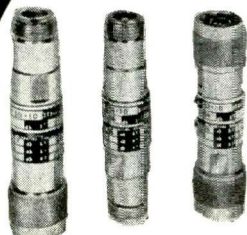
Attenuation: 1 to 50 db

High stability, low frequency sensitivity

Finish: Stainless Steel (Type N Connectors);

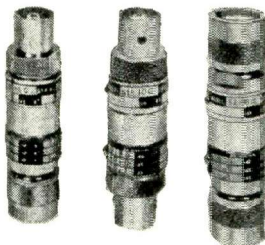
Nickel Plated (Type C or SC Connectors)

Type N Connectors



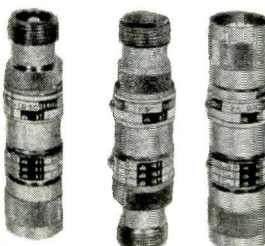
1 male  
1 female    2 female    2 male

Type C Connectors



1 male  
1 female    2 female    2 male

Type SC Connectors



1 male  
1 female    2 female    2 male

Complete specifications upon request.  
Wein-chel Fixed Coaxial  
Attenuators cover the fre-  
quency range of DC to  
12.4 EMC. Write for com-  
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# WASHINGTON OUTLOOK

GOVERNMENT RESEARCH AND DEVELOPMENT contracts worth \$35 million are being awarded this year to foreign research institutions, universities and industrial firms. Almost half the work is supported by the armed services, the rest by at least 10 civilian agencies.

No breakdown is available by technical fields, but the Air Force, which farms out roughly 30 percent of the total amount going abroad this year for R&D work, cites electronics as one of two principal fields of interest for foreign attention (the other is geophysics).

*Bulk of the work is of a basic research nature. In electronics, for instance, the University of Darmstadt is doing fundamental work on pulse-image tubes for the Air Force. A British neuropsychologist is studying for the Navy ways in which the human brain can be simulated mechanically or electronically.*

Some hardware development is being done by Compagnie Generale de Telegraphie sans Fils of Paris. CSF is developing radar-jamming tubes for the Air Force and analog and digital storage tubes for the Navy.

SELF-CONTAINED and unjammable guidance systems to zero long-range missiles in on target are getting increased attention from Pentagon planners. Chance-Vought's aeronautics division, for example, is developing one such system for SLAM (supersonic low-altitude missile), a nuclear ramjet weapons system that Air Force is considering.

*SLAM would operate differently from conventional ICBMs in that it would follow a ballistic trajectory out into near space and through reentry, but in terminal phase would return to controlled powered flight. At an altitude low enough to confuse radar trackers, it would turn on its ramjet and streak to its target. At intercontinental ranges, the missile could not be reliably controlled by ground command; hence the stress on self-contained terminal guidance.*

Present-generation Titan ICBM may be modified to use terminal guidance to correct trajectory errors. Titan uses Bell Labs radio-command guidance on initial phase.

OVERSEAS TELEVISION STATIONS of all types have increased by almost 14 percent since the first of the year—from 1,088 to 1,237—U.S. Information Agency reports. New Free-World stations total 109, of which 98 are in Western Europe. Forty new ones went on the air in the Sino-Soviet bloc, USIA says.

The agency's report, covering the first five months of 1960, excludes the U.S. and its territories, U.S. Armed Forces stations, and Canada. Survey notes that tv receivers in use abroad now number 34,500,000, with the Free World accounting for 28,950,000, an increase of about 2,150,000. The Soviet bloc has 5,600,000 sets, up about 300,000.

PATENT RESTRICTIONS recently caused General Electric to turn down a National Aeronautics & Space Administration contract for space-vehicle guidance development, says NASA. The agency mentions GE to Congress as one of several companies that have refused agency contracts because of reluctance to get tied down by patent rules. NASA patent law requires the agency to acquire full ownership of all inventions produced under contract.

NASA is pushing for liberalization of the rule, says it has been "seriously hampered in efforts to secure research in crucial areas." The House has already passed a bill allowing NASA flexibility on the patent issue, but the outlook for Senate approval this session (see ELECTRONICS, p 14, June 17) is dim.

CONSTRUCTION WORK on the Defense Department's 1,000-ft radiotelescope near San Juan, P. R., is being delayed. Surveyors have run into subsoil difficulties on the site, a natural earth crater; they are making additional borings before permitting installation of equipment.



# TAPCO ELECTRICAL POWER COMPONENTS

TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high-temperature, liquid metal vapor, zero-G and vacuum.

Below are typical TAPCO components now

available for integration into systems for such applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electromagnets and solenoids, nuclear reactor rod drive controls, static inverters, voltage regulators and electronic power conversion devices.

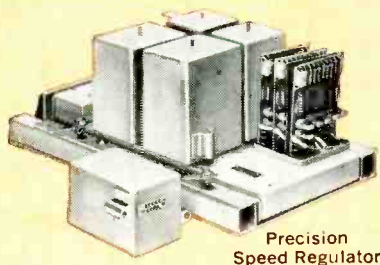
## ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000°F.

**PERFORMANCE DATA: TYPICAL ALTERNATOR—Power Rating:** 3 kw, 0.8 pf lagging. **Ambient Temp.:** 700°F. max. **Operating Speed:** 40,000 rpm. **Output:** 115v, 2000 cps. **Inherent Voltage Regulation:** ±5%. **Harmonic Content:** 5% total. **Efficiency:** 85%. **Weight:** 9 lbs w/o shaft and bearings. **Size:** 3 $\frac{3}{8}$ " OD, 5 $\frac{1}{8}$ " long. **Special Conditions:** Operates in mercury vapor.



High Temperature Permanent Magnet Alternator



Precision Speed Regulator

## VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are system speed and voltage controls for extremely accurate frequency and voltage regulation. The unit shown is adaptable to many drive systems.

**PERFORMANCE DATA: TYPICAL SPEED REGULATOR: Frequency Stability:** 1 part in 100,000 integrated over minimum 1 hour period. **Input:** 115v, 400 cps. **Output:** 0-10v, 400 cps (phase reversing). **Feedback:** Valve position 0-57.5v, 400 cps. **Environmental Conditions:** -65 to +200°F, 50g shock for 11 millisec., vibration 0.1" double amplitude from 3 to 23 cps, 10g from 23 cps to 10 kc. **Weight:** 10 lbs. **Size:** 12" x 6" x 5".

## LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction-producing rotating seals and provides exceptional reliability and life.

**PERFORMANCE DATA: TYPICAL ELECTROMAGNETIC PUMP—Fluid:** Sodium. **Fluid Temperature:** 1000°F. **Capacity:** 20 lbs min. **Driving Speed:** 40,000 rpm. **Pressure Rise:** 3 psi. **Weight:** 3 lbs. **Size:** 2 $\frac{3}{4}$ " diam. flange bolt circle, 1/2" nominal pipe size.



Electromagnetic Sodium Pump

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# OZALID NEWSLETTER

NEW IDEAS TO HELP YOU WITH ENGINEERING REPRODUCTION AND DRAFTING



Standard materials, plus new thinking, result in big time and cost savings.

## How to break the halftone costs barrier

Some of the sharper repro men looking to cut the high cost of using halftones in quantity have come up with this little timesaver that goes for pennies per halftone. Here was the problem: 200 rush copies of 16 technical photographs were needed for a service manual... a total of 3200 prints. This job would usually run about \$2,000 and take ten days... that was too long and cost too much.

A bright lad thought about their Ozalid whiteprinting equipment and worked out this procedure: First an 8" x 10" screened film positive was made by projection from a 4" x 5" negative, emulsion away from emulsion.

This insured proper orientation of the print in the final stage.

Next, the film positive and Ozalid black-line plastic-coated paper (105SZ) were processed in an Ozalid Printmaster 810 at a rate of 12 feet per minute. The 42-inch width of this machine permitted two operators to work simultaneously, cutting total production time virtually in half! The choice of Ozalid paper Type 105SZ was an excellent one. It gave crisp, black-line images of great density due to the paper's plastic coating. The entire project took just under a fast six hours instead of the usual ten days, and cost about \$100.

Total savings: \$1900 and 9½ days of production time. Pretty smart, we think. By the way, we've got sample packages available for the asking that might very well give you the same dramatic results. Why not write us at Ozalid, Box L-6, Johnson City, New York. We'll be glad to help.

## Looking for a fast case of the blues?

The happy kind, we mean. The clean, rich, decisive blue image that Ozalid's new Super-Speed Blue-Line (200SS) gives. And when we say fast, that's exactly what we mean. *Poor originals are copied up to ten feet per minute faster than with regular copy papers.*

This is the first Ozalid copy paper specifically designed for copying semi-opaque originals at higher speeds... at no sacrifice of line density in any sense!

But what does all this mean in practical benefits, other than increased production at no loss in quality?

Well, for one thing, it means that you can now do a fine job on semi-opaque material, such as one-sided letters, documents and bulletins, at the lowest cost of any copying process... even if they're printed on bond papers!

Another benefit is the clean, readable copies you can now produce from soiled, yellowed documents and low-translucency materials much faster than ever before.

Is that all? Not by a long shot. 200SS actually turns low-powered ultraviolet machines into pretty fast units. And the faster printing speeds mean faster return of the original after each cycle.

Why not try this superb, high-density blue-line paper today? It really makes sense. Just call your local Ozalid representative for a demonstration.

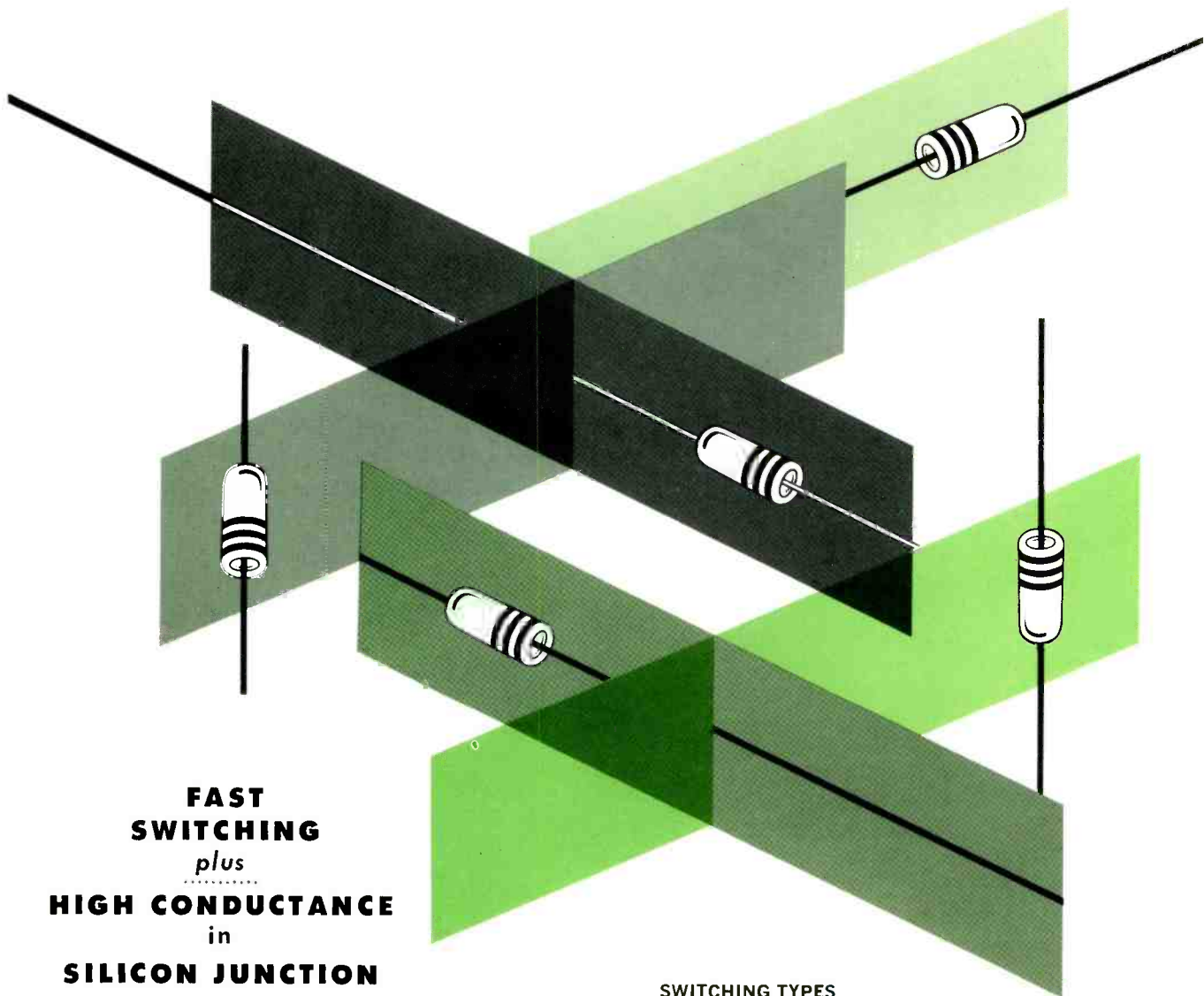




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**FAST  
SWITCHING**  
*plus*  
**HIGH CONDUCTANCE**  
in  
**SILICON JUNCTION  
DIODES**

**SWITCHING TYPES**

New circuit possibilities for low impedance, high current applications are opened up by Clevite's switching diodes. Type CSD-2542, for example, switches from 30 ma to -35v. in 0.5 microseconds in a modified IBM Y circuit and has a forward conductance of 100 ma min@1 volt.

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

**GENERAL PURPOSE TYPES**

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

**MILITARY TYPES**

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

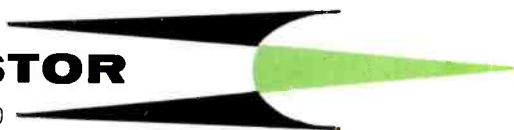
*All these diodes are available for immediate delivery. Write now for Bulletins B217A-1, B217A-2 and B217-4.*

*Reliability In Volume . . .*



**CLEVITE TRANSISTOR**

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





## Telex Buys Component Firm

**Telex, Inc.**, St. Paul, Minn., reports the purchase of **Aemco, Inc.**, of Mankato, Minn., for approximately \$1½ million. The Mankato company, organized in 1918 to produce special timing switches, now also produces custom relays for electronic and electrical application. Aemco, which will continue under its present administration, will become an operating division in Telex's Components Group. Telex reports that combined annual sales total \$8 million.

**Hathaway Instruments, Inc.**, Denver, Colo., announces the proposed acquisition of **Sterling Electric Motors, Inc.**, Los Angeles, Calif., subject to the approval of Sterling stockholders. Hathaway will purchase the Sterling assets for \$2½ million, which will then be distributed to the Sterling stockholders. Sterling reported sales in excess of \$4 million for 1959.

**Electronics Capital Corp.**, San Diego, Calif., reports the purchase of \$250,000 worth of five-year convertible debentures issued by **Remanco, Inc.**, of Santa Monica, Calif. The debentures are convertible into 59% of Remanco's total common stock. Remanco produces microwave test equipment. The transaction is the ninth commitment ECC has made, bringing its total investments to \$5,300,000.

**Dorsett Electronics Laboratories, Inc.**, Norman, Okla., announces its merger with **Carter and Galantin**, Chicago. The merger involves an exchange of all Carter and Galantin shares for 60,000 shares of Dorsett common stock. Dorsett, producer of telemetering systems, acquired the Chicago manufacturer of industrial training and marketing aids in a step toward diversification.

**Atlantic Research Corp.**, Alexandria, Va., reports the acquisition of **Northeastern Engineering Inc.**,

Manchester, N. H., as a new subsidiary. Northeastern, producer of high-precision equipment for the medical profession and the military, reports an annual volume in excess of \$2½ million. The new annual business volume of Atlantic and its subsidiaries totals \$15 million.

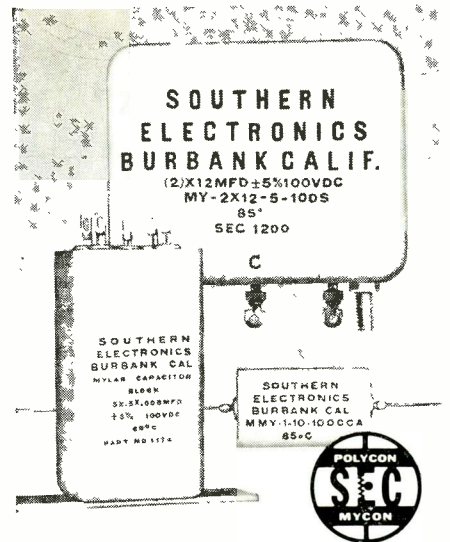
**Waltham Precision Instrument Co.**, Waltham, Mass., announces the acquisition of **Electro-Mec Laboratory, Inc.**, Long Island City, N. Y. The Waltham producer of missile and aircraft equipment, clocks and timers, reports first quarter sales totaled \$1,435,211, producing profits of \$109,309, or 4 cents per share.

**Textron Electronics**, New York, N. Y., reports the acquisition of **Allegany Instrument Co.**, Cumberland, Md., in exchange for 140,000 shares of Textron stock. Allegany, producer of thrust and pressure measuring devices and allied electronic equipment, reports annual sales totalling \$3 million.

### 25 MOST ACTIVE STOCKS

|                      | WEEK ENDING JUNE 17  |      |     |       |
|----------------------|----------------------|------|-----|-------|
|                      | SHARES<br>(IN 100'S) | HIGH | LOW | CLOSE |
| Standard Kollsman    | 5,988                | 27½  | 19  | 27½   |
| Univ Controls        | 2,788                | 19¼  | 15¼ | 17¼   |
| Sterling Precip      | 1,837                | 35½  | 29  | 33½   |
| Lear Inc             | 1,810                | 227½ | 18½ | 225½  |
| Ampex                | 1,803                | 39¾  | 36  | 36¾   |
| Gen Tel & Elec       | 1,635                | 317½ | 30¾ | 31¼   |
| Du Mont Labs         | 1,506                | 11¾  | 97½ | 11    |
| Collins Radio        | 1,503                | 73¾  | 63¾ | 727½  |
| Transitron           | 1,335                | 60   | 51½ | 58¾   |
| RCA                  | 1,028                | 77½  | 70½ | 707½  |
| Gen Inst             | 1,014                | 46¾  | 38¾ | 45½   |
| Bellock Inst         | 964                  | 237½ | 17¾ | 235½  |
| Int'l Tel & Tel      | 912                  | 46¾  | 42¾ | 43    |
| Raytheon             | 889                  | 435½ | 40  | 43½   |
| Sperry Rand          | 879                  | 24½  | 22½ | 227½  |
| Int'l Resistance     | 796                  | 40¼  | 32¾ | 39    |
| American Electronics | 759                  | 18¼  | 15½ | 18½   |
| Amer Tel & Tel       | 753                  | 907½ | 88  | 89¼   |
| Emerson Radio        | 709                  | 167½ | 12½ | 16¼   |
| Cohu Electronics     | 659                  | 12½  | 10¾ | 11¼   |
| Avco Corp            | 654                  | 13¾  | 12½ | 13½   |
| Varian Assoc         | 639                  | 647½ | 60½ | 63½   |
| Burroughs            | 581                  | 39¾  | 37½ | 377½  |
| Gen Elec             | 574                  | 96   | 92¾ | 93¾   |
| Beckman Inst         | 554                  | 97¾  | 87¼ | 96¼   |

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.



Capacitors for

**NO COMPROMISE**

Circuit Design

Unusual requirements in capacitance, tolerance, case size or configuration no longer need compromise your circuit designs. SOUTHERN ELECTRONICS' engineers are experienced in solving these problems to the extent that non-standard capacitors have become routine at SEC.

SEC has developed multiple block capacitors that are now saving space and weight in a production missile. Two 12mfd capacitors were designed to take less space than one, with improved electrical characteristics. In another application, SEC eliminated 6 tubular capacitors, utilizing a single can, 6 terminals and a common ground. Result: Room for additional components, easier wiring, and a less expensive component.

SEC, in addition to designing special capacitors to save weight and space, has developed dual-dielectrics to solve unusual temperature coefficient problems, and has introduced special dielectrics and oils for extreme high temperature and high voltage applications.

This engineering know-how has resulted in the use of SEC capacitors in twelve U.S. missiles, analog computers, and many radar and communications services.

SEC capacitors are manufactured in a wide range of capacitance to meet your needs from 100mmf to any higher value, with tolerances as low as 0.1%. They are made under unusually critical quality control standards, and meet or exceed the most rigid MIL-SPECS.

Write today for detailed technical data and general catalog.

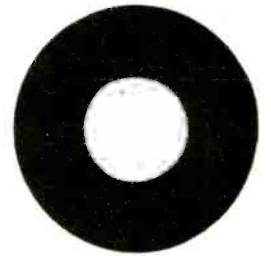
Pioneers in custom precision capacitor engineering



**SOUTHERN ELECTRONICS Corporation**

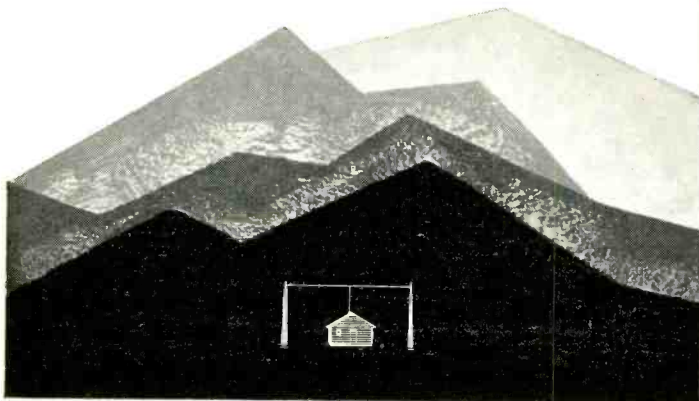
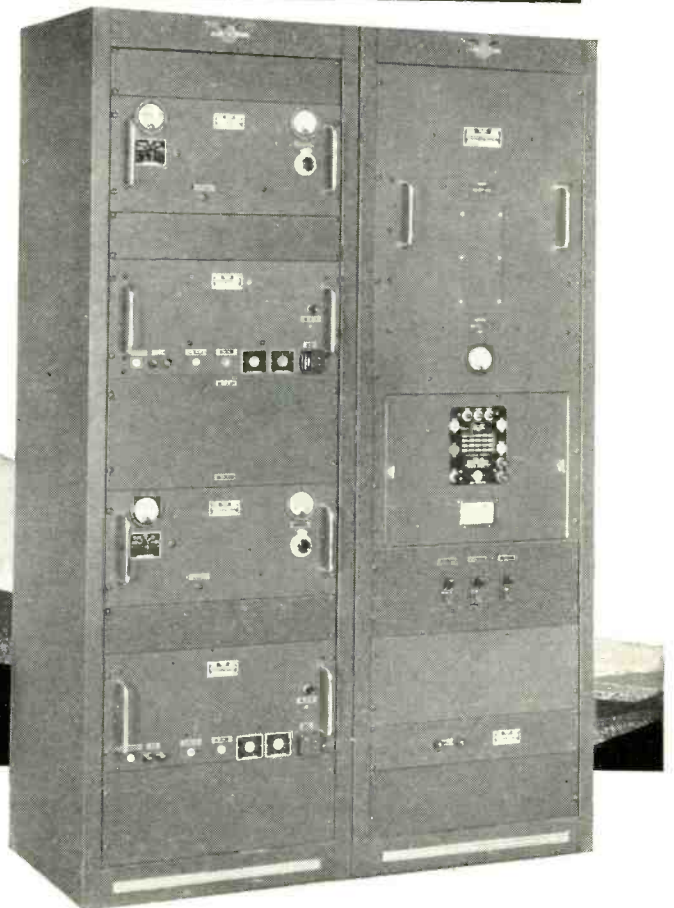
150 WEST CYPRESS AVENUE  
BURBANK, CALIFORNIA

# population -



Even in the most remote areas, wings aloft are guided on their way by AeroCom's new medium range N.D. Beacon Transmitter. This transmitter was designed and built to provide long, trouble-free service with no attendants...even where the total population is Zero.

NOW — FCC type accepted — single or dual automatic—for carrier powers of 10, 12, 15, 20, 25, 50 and 100 watts.



## **AEROCOM'S** Dual Automatic Package-Type Radio Beacon

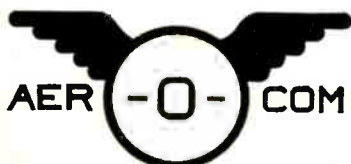
for completely unattended service. This N.D. Beacon (illustrated) consists of two 100 watt (or 50 watt) transmitters with 2 keys, automatic transfer and antenna tuner. (Power needed 110 or 220 volts 50/60 cycles, 465 V.A. for 50 watt, 675 V.A. for 100 watt.)

Frequency range 200-500 kcs.: available with either crystal or self excited oscillator coil. High level plate modulation of final amplifier is used, giving 97% tone modulation. Microphone P-T switch interrupts tone, permitting voice operation.

The "stand-by" transmitter is selected when the carrier or modulation level of main transmitter drops 3 db or more, in case of failure to transmit the identification signal or if carrier frequency changes 5 kcs. or more. Audible indication in monitoring receiver tells which transmitter is in operation.

Unit is ruggedly constructed and conservatively rated, providing low operating and maintenance costs.

Also available in 400 watt, 1 K.W. and 4 K.W. Models, 200-415 kcs.



**3090 S. W. 37th AVENUE • MIAMI 33, FLORIDA**





# cool



**COOL** is the word for General Electric NPN silicon transistors, Series 2N332 through 2N338. At 150 mw the junction temperature is 70°C at an ambient of 25°C. Compare this with the registered derating factor which calls for a junction temperature of 175°C.

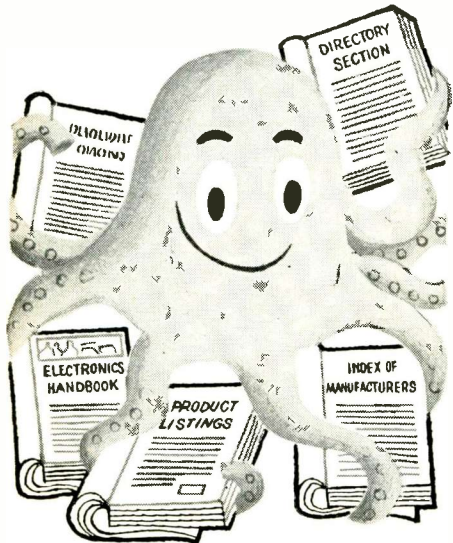
The "A" versions of these transistors dissipate 500 mw at 25°C, 83 mw at 150°C — all without a heat sink.

When junction temperatures go down, reliability goes up. The wide safety factor you enjoy with General Electric silicon transistors means better performance and longer life than you may ever have seen achieved before in a similar device. See your G-E Semiconductor Sales Representative for complete details.

**On the shelf at your General Electric Distributor.**

**GENERAL**  **ELECTRIC**

# Get the facts together quickly

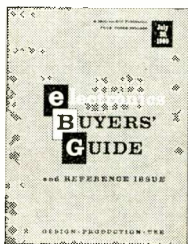


Buying is easier when you've got all the facts in *one* place.

The BUYERS' GUIDE tells who makes it. Gives detailed catalog-type product information and specs. Gives choices in mechanical and electrical characteristics. Gives more choices in terms of materials and design. Also objective and authoritative facts about markets . . . materials . . . design . . . in an exclusive 64-page reference section.

That's why the GUIDE will put you in the *strongest* position to make the best buying choice for yourself and your company.

It's *all* between the covers of one volume. The accurate, complete and authoritative electronics BUYERS' GUIDE and Reference Issue. O.B.E.



FIND WHAT YOU NEED IN THE **electronics BUYERS' GUIDE**

## MARKET RESEARCH

### Defense Spending to Move Up

DIRECTION of federal spending is expected to turn around this month, the beginning of the new fiscal year, McGraw-Hill's Department of Economics reports.

Because of national defense program cuts initiated more than a year ago, government spending during the first six months of 1960 declined to its lowest level since early 1958. But the outlook from here on out is for slightly rising defense expenditures.

There is good news also for manufacturers of entertainment and other consumer electronic products. Latest surveys of consumer intentions indicate consumers expect to increase their spending for durable goods and housing during remaining months of 1960.

For every dollar the United States spends in purchasing existing types of military weapons and equipment, 40 cents is spent developing and testing new types to replace those already in hand, said Dr. Herbert York, director of research and engineering for the U. S. Department of Defense, in a commencement address at Case Institute in Cleveland. Aerospace Industries Associations says that research and development accounts for 60 percent of the intercontinental ballistic missile weapon dollar.

Solar cell sales are rising at a lively pace under impact of increasing activity in space. Major use of the device is as primary source of power for satellites. Market investigators estimate sales this year will total \$9 million, twice 1959 sales.

EIA monthly count of transistors shows sales of \$78,246,279 and 31,155,798 units in the first quarter of 1959 are running ahead of the 1958 quarter by 70 percent for dollar sales and 84 percent for unit sales. Number of units sold in March increased by 2½ million over units sold during February while reve-

nue rose nearly \$4 million. But average prices dropped from \$2.61 in February to \$2.39 in March.

During 1959 manufacturers' shipments of home-type television receivers totalled 6.0 million sets with a factory value of \$815 million, a 13-percent unit increase and an 18-percent dollar increase over 1958 shipments, Bureau of Census states in recent issue of its Current Industrial Reports series.

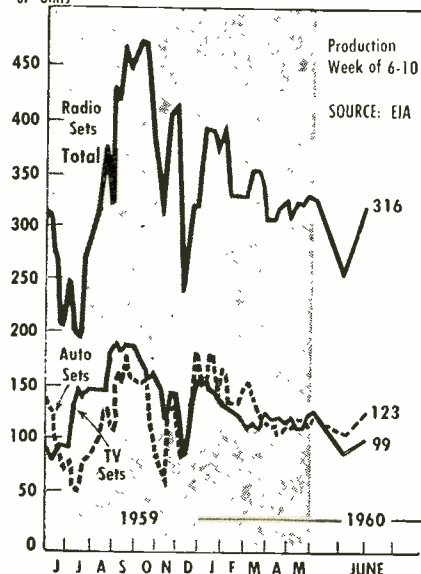
Shipments in 1959 of radios and radio-phono combinations, excluding auto radios, totaled 10.3 million sets worth \$289 million, as against 8.8 million sets worth \$242 million in 1958.

Auto radio shipments rose from 3.9 million units (\$102 million) in 1958 to 5.7 million units (\$133 million) in 1959.

Transistor portable radios represented 90 percent of the 4,034,000 portable radio sets sold in 1959. In the preceding year a total of 3,342,000 portable sets were sold and 70 percent were transistorized.

Business and Defense Services Administration is planning annual reports on electronic components sales. First will cover 1952-59.

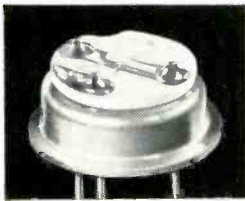
Thousands of Units **FIGURES OF THE WEEK**







# solid



General Electric silicon transistors are manufactured by the Fixed Bed Mounting process. All parts are firmly fastened to a ceramic disk, with no suspended parts. The transistor reacts as a solid block in resisting shock and vibration.

G-E type 2N332 through 2N338 transistors (including "A" versions and USN versions) have been struck with a golf club, rattled 700 miles in a hub-cap, fired from a shotgun and shot from an artillery piece (40,000 G's) — and still survived to operate! Call your G-E Semiconductor Sales Representative for full details.

| Absolute Maximum Ratings                          | 2N332-6*            | 2N337-8†            | 2N332A-6A          |
|---|---------------------|---------------------|--------------------|
| Collector to base voltage                         | 45 V <sub>CB0</sub> | 45 V <sub>CB0</sub> | 45 V <sub>CB</sub> |
| Emitter to base voltage                           | 1 V <sub>EB0</sub>  | 1 V <sub>EB0</sub>  | 4 V <sub>EB</sub>  |
| Collector current (I <sub>c</sub> )               | 25 ma               | 20 ma               | 25 ma              |
| Collector dissipation<br>@ 25°C (P <sub>c</sub> ) | 150 mw              | 125 mw              | 500 mw             |
| Operating temperature (T <sub>J</sub> )           | -65 to 175°C        | -65 to 150°C        | -65 to 175°C       |

\*USN versions of all units except 2N332 have QA per MIL-T-19500/37A.

†USN versions have QA per MIL-T-19500/69B.

**Immediate delivery from your General Electric Distributor**

**GENERAL**  **ELECTRIC**



(Actual Size)

One kilowatt power in a compact ceramic package is now available to 400Mc., with the Eimac 4CX1000A radial-beam power tetrode.

The new, expanded frequency range coverage of the versatile 4CX1000A makes it ideal for AM, FM and SSB operation in the important government communication band, 225-400Mc., and for FM and VHF-TV broadcasting.

An excellent linear amplifier tube,

the 4CX1000A has low voltage, high current, high gain characteristics. It achieves maximum rated power output in Class AB<sub>1</sub>, SSB service without grid current.

Illustrated here, actual size, it is easy to see why this compact, rugged ceramic tetrode is ideal for tight space, high power situations.

A companion air-system socket to meet your specific requirement is available with the 4CX1000A.

**TYPICAL OPERATION 4CX1000A (400Mc FM Amplifier)**

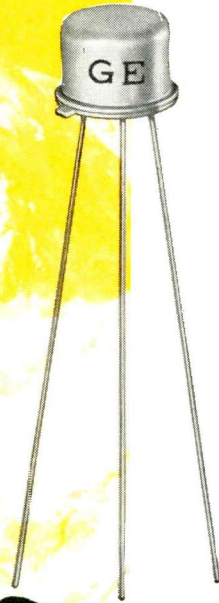
|                     |            |
|---------------------|------------|
| DC Plate Voltage    | 3000 volts |
| DC Screen Voltage   | 250 volts  |
| DC Plate Current    | 750 ma     |
| DC Screen Current   | 45 ma      |
| Driver Power Output | 15 watts   |
| Useful Output Power | 1100 watts |

**EITEL-McCULLOUGH, INC.**



San Carlos, California





# proved

Before any lot of G-E silicon transistors may be delivered, a representative number of units are selected for each of the four restrictive life tests. These tests include operation at maximum power at 25°C ambient, operation at high temperatures and peak ratings, storage at 200°C, and shelf life at 25°C—all tests for 1000 hours. If the sample fails any one of these tests, the lot cannot be shipped.



Only General Electric silicon transistors (Series 2N332-2N338, including "A" and USN versions) are subjected to such rigorous restrictive testing. *And we keep them pure inside*—no grease or surface contaminants that degrade performance are permitted to enter. Write for a full report on the restrictive tests which G-E silicon transistors must pass *before* they're shipped to you. Section S2570, General Electric Co., Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

**At factory-low prices from your General Electric Distributor,**

**GENERAL**  **ELECTRIC**

America's modern way of doing business



The NASA-USAF-Navy X-15 manned rocket gets a vital part . . . delivered with jet-age speed by AIR EXPRESS

## **X-15 part flies first 3000 miles by Air Express**

The scene: Edwards Air Force Base, Calif. Crack engineers work 'round the clock to ready the X-15 for its flight to the brink of outer space. Its engine, built by Thiokol in Denville, New Jersey, packs a 400,000 HP punch—more than the power of two giant ocean liners! Because of an accelerated assembly schedule, some parts—like this turbine pump control—are installed right on the flight line. They must be shipped fast, with kid-glove handling. In short, a job for low-cost AIR EXPRESS. Give your business these advantages, too. Call AIR EXPRESS to speed your products **FIRST TO MARKET . . . FIRST TO SELL.**

**AIR EXPRESS**



CALL AIR EXPRESS DIVISION OF RAILWAY EXPRESS AGENCY • GETS THERE FIRST VIA U. S. SCHEDULED AIRLINES





# sensational

The performance of General Electric's silicon transistors is sensational:

**Fixed Bed Mounting provides the most rugged construction yet developed for transistors.**

By operating at a low junction temperature, reliability and stability are inherently increased.

**Beta hold-up at low current is superior.**

The "A" versions offer a 4V emitter-to-base breakdown and a 45V collector-to-emitter breakdown.

**Every lot of transistors is subjected to four types of restrictive life tests.**

USN versions are available in the Series 2N333 through 2N338.

Units tested to 5000 hours have shown an overall performance rate greater than 99 per cent.

**Send for the complete specifications and test data and prove to yourself how G.E.'s silicon transistors will do a sensational job in your design.**

**Section S2570, General Electric Company, Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.**

GENERAL  ELECTRIC

# Computer Installation Speeds Saturn

*Army Ballistic Missile Agency in Huntsville gets a new name, a new computer and*

By NILO LINDGREN  
Assistant Editor

HUNTSVILLE, ALA.—Newsmen visiting Redstone Arsenal here a few days ago witnessed a spectacular show of rocket power.

The Saturn space vehicle booster stage, capable of a 1.5 million-pound thrust, was successfully static fired in a full-duration run, 122 seconds to burnout. The white columnar configuration of the Saturn booster looked like the Lincoln Memorial ready to be blasted into space. On the hill 2,000 feet away where newsmen stood watching, the 120-decibel noise drowned exclamations and the heat from the searing orange exhaust flaming out across the valley added to the hot sunlight. This test firing, the eighth of the series and the second with all eight engines, was instrumented to give Redstone scientists information on environmental and interactional effects in the booster tail region.

Working overnight, computer men had ready the next morning the correlated results on 250 different variables on the complete engine run. The massive correlation job is carried out with the aid of the newly installed IBM 7090, an all-solid-state machine that can make 13,740,000 logical decisions per minute. The system, which was officially dedicated at the National Aeronautics and Space Administration's Marshall Space Flight Center (formerly Army Ballistics Missile Agency), on the day of the static firing, will be followed by a second one next month. The two 7090's will accomplish in 8 hours what three large scale vacuum-tube machines did in twenty hours, and will provide a 25-percent saving in machine time costs.

The greatly enlarged computer

capacity at the computation center will be monitored by a system called SPOOK, a master programmer. SPOOK means Supervisory Program Over Other Kinds. Developed by IBM, the system is an outgrowth of the SHARE Operating System (SOS). Containing up to 50,000 instructions, it lines up and processes data on different kinds of problems to minimize delays between jobs. More than 200 different computational problems are brought to the computation division every month.

Still another computer for the Saturn project has been under development for more than a year. This computer, being developed competitively by IBM and Librascope, will be part of the final Saturn payload. It is a microminaturized digital computer contained in a volume probably not much larger than a filing cabinet drawer. Working from a magnetic drum storage with a capacity of a thousand digits, this computer will be used as a guidance programmer,

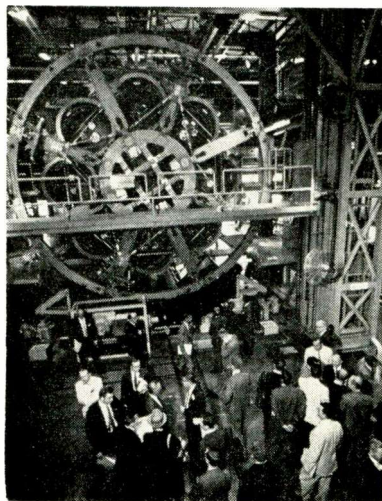
handling up to 15 or 20 variables of flight. In moon flights and deep space probes, this computer will be continuously monitoring and re-computing Saturn's trajectory.

But long before the first live firing of the Saturn from Cape Canaveral next summer, Saturn flights will have been simulated on the computers at Huntsville thousands of times in addition to eleven static firings. Simulation of an entire Saturn circumlunar trajectory can be run off in minutes. Major points of the three-dimensional flight path come off a mechanical printer. A high-speed printer-plotter prints off data from magnetic tape for every 4-hour interval of the six- to seven-day trip around the moon and back.

Relatively few live firings of Saturn have been scheduled because of the vehicle's cost. Helmut Hoelzer, director of the Marshall Space Flight Center's Computation Division, who has worked with Wernher von Braun in rocketry and space flight for more than twenty years, said, "The V-2 rocket was developed at Peenemunde basically without automatic digital computers. As a result, there were approximately 1,000 test firings. Yet with the vastly more intricate Saturn, we have scheduled only 10 research and development firings. We now can simulate a trajectory in a few minutes for several hundred dollars. It would cost millions to stage a live flight."

According to von Braun, director of the Marshall Center, the Saturn project has been moving ahead perfectly on schedule. The objective of the program is to develop by the 1963-64 time period an efficient and reliable vehicle for lifting 25,000 lb payloads into orbit around earth and into deep space.

The long-range program calls for



*This great spider network at base of Saturn booster holds the eight engines, four centrally fixed, and four outer engines gimballed for steering*



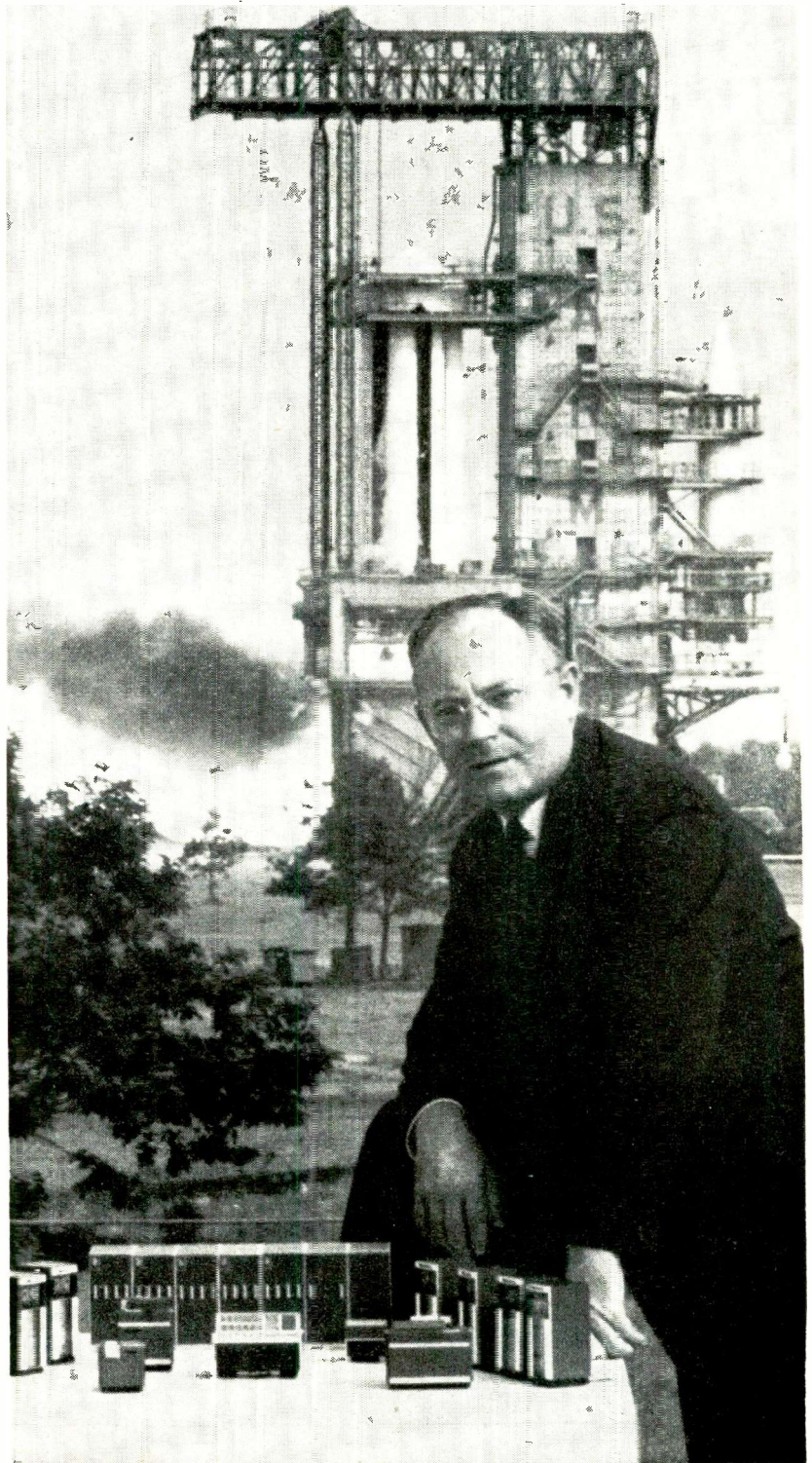
# Space Project

## *a successful static test firing*

several Saturn configurations. The first configuration is made up of the eight-engine booster under development at Huntsville, powered by liquid oxygen and kerosene; a second stage powered by four liquid hydrogen fueled engines of 20,000 pounds thrust each, being developed at Douglas Aircraft; and a third stage, powered by two liquid hydrogen fueled engines identical to those of the second stage. The entire three-stage vehicle stands 180 feet high.

Although the first Saturn shot is slated for summer, 1961, it will be late 1963 before the vehicle is fired with all three stages live. The '61 shot will carry a 500,000 pound water-filled mockup of the second and third stages. Only one shot will be made in 1961, three firings are scheduled for 1962, and five in 1963. The last three shots of the 1963 series will put the Saturn into a 300 nautical mile orbit around the earth. Possibly two shots will be made in 1964, both into deep space. According to von Braun, the final Saturn payload has not yet been frozen—several competitive payloads are under consideration. Conceivably, the Saturn could carry two men around the moon and back to earth or place instruments on Mars and Venus.

An interesting sidelight to the Saturn development is the problem of delivering the great booster to Cape Canaveral. Ordinary roads cannot sustain its weight, and it is too big for Flying Boxcars to carry. Thus, a special carrying platform and truck will carry the booster over a reinforced highway to the Tennessee River where a specially designed barge will pick it up, carry it down the Tennessee into the Ohio and the Mississippi, then along the Gulf coastline to the Florida launching pad.

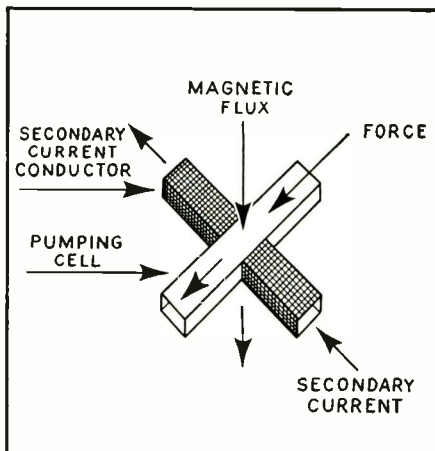


*Helmut Hoelzer, director of computation division at NASA's Marshall Space Flight Center, poses by model of new IBM computer installation against backdrop of a static test firing of the Saturn booster*



## Grade "A" Nickel bus bar keeps molten metals flowing at 1000°-1600° F

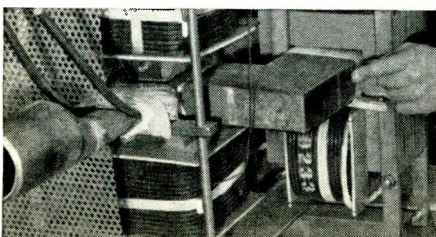
CALLERY, PA.—In nuclear reactor systems, molten metal coolants must be pumped safely and effectively. To do this, the MSA Research Corporation has developed an interesting ac conduction-type electromagnetic pump. It has no moving parts, packing glands, or throttling valves. This pump can handle molten sodium, potassium, NaK, lithium, and mercury at temperatures up to 1600°F.



**WHEN A CURRENT** is passed through the molten metal, perpendicular to a magnetic field, a force is produced on the liquid metal that results in motion within the pumping section. This motion is at right angles to the current and flux. (See diagram above.)

Current is conducted into the liquid metal by connecting the secondary of a current transformer in the pumping section. In the 1000°-1600°F range Grade "A" Nickel is used for the bus bar secondary because it is corrosion-resistant, and has satisfactory electrical conductivity.

A pump of this type will effectively pump fluids having a lower electrical



## TRANSFORMERS OPERATE AT 600°C ...ENCLOSED IN LOW CARBON NICKEL

WALTHAM, MASS. — Missiles and rockets have created environmental conditions which can destroy or seriously impair the operation of presently available electronic parts. There are two approaches to the solution of this problem. The first is to create an artificial atmosphere to support the *present* type component. The second is to create *new* components that will give reliable operation under high temperature environments.

Raytheon Company has designed and tested transformers of four basic types — plate, radar pulse, audio and high-voltage plate and filament — for operation at temperatures in the vicinity of 600°C for 1000 hours.

**To eliminate effects of oxidation** and other environmental factors, hermetic sealing in inert dielectric gas is used. Extensive evaluation tests were undertaken on various types of materials. Included in these tests were magnet and lead wires, layer and barrier insulation, sleeving and core materials, ceramic terminals, high temperature brazing materials and container metals.

Winner of the container metal test was Low Carbon Nickel because of 1) resistance to oxidation, 2) high temperature creep strength, 3) ease of degassing, 4) general strength and 5) ease of brazing and welding.

Softer than pure Nickel, Low Carbon Nickel does not work harden as rapidly, and for this reason finds wide use in the fabrication of articles and in coining operations. Low Carbon Nickel is somewhat more ductile than

resistance than that of the pumping section wall.

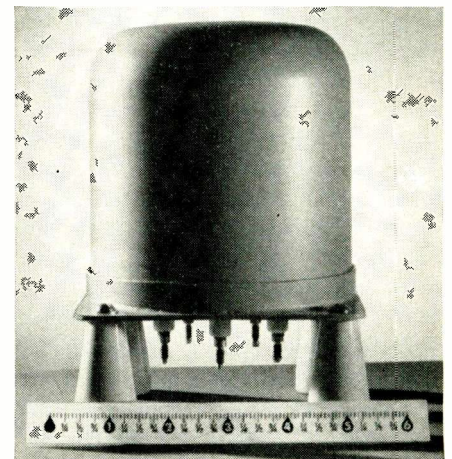
The flow rate of all MSA Research Corporation conduction type EM pumps is positively controlled from zero to maximum flow by an adjustable autotransformer. A capacitor is used for power factor correction due to the high magnetization current required.

Conduction type EM pumps may be used to pump any liquid metal which will wet the pumping section and which has a high conductivity.

**Pertinent Literature:** Booklet, *Nickel Alloys for Electronic Uses*.

Nickel, and its mechanical properties, particularly the yield strength and the elastic limit of annealed material, are lower.

**Pertinent Literature:** Electronic grades of Nickel and Nickel Alloys — with their applications — are fully described in our booklet, *Nickel Alloys for Electronic Uses*. Write us for a copy.



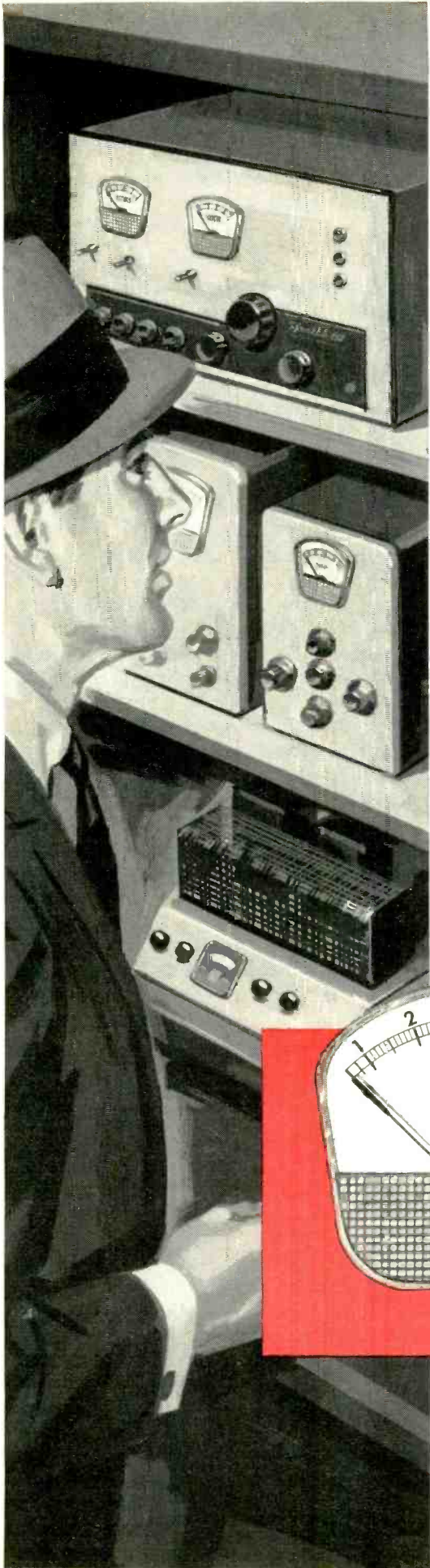
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Huntington 17, West Virginia



# ALLOY PRODUCTS





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*New AC instrument now available in  
economy line of matched panel meters*

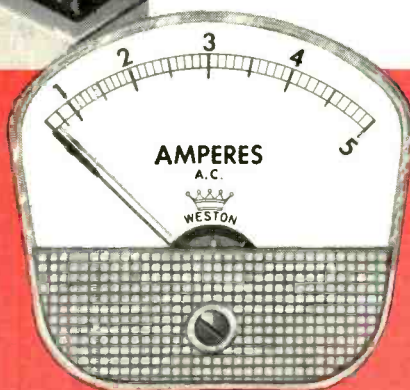
A newly-designed AC moving iron instrument with improved ballistic characteristics joins the Weston line of "Crown" meters. Instruments in this matched group combine economy with dependable accuracy, and incorporate many time-proven Weston features.

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**Accuracies within  $\pm 2\%$**  full scale are available in DC and moving iron AC meters, and  $\pm 3\%$  in rectifier types.

Call your Weston representative for specifications on "Crown" instruments, or write for Catalog 01-112. Daystrom, Incorporated, Weston Instruments Division, Newark 12, New Jersey. *International Sales Division, 100 Empire St., Newark 12, N. J. In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ontario.*



New Model 1724 AC instrument with moving iron mechanism has a 2.25" long scale. Supplied as: Voltmeters, ammeters, milliammeters. Model 1721 (2.5" scale) and Model 1741 (4.9" scale) are supplied as: DC voltmeters, ammeters, milli- and microammeters. Rectifier-type AC Model 1722 (2.5" scale) is supplied as: Voltmeters (1,000 ohms/volt), milli- and microammeters.

**DAYSTROM, INCORPORATED**  
WESTON INSTRUMENTS DIVISION

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# Will Space Equipment Sales Reach \$6 Billion in 1975?

By EDWARD DeJONGH  
Market Research Editor

MINNEAPOLIS, MINN.—Military manufacturers should look to space equipment to provide growing military equipment sales totals in future years, military analysts said at the recent national conference of the American Marketing Association held here.

Electronics and missile industries responded to the increasing attention given by AMA to military and electronics problems by sending about 100 representatives to the association's 43d convention.

Annual expenditures for space equipment by National Aeronautics and Space Administration and Department of Defense will pass aircraft expenditures in 1968 at about the \$3-billion level, said Edmund J. Richards, manager of market research for Thiokol Chemical Co. By 1975 total will be \$6 billion.

Richards also offered an answer to a question to which military marketing men have been giving more and more thought. When will missile spending start to decrease? Missile expenditures will crest at \$6½ to \$7 billion about 1968, he said. They will then start to taper off, receding to \$5½ to \$6 billion by 1970 and \$5 billion by 1975.

Behind the predicted downtrend in missile dollars is the expectation that the development phase of our family of missiles will be largely over. Consequently duplication of missile weapons systems will be almost completely eliminated. Huge expenditures for space equipment in future years will also tend to depress missile spending, he said.

Between 1960 and 1964 the number of operational missile systems in production will rise from 24 to 30, but the number will decline to 23 in 1967 and 15 in 1970. Space systems in production will rise from none in 1960 to four in 1964, six in 1967 and seven in 1970, he said.

Rapid rate at which aircraft expenditures are currently dropping will slow down and level off around the \$3-billion mark in 1968, Richards said. Despite the pressure to concentrate on more advanced weapons system, there will always be a need for aircraft in surveillance, reconnaissance, transport and for some bombing-interception work, Richards added.

Net effect of the expected rise and fall among three types of systems will be a moderate overall annual increase of three percent per year, which will bring combined expenditures, up from \$10½ billion in 1960 to \$12 billion in 1975.

Albert Shapero, manager of systems analysis for Stanford Research Institute, spoke on government research and development markets.

He said, the federal government will spend over \$8 billion dollars for R&D in fiscal 1961. Seventy percent of this total will go to DOD, 13 percent to Atomic Energy Commission and seven percent to

NASA, with most of the remainder to Departments of Health, Education and Welfare and Agriculture.

National security portion of federal R&D spending (DOD and AEC) will decline to about 60 percent by 1970, Shapero said. However, expected rise in federal R&D total will compensate. Shapero looks for a total somewhere between \$10 and \$15 billion in 1970.

Attention was called to the dynamic government construction market by Edward J. Stockton, development planning economist for North American Aviation. Total market, including federal, state and local governments, is estimated at \$16.2 billion for 1960 and is projected to around \$26 billion for 1970, he said. Of particular interest to electronics and missiles firms is the portion which represents military facilities. It is currently worth \$1.5 billion annually, is expected to run about \$1.3 to \$1.4 billion over next 10 years.

During the period there will be a shift in emphasis from items like

## Helicopter Fires Bullpup Missile



*Bullpup, radio-guided air-to-air missile built by Martin, is launched from helicopter in recent tests. Missile is 12½ ft long, weighs 570 lb*



military barracks to test facilities, satellite and missile launching facilities, nuclear installations and radio telescopes, Stockton said.

Electronics industry was well represented at a panel on the role of market research in production planning. All three speakers were drawn from electronics firms.

David W. Day, manager of systems planning for General Electric, pointed out the need to relate new product plans to policies and goals of a business, its products, customers and capabilities.

Market researchers were lightly roasted by Hal Gordon, product planning manager for Westinghouse Electric.

Of particular interest to engineers was Gordon's suggestion that market research departments could do a better job in technical industries if they would include some engineers in their departments.

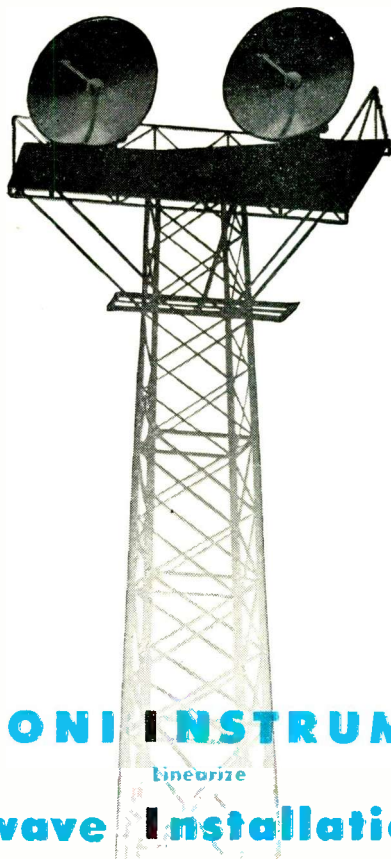
Day also recommended that less use be made of company sales forces for market survey work. "One thing you can be certain of is that surveys by salesmen will not contain any information derogatory to the sales force," he said.

He also called on market researchers to go beyond gathering facts and to make specific recommendations; to write their reports in simple English; and to remember the purpose of graphs is to reduce complicated data to simple pictures and not to make complicated pictures of simple facts.

Irving Kingsford, director of consumer product planning for RCA, pointed out the high mortality rate of suggested new product ideas. On the average, only one of every 40 suggested ideas will ever get to market. Remainder will be dropped out in the various stages of product planning—screening, specification, development, testing and commercialization.

Growing importance of industrial electronics came in for comment at the panel on industrial distribution. George Ganzenmuller, editor, McGraw-Hill's *Electrical Wholesaling*, said:

"Industrial electronics has reached a state of market demand and development where it is ready for wholesale distribution. From the distributor viewpoint, it is a products group that is up for grabs."



## MARCONI INSTRUMENTS

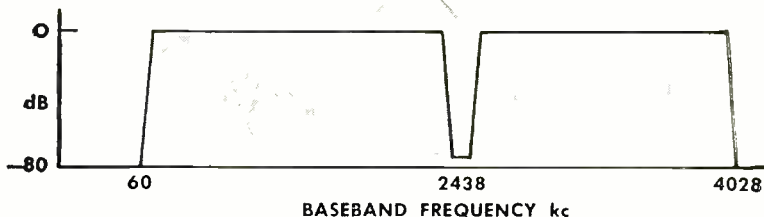
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# Recent Economic Growth — The Numbers Game

If it truly portrayed recent rates of economic growth in the United States, the report on employment, growth and price levels recently issued by the staff of the Joint (Congressional) Economic Committee would point up scarcely less than a national disaster. Among other things, it would document impressively Premier Khrushchev's crack that "the capitalist steed the United States is riding . . . is worn out."

One of the major findings of the Joint Committee's staff (in the Eckstein Report, named for its staff director Otto Eckstein) is that between 1953 and 1959 the average rate of growth of physical output in the United States was only 2.4 per cent per year. This is scarcely more than half the average annual rate of growth of 4.6 per cent the staff found to have prevailed between 1947 and 1953.

**Happily, however, the report does not reflect the basic economic realities.** Its finding on relative

rates of economic growth for the two periods is a statistical *tour de force* which, by the selection of certain figures and certain dates, distorts the record of America's long-term economic growth.

## Playing The Numbers Game

By the selection of appropriate starting and terminal periods it is possible to document almost any rate of economic growth that is desired. The table at the bottom of this page shows you how this can be done. It will also show you how the Eckstein staff worked out its shocking contrast in growth rates. The table is built like a schedule of airplane fares between different cities. The postwar years 1946 through 1959 are put down on two axes. One runs down the left hand column, the other runs across the top of the table. Put your finger on the point where the two axes intersect and you have the average rate of growth for the period covered.

**ANNUAL AVERAGE GROWTH RATES OF THE U.S. ECONOMY, 1946-1959\***

(Percent increases, starting year to terminal year, of GNP in 1954 dollars).

| Starting<br>Year | Terminal Year |      |      |      |      |      |      |      |      |      |      |      |      |      |
|------------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                  | 1946          | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
| 1946             | X             | -0.1 | -1.9 | -1.2 | 3.0  | 3.9  | 3.8  | 3.9  | 3.2  | 3.7  | 3.6  | 3.4  | 2.9  | 3.2  |
| 1947             | X             | X    | 3.8  | 1.8  | 4.1  | 4.9  | 4.6  | 4.6  | 3.7  | 4.2  | 4.0  | 3.8  | 3.2  | 3.5  |
| 1948             | X             | X    | X    | -0.1 | 4.2  | 5.3  | 4.8  | 4.7  | 3.6  | 4.3  | 4.0  | 3.8  | 3.1  | 3.4  |
| 1949             | X             | X    | X    | X    | 8.7  | 8.1  | 6.5  | 6.0  | 4.4  | 5.0  | 4.6  | 4.2  | 3.5  | 3.8  |
| 1950             | X             | X    | X    | X    | X    | 7.4  | 5.4  | 5.1  | 3.4  | 4.3  | 3.9  | 3.6  | 2.9  | 3.3  |
| 1951             | X             | X    | X    | X    | X    | X    | 3.4  | 3.9  | 2.0  | 3.5  | 3.2  | 3.0  | 2.2  | 2.8  |
| 1952             | X             | X    | X    | X    | X    | X    | X    | 4.4  | 1.3  | 3.6  | 3.2  | 2.9  | 2.0  | 2.6  |
| 1953             | X             | X    | X    | X    | X    | X    | X    | X    | -1.6 | 3.2  | 2.8  | 2.6  | 1.6  | 2.4  |
| 1954             | X             | X    | X    | X    | X    | X    | X    | X    | X    | 8.1  | 5.1  | 4.0  | 2.4  | 3.2  |
| 1955             | X             | X    | X    | X    | X    | X    | X    | X    | X    | X    | 2.1  | 2.0  | 0.5  | 2.0  |
| 1956             | X             | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | 1.8  | -0.2 | 2.0  |
| 1957             | X             | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | -2.3 | 2.0  |
| 1958             | X             | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | 7.0  |
| 1959             |               |      |      |      |      |      |      |      |      |      |      |      |      |      |

\*Compound rates of growth



Following this procedure, you can find growth rates ranging all the way from -2.3 per cent, between 1957 and 1958, to +8.7 per cent, between 1949 and 1950, along with almost any other rate you would choose for various years and sequences of several years over the postwar period.

For example, if you want to demonstrate that the postwar growth rate through 1953 was less than 4% per year, you take off from 1946, include a drop of 0.1 per cent between 1946 and 1947, and come up with a growth rate for the 1946-1953 period of 3.9 per cent. But if you want to show it was quite high, you take off a year later, from 1947 (which drops out that dismal -0.1 per cent for 1947) and come up with a fine growth rate of 4.6 per cent for the 1947-1953 years.

### Statistical Hocus-Pocus

That's what the Eckstein staff did. It took off at one end from a year when there was just about no growth, went to the Korean War boom year of 1953 at the other end, and got that average growth rate of 4.6 per cent. Then it took off from the Korean War boom year of 1953 and ran to the year 1959, when business was recovering from a recession and suffered through a steel strike of 116 days, to come up with its 2.4 per cent growth rate for the second postwar period. As the table indicates, by taking off a year later (1954) the average growth rate would have become 3.2 per cent, and if the take off had been 1949 it would have been 3.8 per cent.

**There are those who, in nontechnical terms, would characterize this as statistical hocus-pocus. There are also those who would see in it an element of political hocus-pocus, too.** This is because the years 1947-53, when the Eckstein staff found there had been the healthy 4.6 per cent growth rate, were roughly years when we had a Democratic president, while the anemic growth rate of 2.4 per cent it calculated for the subsequent years was for years of a Republican presidency.

Actually it can be shown that the civilian part of our economy has had more rapid growth during the Republican administration than it had during the Democratic years. If military expenditures are subtracted from the national output, the resulting growth rate for 1953 to 1959 is slightly higher than for 1947 to 1953.

However, we do not question the *bona fides* of the Eckstein staff. **But we do assert that it has produced a statistical picture of the postwar growth of the American economy which is dangerously misleading both at home and abroad.**

Abroad, the report appears to give official documentation to the propaganda line that the Soviet economy is running rings around the U.S. economy in growth, and that it is Communism a country should choose if it really wants to develop rapidly. Building on a much smaller economic base than the U.S.A., the Soviet Union — as well as almost every less advanced nation

in the world — is bound to show a larger percentage increase in output than the U.S.A. But the Eckstein staff calculation gives the Communists ammunition they don't deserve.

### Are We Facing A Crisis?

The contrast drawn by the Joint Committee staff in postwar U.S. growth rates suggests that we are facing scarcely less than a crisis through paralysis of our economic growth which calls for drastic remedies. But this, as the full 1947 to 1959 growth record set forth in the table makes clear, is very definitely not the case. Our over-all postwar rate of growth, as measured by the gross national product in physical terms, has been 3.5 per cent per year, a rate nearly double the long-term growth rate of 2 per cent per year between 1909 and 1939. In the continuing fluctuations in the rate of growth which more or less inevitably characterize a relatively free economy, we have had some downs in recent years. **But our economy is now on the upbeat again. And at the end of this year, the U.S. economic growth rate for the postwar period can be expected to be 3.7 per cent per year.**

**It is extremely important for the United States to continue to maintain this rate of economic growth or even to surpass it.** Upon this effort depends our capacity to meet our defense requirements without dangerous strain, to provide an adequate margin for foreign aid, to improve our own productive facilities, and to continue to raise our own standard of living.

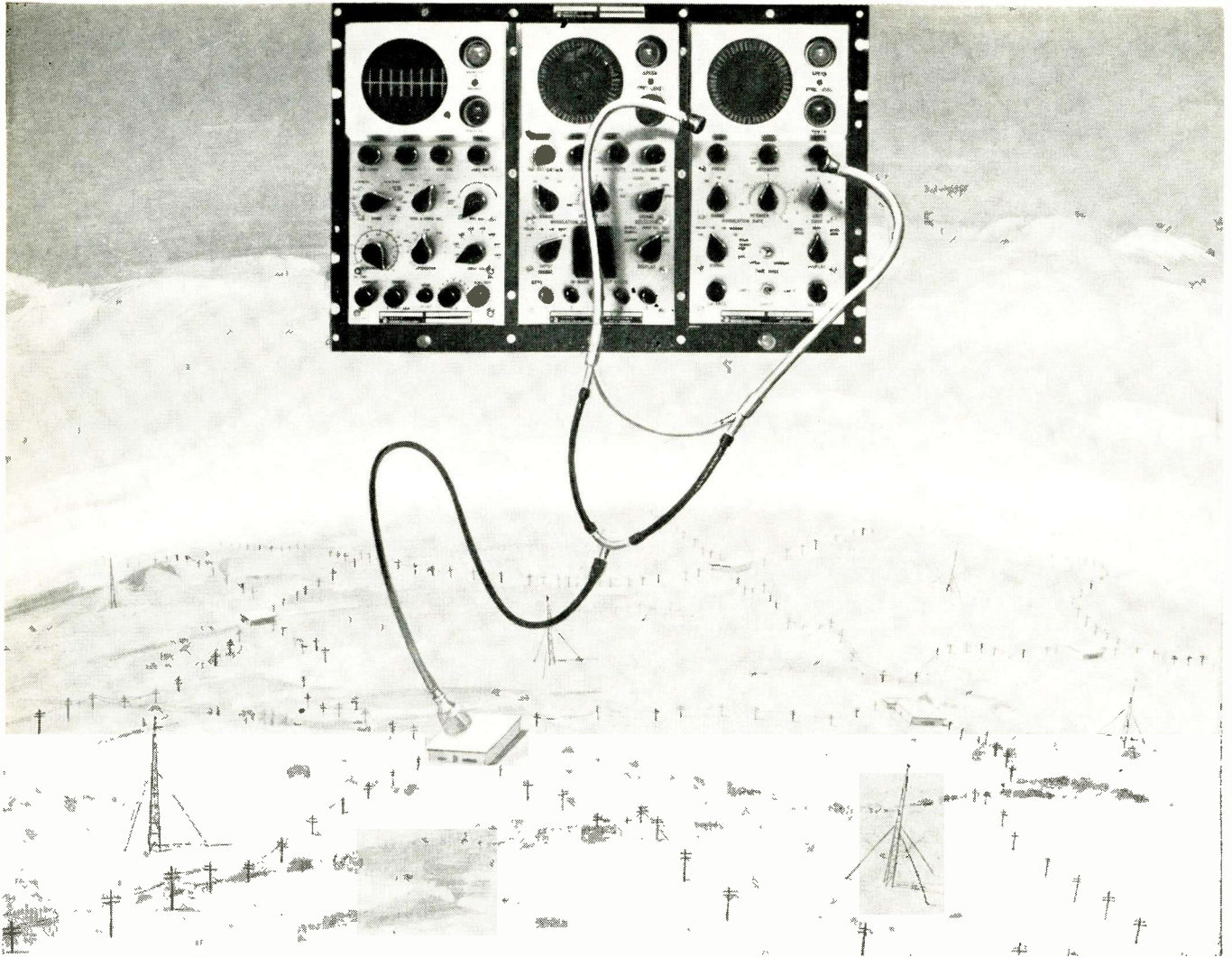
How not only to maintain but possibly improve upon our postwar pace of economic growth will be the subject of strenuous debate in the months ahead. However, the debate will have a much better chance of being constructive if the postwar growth record is seen in proper perspective. To this end one of the first things to do is to junk panic rousing statistical portrayals such as that in the Eckstein report.

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*Donald McGraw*

PRESIDENT

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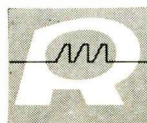
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# Services Adopt Interference Standard

*Symposium hears Defense plan for center to analyze r-f interference*

WASHINGTON—ADVANCES in the battle with r-f interference were discussed here recently at the meeting of the second National IRE Symposium on Radio-Frequency Interference. Keynote speaker Henry Randall of the Office of Scientific Development disclosed Department of Defense plans to speed up prediction and measurement of unwanted noise in the spectrum.

Big step forward is a new military standard, "Measurement of Radio Frequency Spectrum Characteristics" (Mil-Std-449), now mandatory. It marks the first time that all three military services have agreed on such a joint standard. The purpose is to provide standard techniques for the measurement of spectrum characteristics of military electronic equipment in order to ensure the full usefulness of the data. It will be valuable, Randall said, in determining whether subsystems and systems will be compatible with their electromagnetic environments.

The new standard is not intended to provide measurement specs for near-field or conducted interference; it is strictly for measurements in the far field. The publication lists testing procedures and techniques for both transmitters and receivers. Major deviation from individual service specs is the requirement that receiver sensitivity be tested and evaluated in terms of power rather than voltage.

Plans now in the works at the Defense Department, Randall said, may see the establishment of an analysis center to use the data gathered from various sources. It will serve operational planners, those who assign frequencies, the development engineers, and users of interference-prediction information.

Of special interest to engineers from government and industry attending the Symposium was a roundtable discussion of standards and specifications. Inconsistencies, ambiguities and loopholes in the military specs and Federal Communications Commission regula-

tions were aired. Moderator Arthur Loughren of Airborne Instruments Laboratory called r-f interference one of the least understood problems today. Albert R. Kall of ARK Engineering contended that military specs provide far more stringent controls on radiated and conducted interference than on receiver susceptibility, suggested that the industry needs more accurate susceptibility tests for receivers.

Kall also suggested establishment of three categories of compliance: absolute compliance, where radiated and conducted interference are either not detectable above ambient or else remain more than 3db below specification limits; absolute non-compliance, where most of the measured values exceed specification limits and at least one measured parameter is greater than 6db above limits; and transitional compliance, where most of the measured data lie below the curve of limits, but fewer than half the readings approach or exceed the limits curve by no more than 3db. The three categories, he said, could be refined to cover all possibilities.

Kall also charged that FCC regulations are too general and do not make necessary distinction between narrow- and broad-band equipment. FCC's Edward W. Allen pointed

out that the Commission's rules must be general in order to represent the needs of thousands of users with conflicting interests. The reason for putting emphasis on transmitter controls, Allen suggests, is that the law has been interpreted to mean that FCC can control only transmission, and has no jurisdiction over manufacturers.

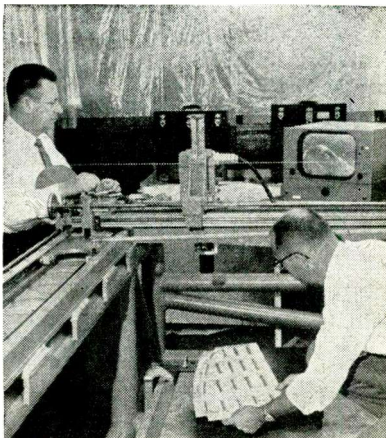
Another paper, by Herbert M. Sachs of Armour Research Foundation, discussed determining radar performance characteristics as related to the prediction of radar interference. Information contained in the paper was developed from a program for establishing techniques of measurement for radar system parameters, and cataloging pertinent radar characteristics in a form accessible for interference prediction. Radar systems under analysis were pulsed search systems; measurements were performed over the frequency range 900 Mc to 10 Gc.

An interference-prediction model was described by Delmer C. Parts and Kenneth G. Heisler Jr. of Jansky & Bailey. Prediction techniques were confined to "discrete source interference," defined as a type brought about by specific identifiable sources of electromagnetic radiation from which one can trace definite propagation paths to the point of interference.

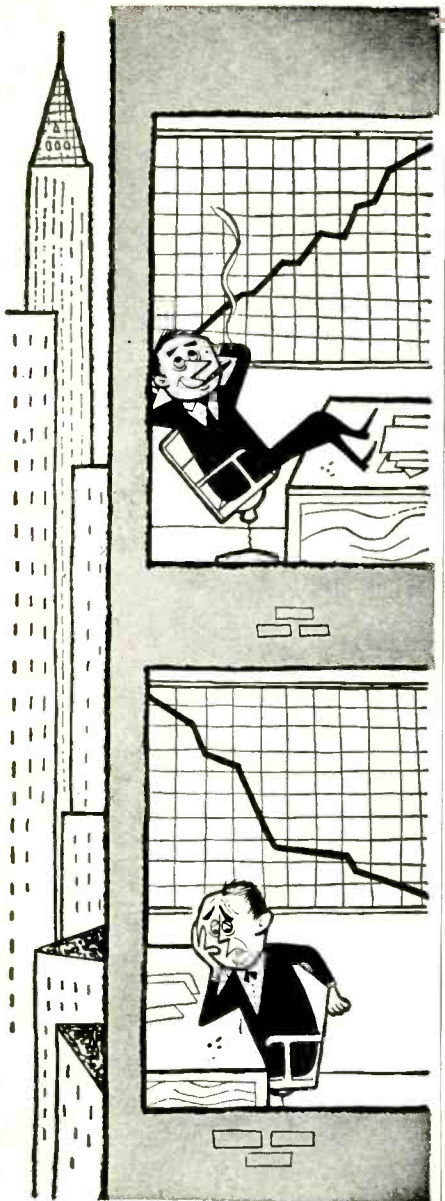
Digital-computer simulation program for the prediction of ship-board interference was described by Wilbur G. James of American Machinery & Foundry. The computer program is designed to predict the signal environment in the vicinity of each receiver under consideration and the response of each receiver to its environment.

Symposium was sponsored by the IRE's Professional Group on Radio-Frequency Interference. Sponsors plan to make it an annual meeting, figure that with recent increases in transmitter power, antenna gain, receiver sensitivity and number of r-f sources in operation, problems of interference have reached "ominous proportions."

## Tv Inspects Parts



*KinTel closed-circuit tv makes dimensional checks on aircraft components at Convair-San Diego*



## Nuclear Society Ponders Controls

*Members discuss new instrument systems, computer techniques; full control years away*

CHICAGO—CONSENSUS OF MEMBERS of the American Nuclear Society, which met here recently, is that completely automatic nuclear power systems are still far in the future. New instrument systems are being developed, and novel techniques for computer use are coming to the fore. But economic considerations currently block complete instrumentation of a working reactor core and put off for the present the concept of computer-controlled reactors.

A reactor core designed for a certain job, for instance, may produce maximum practicable power. If several temperature-sensing devices are put into the core, thermal and nuclear anomalies are produced which change operating characteristics, requiring that the core be redesigned. Reactor core design, never an easy job, becomes increasingly difficult as more instrumentation is added.

Discussion sessions on computers disclosed that it may not be any more feasible to run a nuclear

power system by computer than it is for a conventional power station. Sessions dealt largely with plans for computer use and with new advances in programming. Automatic coding and compiling systems such as Fortran II for IBM and Philco Transac systems, and Flame for Remington Rand Univac's Larc, were widely discussed. Navy's David Taylor Model Basin will get a Larc system next year and put it to work designing naval propulsion reactors.

Another paper at the meeting described a device which simplifies the identification of metals. The instrument was described by R. A. Nance, J. W. Allen, and F. M. Glass, all of Oak Ridge National Laboratories. It uses the conductivity and permeability of the metals as identifying parameters.

A pickup coil is placed against the unknown metal, and the user adjusts a dial until the meter on the instrument deflects full scale. The coil is the inductive element in a tank circuit; when placed against

## WHO'S MAKING OUT BEST?

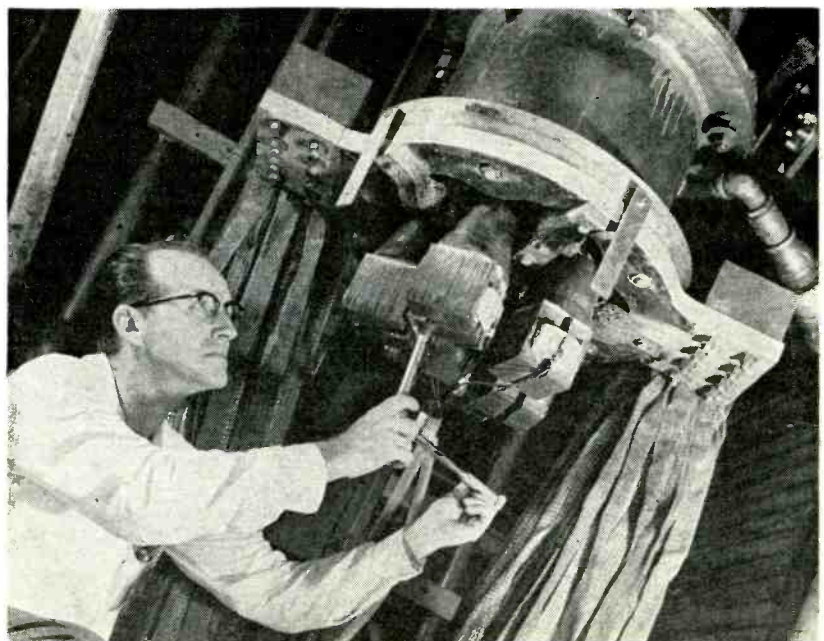
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## Ultrasonic Unit Added to Arc Furnace



*Grain refining unit goes on arc-melting furnace at Westinghouse metals plant. The combination improves properties and yield of metals*



a metal specimen, its impedance shifts and causes a shift in the oscillator frequency.

Adjusting the dial in effect measures the amount of frequency shift, giving a measure of conductivity and permeability characteristics of the unknown metal. Dial setting required for full-scale deflection is unique to many metals and alloys: phosphor bronze, for instance, requires a reading of 854; type 316 stainless steel, 712; hastelloy B, 661.

R. E. Nather, of General Atomics division of General Dynamics, described a means for converting multichannel pulse-height analyzers into time analyzers. Nather's device is an all-transistor attachment to pulse-height analyzers which have magnetic-core memories. The attachment is basically digital in nature, and makes direct use of the arithmetic, storage, display, and output circuitry of the pulse-height analyzer, obviating the necessity of converting time information into amplitude form.

Time-channel widths of 16, 32, 64, 128, 256, and 512 microseconds are provided, with an average dead time (assuming random arrival of input signals) of 8 microseconds. A zero-time, or "shutter," signal is used to start operation; random signals are stored in the proper time channel as they arrive.

Internal timing is provided by a crystal oscillator. Basic clock frequency of 1 Mc is divided by 16 or more (depending on the channel width chosen) which provides a maximum time jitter of 1/16 of a channel if the shutter pulses are not synchronized with the oscillator phase.

When compared with a secondary frequency standard, the oscillator gave an apparent frequency of 1,000,015 cps at 23 C, 1,000,012 cps at 45 C.

Only one input pulse can be accepted for each 16-microsecond interval, which means, for example, a maximum of four signals per scan can be accepted by a channel 64 microseconds wide. No channel overlap or gaps have been found in the device. The instrument is designed in modules, contains all solid-state components; it has been in service since February, 1959.



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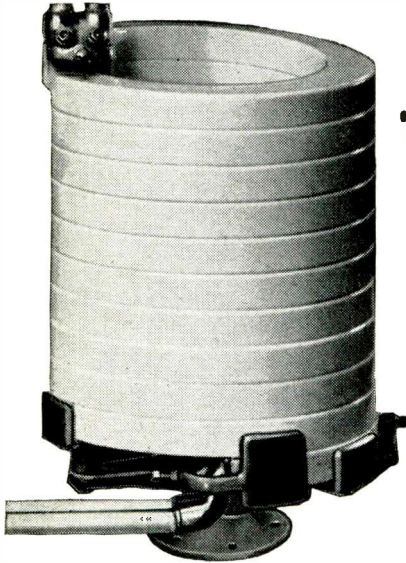
WRITE for B&L Capabilities Bulletin . . . and for help in the development and manufacture of optical-electronic-mechanical systems. Bausch & Lomb, 61407 Bausch St., Rochester 2, N. Y.

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WRITE for Bulletin 301 containing complete description and specification data. Lapp Insulator Co., Inc., 168 Sumner Street, Le Roy, New York.



# Lapp

## MEETINGS AHEAD

July 20-22: Forestry, Conservation Communications Assn., Annual Conf., Hotel Duluth, Duluth, Minn.

July 21-27: Medical Electronics, International Conf., Inst. of Electrical Engineers, Olympia, London.

Aug. 1-3: Global Communications Symposium, PGCS of IRE, U. S. Sig. Corps., Statler-Hilton Hotel, Wash., D. C.

Aug. 8-11: American Astronautical Society, Western National, Olympic Hotel, Seattle, Wash.

Aug. 9-12: American Institute of Electrical Engineers, Pacific General, San Diego, Calif.

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

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

Aug. 22: Scientific Apparatus Makers Assoc., Market Managers, SAMA, Statler-Hilton Hotel, San Francisco.

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

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

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

Sept. 7-9: Automatic Control, Joint Conf., ASME, IRE, AIEE, ISA, Massachusetts Institute of Technology, Cambridge, Mass.

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

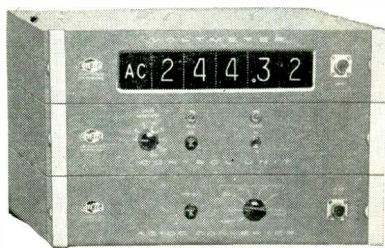
Oct. 10-12: National Electronics Conf., Hotel Sherman, Chicago.



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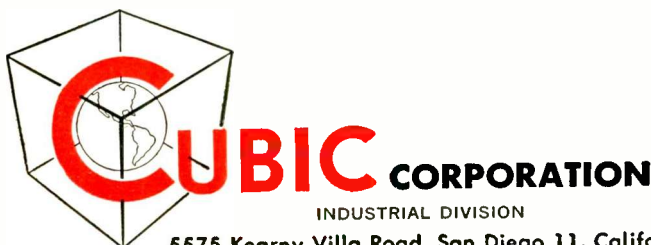
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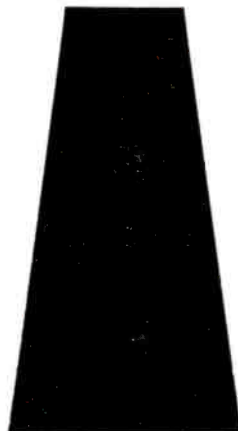
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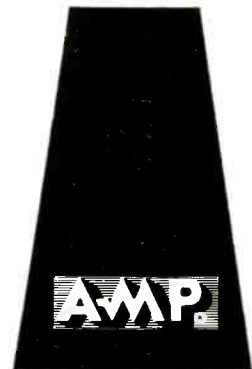
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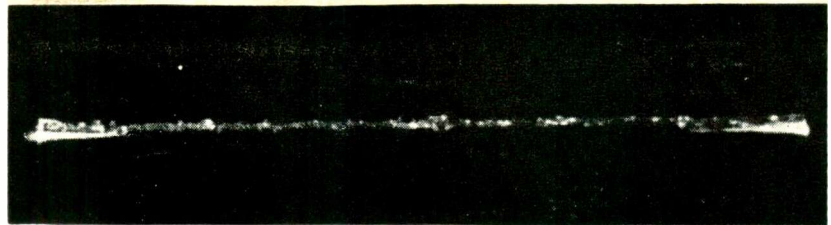
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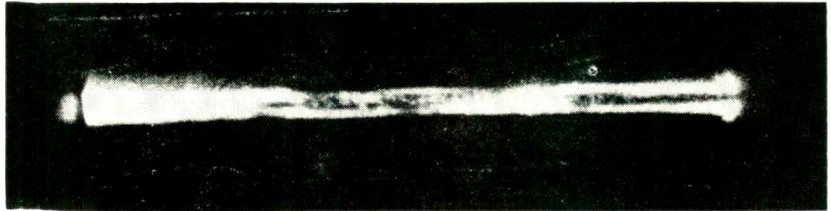
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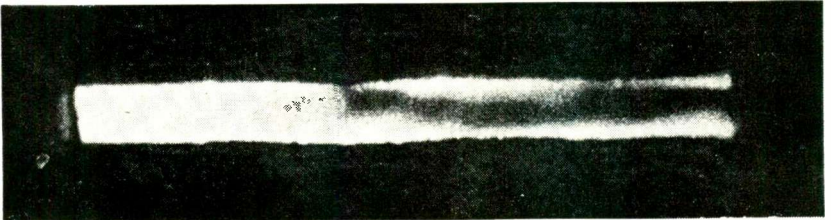




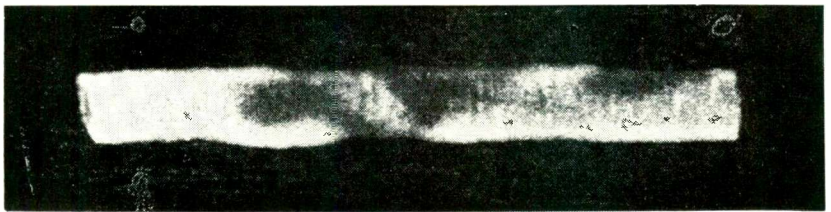
3 nanoseconds after switching of current



8 nanoseconds



32 nanoseconds



45 nanoseconds

From top to bottom, exploding aluminum wire 1 mil in diameter, 3/16 inch long and charged with 23.5 Kv. Camera exposure: 5 nanoseconds

## Instrumentation for

# EXPLODING WIRE RESEARCH

*Electrical explosion of 1-mil wire yields high current density, pressure and temperature. Kerr cell camera photographs exploding aluminum wire*

By NORMAN CHASE, NORBERT HANKIN and FRANCIS WEBB,  
Electro-Optical Systems, Inc., Pasadena, California

ULTRA-HIGH-SPEED ELECTRICAL explosions of fine metallic wires, clusters or films may be applicable in space propulsion, optical radar, hypervelocity particle impact research, light sources for photochemical reactors and explosive detonators.

Current laboratory research indicates that 1,000-second specific impulses can be obtained in the explosion of clusters of metallic

wires or thin films. A high degree of efficiency appears possible, thus making this an interesting possibility as a propulsive system for space vehicles. (Optimum wire size will depend upon vehicle and mission requirements.) To obtain such an impulse in a 1-mil wire requires a current density rise greater than  $10^{16}$  amp/sec/cm<sup>2</sup>.

Use of exploding wire phenomena in optical radar is another potential

application. It now appears that brightness temperatures above the range of 50,000 C are readily obtainable. This would provide a light source far brighter than a carbon arc, and is competitive with or better than high pressure gas discharges or air spark gaps.

Exploding wires may also provide an answer to the problem of obtaining hypervelocities on a laboratory scale for high-speed impact

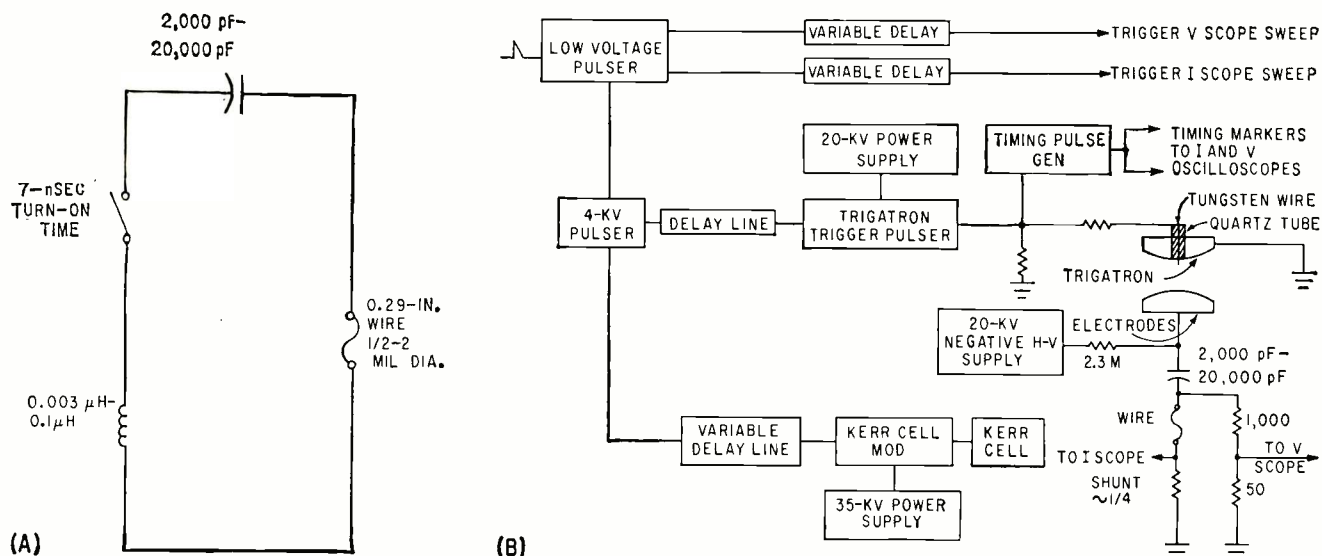


FIG. 1—Basic exploding wire circuit (A) uses switch with 7-nanosecond turn-on time; experimental test circuit (B) includes two traveling-wave oscilloscopes and Kerr cell camera. (See the front cover)

studies. Dense vapor or plasma produced by exploded wires possess impact characteristics similar to solid materials and could be accelerated to 20 to 30 km/sec.

A wire is suddenly exploded electrically by discharging a stored energy source such as a capacitor into it. The entire phenomenon is usually complete in much less than a microsecond.

For a single exploding wire, the voltage across the wire and the current flowing through it are simultaneously recorded as functions of time on two traveling-wave oscilloscopes. Single-frame photographs of the exploding wire in known time synchronism are also obtained by actuating a Kerr cell shutter.

The timing and energy input are highly reproducible, so that a timed series of single-frame photographs of separate wires can be put together to make a movie of the explosion. The products from the exploding wire are typically luminous, and it is possible to follow the expansion rate and other visible characteristics of the exploding wire.

The basic exploding wire circuit is shown in Fig. 1A and an experimental setup in Fig. 1B. The setup employs two traveling-wave oscilloscopes (with frequency response to 2,000 Mc), a Kerr cell camera with a 5-nanosecond exposure time, a time marker pulse generator, wire exploding circuit with voltage and current sensors, and auxiliary apparatus.

Sequence of operation is as fol-

lows. A triggering pulse activates a low-voltage pulser whose output pulse is split, with part simultaneously triggering the oscilloscopes after the appropriate time delays, and also activating a high-voltage pulser. The high-voltage pulser in turn activates the wire exploding circuit and the Kerr cell modulator after appropriate time delays. A pulse, taken from the wire exploding circuit with appropriate attenuation is applied to the vertical deflection of the I (current) and V (voltage) scopes, serves as a timing marker, allowing a time correlation to be made between the current and voltage measurements. Pulses from the current and voltage sensors are recorded on the I and V scopes respectively.

The Kerr cell modulator charges a delay line to 35 Kv which is actuated and discharged into the KSC-50 Kerr cell shutter at the appropriate time during the wire explosion. The voltage pulse to the Kerr cell is sensed with a resistive voltage divider placed between ground and the input to the Kerr cell then attenuated and applied to the scope. This provides the exact timing of the Kerr cell wire picture with respect to the voltage and current measurements. After the wire explosion, in another sweep, a 100-Mc sine wave is placed on the oscilloscopes for a time base.

The wire exploding circuit consists of a capacitor, switch, wire holder and wire, and current and voltage sensors. These components are housed almost completely coax-

ially and have a low inductance. The capacitor itself has a low inductance.

The switch is a triggerable air spark gap (or trigatron); it is operated by placing a negative high voltage across two electrodes, whose surfaces have a 3-inch radius of curvature, and then suddenly applying a high-voltage positive pulse to a tungsten wire placed in the center of the grounded conductor and insulated from it by a quartz tube. The high-voltage pulse causes a breakdown to occur between the tungsten wire and the ground electrode, which then causes a discharge between the ground and high voltage electrodes. The rise time of this switch is typically  $7 \times 10^{-9}$  second. The potential difference between the ground and high voltage electrode is originally placed at approximately 95 percent of that required to break down the air gap. The adjustment of the spacing between these two electrodes is critical.

A resistive, high-voltage, high-frequency current shunt is shown in Fig. 2. It is composed of 40, 10-ohm,  $\frac{1}{2}$ -watt carbon resistors mounted circumferentially between two copper plates yielding a shunt resistance of  $\frac{1}{4}$  ohm. The lower end of the wire holder is mounted into the top plate of the current shunt. The lower plate of the current shunt is circuit ground. The ground return conductor is placed coaxially around and very close to the shunt resistors, permitting large conductor diameters and very small shunt



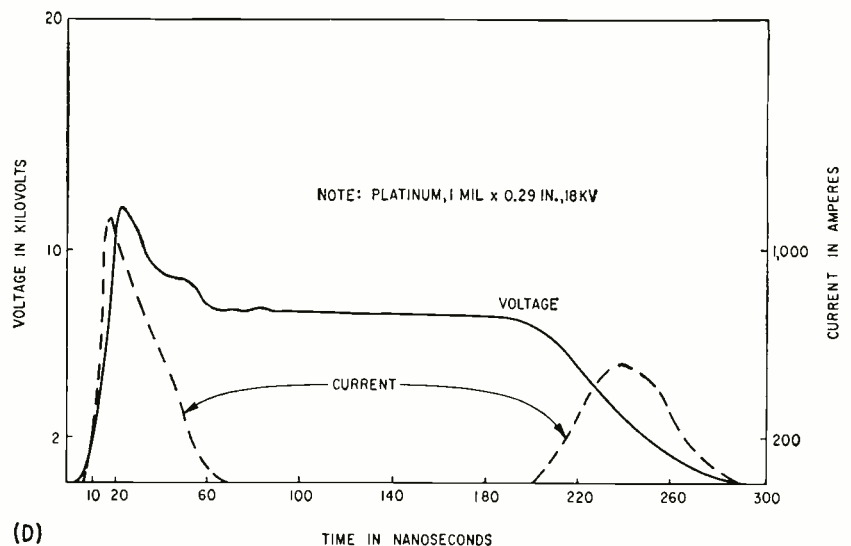
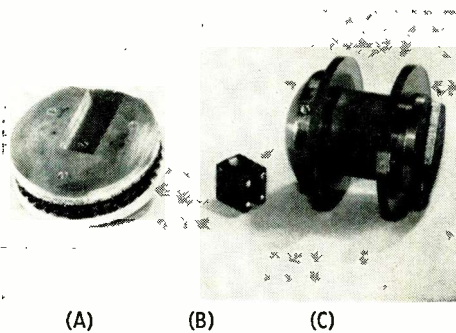


FIG. 2—Trigatron shunt (less coaxial return conductor) is shown in (A), trigatron wire holders in (B); trigatron energy storage unit (C). Current and voltage for an exploded platinum wire are indicated in (D)

inductance. The frequency response of this shunt is probably close to 1,000 Mc.

Certain basic requirements can be established for the circuit components of exploding wire apparatus for use in the submicrosecond range. First, the capacitor should be able to store many times the energy required to vaporize the wire, and have a low inductance.

Second, to dump the energy rapidly into the wire requires circuit inductances of a small fraction of a microhenry. Third, the switch must be capable of closing in a small fraction of the circuit period. A switching time of a few nanoseconds is desirable. Also, the sensing instrumentation must not unduly influence the phenomena being observed.

Typical values of the circuit parameters employed in our work are: capacity of approximately 2,000 to 20,000 pf, circuit inductances of about 0.03 to 0.1  $\mu$ h, charging voltages from 10 to 20 Kv,  $\frac{1}{2}$ - to 2-mil wire approximately  $\frac{1}{4}$  inch long, and triggerable switches with rise times of approximately  $7 \times 10^{-9}$  second.

The technique of measuring voltages across the wire of the order of 20 Kv with rise times of the order of several nanoseconds has been developed to the point where these measurements are accurate to about 5 percent. A similar statement applies to the measurement of current through the wire. The currents have an order of magnitude of 10,000 amperes, and a rise time

of several nanoseconds. This technique has permitted determining wire energy input and resistance as functions of time.

The wire current is determined by measuring the voltage across the known shunt resistance. The voltage across the shunt is sensed on the shunt axis, attenuated and displayed on the I scope. The voltage across both the wire and shunt is sensed on the V scope and the shunt component subtracted. Because both current and voltage are measured and it is necessary to maintain an appropriate ground, the voltage must be measured in this way.

The voltage sensor is a resistive divider placed across the wire and shunt. The divider consists of ten 100-ohm, 2-watt resistors connected in series, terminated at the divider by a 50-ohm resistor in parallel with a 50-ohm terminated cable going to the V scope. The divider ratio is then 40:1. The frequency response of the divider is better than 500 Mc. Additional attenuation is used and the signal is then displayed on the V scope.

When wires are exploded in this experimental setup, they heat rapidly and vaporize with explosive force. Current begins to flow with the initial switching of the voltage across the wire, but is gradually halted by the increasing wire resistance. Initially the voltage drop across the wires is predominantly inductive, but with the increasing resistance it soon becomes predominantly resistive.

Usually not all of the charge initially on the capacitor has left it by the time vaporization occurs, so that a high voltage (many Kv) remains across the gap. The initial conduction phase is followed by a period of low current conduction which is called current dwell. Current dwell is followed by a phase of resurgence of current flow called post-dwell conduction which presumably occurs when the pressure of the metallic vapor is reduced to a sufficiently low level to permit an arc-type discharge to restrike across the gap. If all the charge is removed from the capacitor in the initial conduction stage, however, no post-dwell conduction phase occurs. The current and voltage as functions of time for an exploded platinum wire are shown in Fig. 2D.

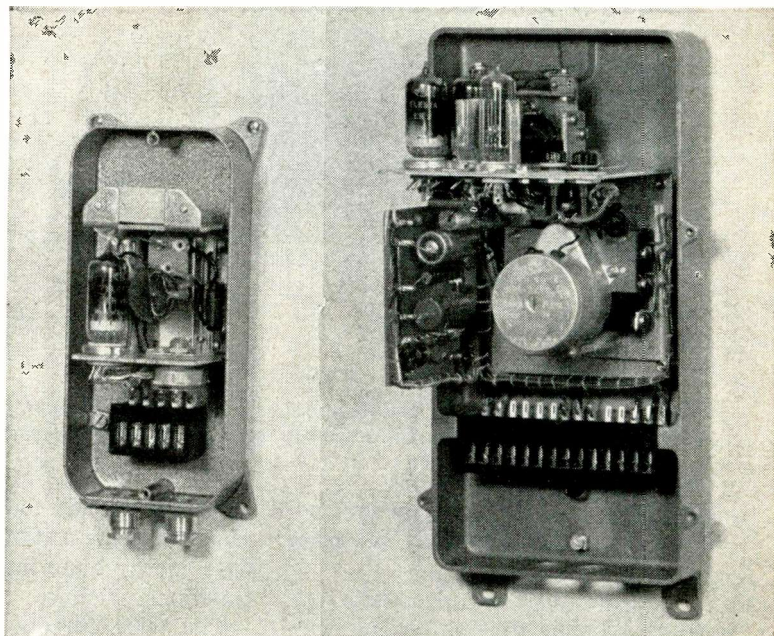
High energy densities can be placed in the wire during the initial conduction period. A typical value of the energy density obtained in an aluminum wire 1 mil in diameter and 0.29 inch long at 18.3 Kv is 11 electron volts per atom (corresponding to an energy input of about 400 millijoules.) These energy densities result in such characteristic exploding wire phenomena as emission of intense light, generation of strong shock waves and magnetic fields, high current densities (typically  $4 \times 10^9$  amp/cm<sup>2</sup>), pressures, temperatures and plasma density regions.

This work is supported by contract with U. S. Army Ordnance Corps, Picatinny Arsenal.

# Photoelectric Control

*Merits of photoconductive cells and photoemissive vacuum tubes are discussed and contrasted. Two control circuits use both types of light sensing elements*

By P. BERGWEGER,  
Elesta AG, Bad Ragaz, Switzerland



*Smaller control box on left uses photoconductive cell and is operated from an a-c supply. Precision control on right uses photoemissive vacuum tube and requires d-c supply*

NUMEROUS circuits and designs of automatic light controls have been published whose usefulness is essentially a question of reliability; that is, they must all have long and trouble free operating life, they must be insensitive towards voltage surges, and, to carry out the function for which they were designed, the controls must offer high stability even under adverse operating conditions.

The crucial elements of such controls are of course the light sensitive element and the associated amplifier. Two basic circuits satisfying the above requirements will be described and some applications discussed. One of the circuits employs a high-vacuum photocell and d-c cold-cathode-tube amplifier to provide a high degree of accuracy and stability, whereas the second combination uses a photoconductive cell and a-c cold-cathode-tube amplifier where switching requirements are less stringent.

Experience shows that the best light sensitive elements are vacuum phototubes and some photoconductive cells. Vacuum phototubes offer a very high degree of stability and long life expectancy, provided they

are operated at sufficiently low currents. Cadmium sulfide and cadmium selenide photoconductive cells on the other hand belong to the most sensitive group of photo elements. Typically, the sensitivity of these cells is about 1 million times greater than that of photoemissive tubes.

Several years of experience with large numbers of photoconductive cells have shown that the hermetically sealed types can be used for a large number of lighting control applications, even though they do not quite reach the stability levels of high vacuum cells. Furthermore, the high sensitivity of these photoconductive cells enables them to actuate relays directly, whereas the vacuum phototubes must always be followed by an amplifier before they can operate a relay. However, when photocells are used to operate a relay directly—without an amplifier—they must be protected against overheating.

Photoelectric light controls often have to sense the difference between night and day; moreover, they must operate at a given level of dust and switch off again when daylight is partially restored. Since this ambient level of illumination changes

very slowly, such controls incorporate a special delay circuit which prevents triggering by fluctuations in ambient illumination, as might be caused by automobile headlights or lightning, for example. With this added complication, it is easier to use a miniature photoconductive cell that operates a delay relay through an amplifier stage.

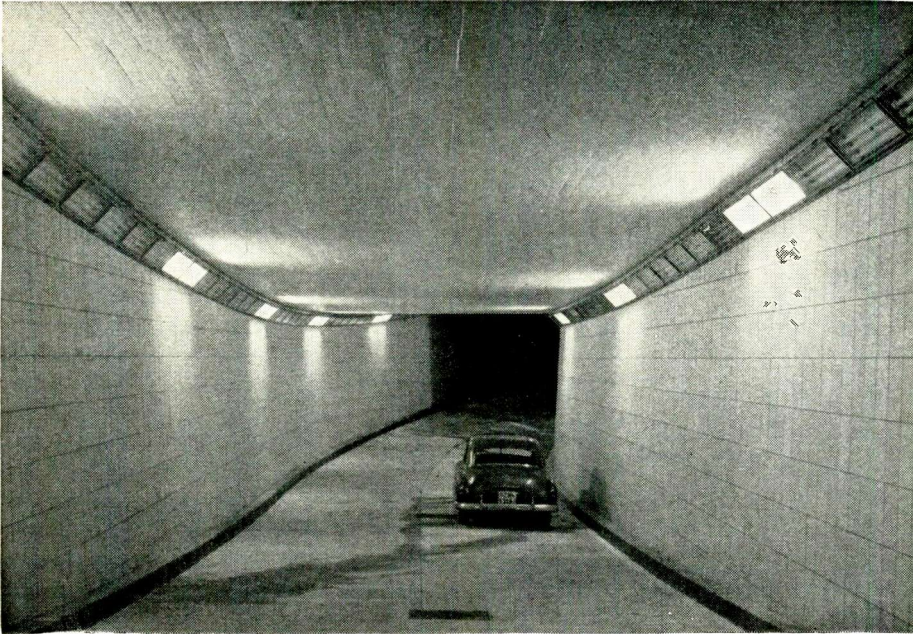
Cold Cathode Tubes with pure metal cathodes offer a number of exclusive features for illumination control applications.

Such tubes are on-off devices with normally three main electrodes but no heater. Absence of heater eliminates stand-by power and warm-up difficulties and so removes a source of potential trouble. The anode cathode gap can be triggered by extremely low starter-electrode currents, which may, with capacity control, be as low as  $10^{-6}$  amp for a-c tubes and  $10^{-9}$  amp for d-c operated tubes.

The anode current is normally about 15 to 30 ma, thus being high enough to control robust industrial relays. The extremely low starter current with d-c operation permits use of much higher load resistors in connection with photocells than



# Using Cold Cathode Amplifiers



Automatic light control continuously adjusts tunnel illumination so that it equals the ambient light outside, thereby preventing automobile drivers from being temporarily blinded

in any vacuum tube or transistor amplifier. Further advantages are an extremely long service life (exceeding 50,000 hours in a control application having a 50 percent duty cycle) with a high constancy of electrical characteristics, and insensitivity towards temperatures up to 80 degrees C.

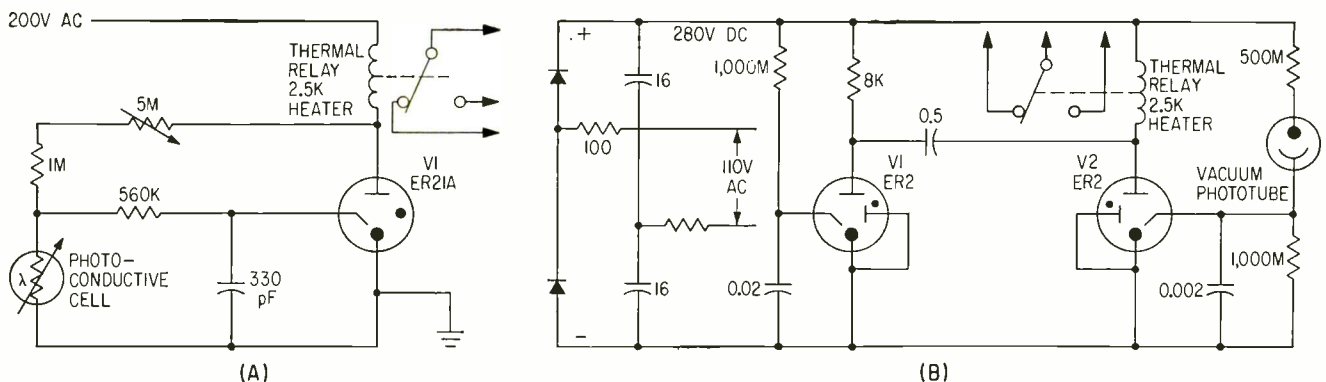
Figure (A) shows the circuit of a simple automatic light control with photoconductive cell and cold cathode tube for a-c operation. The voltage at the starter electrode of cold cathode tube  $V_1$  is determined by the voltage dividing resistors in

series with the photoconductive cell. At dusk the cell resistance increases till the starter breakdown voltage is reached, thereby switching the tube on. In the tube's anode circuit is a temperature compensated thermal relay consisting of a bimetal operated micro switch, which prevents the control from reacting to short fluctuations of the ambient illumination. During each positive half cycle, until at dawn, the illumination increases and reduces the output of the photo-

conductive cell below the triggering level of the cold cathode tube.

As mentioned before, d-c cold cathode tubes give an extremely high d-c amplification. Vacuum phototubes may typically be operated at emission currents of  $10^{-7}$  amp, giving them a practically unlimited and stable service life.

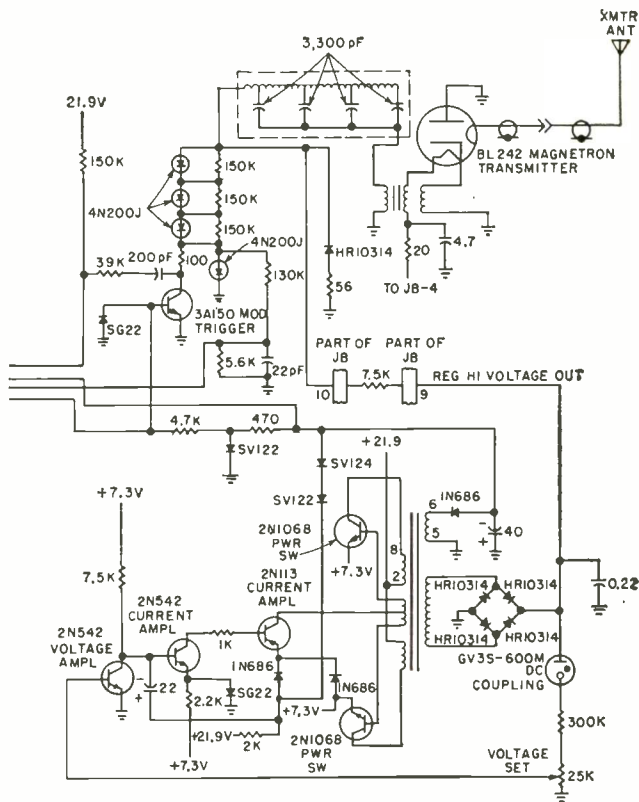
With d-c operation, a conducting cold cathode tube can only be switched off by interrupting or lowering its anode voltage, therefore for on-off devices, two tubes are often used in multivibrator circuits. Figure (B) shows such an arrangement for an automatic light control. With the blue-sensitive phototube not sufficiently illuminated, a stable condition exists with  $V_1$  conducting. The thermal relay is not heated, the lights being switched on by its normally closed contacts. Increased illumination raises the voltage at the starter grid of  $V_2$  and the multivibrator becomes astable or free running. The mark-space periods of the cold cathode multivibrator are chosen in such a way that  $V_2$  is on most of the time, being switched off only for very short intervals. The thermal relay gets heated sufficiently to switch off the lights, and serves the dual purpose of bridging the off periods of the multivibrator and preventing the control from reacting to short fluctuations of the ambient light. High switching accuracy without voltage stabilization is possible because the phototube is a saturating element.



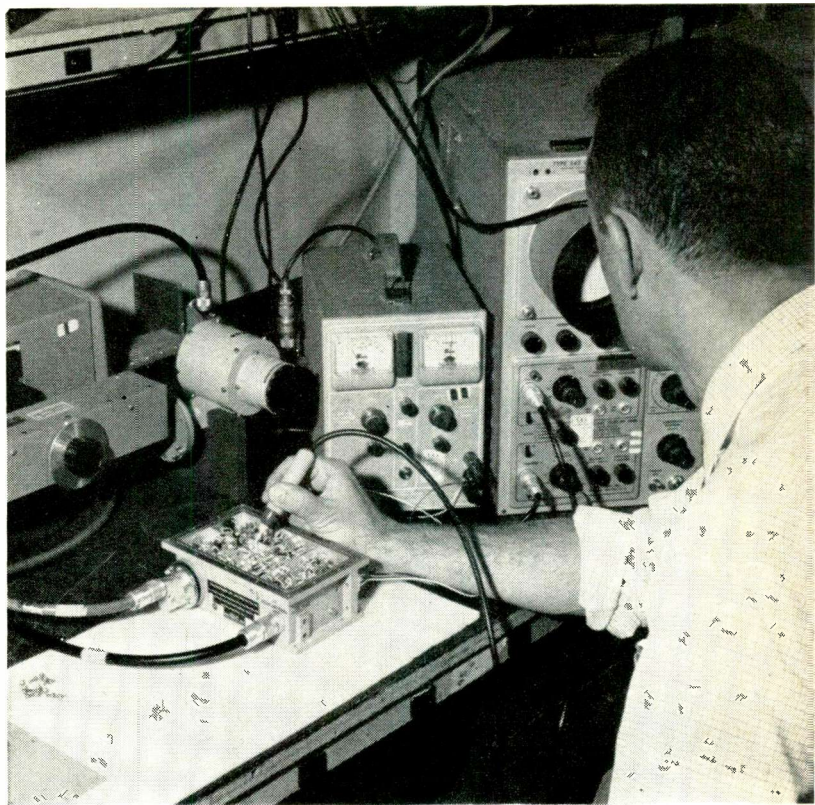
Simpler of the two control schemes uses photoconductive cell to sense light changes (A); photoemissive vacuum tube provides greater precision in light sensing, and is followed by a multivibrator-type d-c amplifier (B)







age in transistorized crystal video receiver



Typical production transponder undergoes final test in laboratory

## Feeds Subminiature Transponder

The resultant transponder, bearing the military nomenclature AN/DPN-63, has a sensitivity of  $-45$  dbm and is tunable over a frequency range of 5,400-5,900 megacycles. It is a crystal video type, compact but designed for easy maintenance. Weight without batteries is about 4 pounds; with self-contained batteries, 5 pounds 3 ounces. The transponder will operate for one hour or more from these batteries. The transponder itself is pressure sealed for operation up to 100,000 feet, and meets other missile environmental requirements of temperature, vibration, shock and humidity. Power consumption is 7 to 15 watts, depending on the interrogation rate.

Volume of the AN/DPN-63 alone is 75 cubic inches and with batteries is about 100 cubic inches. The magnetron transmitter is rated at 400 watts peak power and is the only tube in the transponder. Silicon semiconductors are used exclusively. Figure 1 shows the complete schematic of the transponder.

A feature of this transponder is

its high delay stability. For an input signal range of 0 to  $-40$  dbm, the change in delay of transponder reply is no greater than  $\pm 6$  millimicroseconds. An automatic gain control circuit for the transistor video amplifier was developed so that the rise time of the received pulse would not cause delay change, which would be the case without such provisions. For signal inputs of 0 to  $-45$  dbm, the automatic gain control provides a constant amplitude pulse to the modulator with unchanging rise time. Automatic gain control is applied to two stages, and also to the crystal detector.

The antenna feeds a double-tuned preselector cavity and crystal detector. Video amplifier bandwidth has been made 10 Mc to preserve rise times, thus reducing delay variations. The output amplifier feeds both the agc circuitry and an avalanche triode which serves as a modulator trigger. The semiconductor modulator switch drives a Bomac BL-242 magnetron transmitter. High voltage for the modu-

lator is derived from a d-c to d-c converter. Power for the transponder comes from a battery pack of 15 silver-zinc cells.

The preselector prevents crystal burnout by the beacon transmitted pulse and prevents triggering by radars operating at frequencies other than the frequency to which the beacon receiver is tuned.

The preselector and video detector, shown in Fig. 2, are assembled as an integral unit. The preselector is a two-cavity quarter-wave coaxial resonator operating in the fundamental TEM mode.

The two cavities are machined in a brass block with a coupling aperture milled between them. Energy is coupled in and out by loops that are effectively extensions of the input and output coaxial connectors. The input antenna connector is type N pressurized and makes an O-ring pressure seal with the wall of the beacon body. Tuning elements are slotted for screwdriver adjustment and are accessible externally from the beacon. The tuning elements are made of

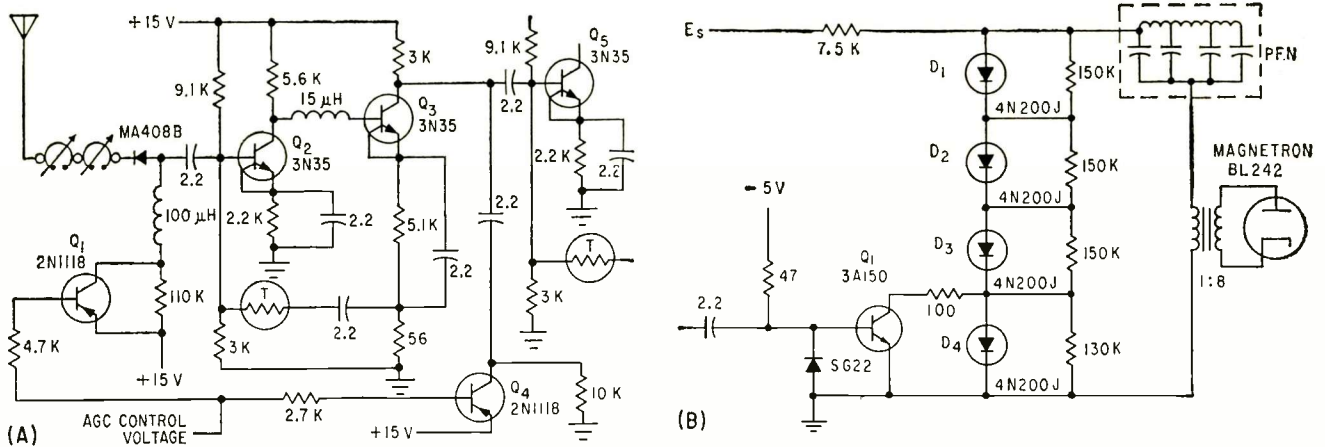


FIG. 3—Enlarged views of typical video and age stages (A), and modulator (B) whose switching action is similar to that of a hydrogen thyratron, but which requires no heater power or warm-up

invar and provide a good frequency stability with temperature.

The video detector crystal requires a nominal bias current of 65  $\mu$ a. This bias current optimizes sensitivity, lowers both the video and r-f impedance of the crystal, and produces more stable operation with temperature variations. The d-c return for this bias is provided through the output coupling loop of the preselector.

The video amplifier, consisting of 10 transistor stages, provides 98 db of voltage gain. The output pulse has a rise time better than 0.1  $\mu$ sec. The amplifier operates with essentially constant gain over an ambient temperature range from -55C to +85C.

The first six stages consist of three direct coupled pairs. A typical pair is shown in Fig. 3A. It uses 3N35 tetrode transistors. Direct-current pairs are used to reduce the number of components required, provide bias stability, and minimize overshoot.

High-value emitter resistors set the base operating point and provide d-c stabilization against changes in gain with temperature and source voltage variations. Bandwidth is improved by a 15  $\mu$ h series peaking coil.

The series feedback path includes a thermistor with a negative temperature coefficient that provides more feedback with increasing temperature to compensate for changes in transistor characteristics with temperature. The lower limit of the video amplifier pass band is set by value of the coupling

capacitor in the first pair. This cut-off frequency is kept high to improve s/n ratio, since the main source of transistor noise is inversely proportional to frequency.

Zener diodes, used for voltage stabilization throughout the amplifier, have been chosen such that changes in voltage reference with temperature compensate for the negative temperature coefficients of the base emitter diodes of associated transistors.

The video amplifier output stage is a 2N1118 transistor operated as a saturating switch that drives the modulator trigger stage through an emitter follower.

A blanking pulse, derived from the modulator, disables the receiver during transmission to prevent the transmitter from affecting the agc voltage or retriggering the beacon.

Delay stability with change in input r-f signal is accomplished by an agc loop applied to the video amplifier.

A signal from the video amplifier output is stretched, rectified and applied as a d-c control current to shunt attenuators across the first two video stages and the detector crystal as well. Attenuator transistor Q<sub>1</sub> (Fig. 3A) forms a portion of a voltage divider network which shunts larger amounts of video signal to ground through the 2.2  $\mu$ f capacitor with increased agc voltage. The d-c operating point of the video pair is not affected, thus ensuring stability of gain and bandwidth with agc action.

Increased signal level will also tend to turn transistor Q<sub>1</sub> on,

shunting the resistor across it and increasing crystal bias current.

By increasing current from the nominal 65  $\mu$ a to 4 ma, over 45 db of video attenuation may be obtained. Use of this technique avoids overload and delay change at high signal levels.

Figure 3B shows a schematic of the modulator. It resembles the conventional line-type pulser, with a pulse-forming network (PFN) and a 1:8 pulse transformer driving the magnetron. However, the hydrogen thyratron has been replaced with a semiconductor switch consisting of four Shockley 4N200J four-layer diodes in series, triggered by a type 3A150 avalanche triode connected in parallel with the bottom diode.

The switching action is similar to that of a hydrogen thyratron, but with the advantage that no heater power and warmup is required, dynamic impedance is lower, and recovery time is shorter than with the more conventional thyratron circuit.

The avalanche triode (Q<sub>1</sub>) will not conduct unless the voltage across it exceeds 150 volts, or unless the base is triggered with a positive going pulse. For a 10-ampere pulse the four diodes in series have a total voltage drop of 25 volts, that is, a dynamic resistance of 2.5 ohms for the entire switch.

Each of the four diodes has a voltage breakdown rating of approximately 200 volts for a total hold-off condition of 800 volts, well above the 635-volt potential on the PFN. Thus, an external trigger is



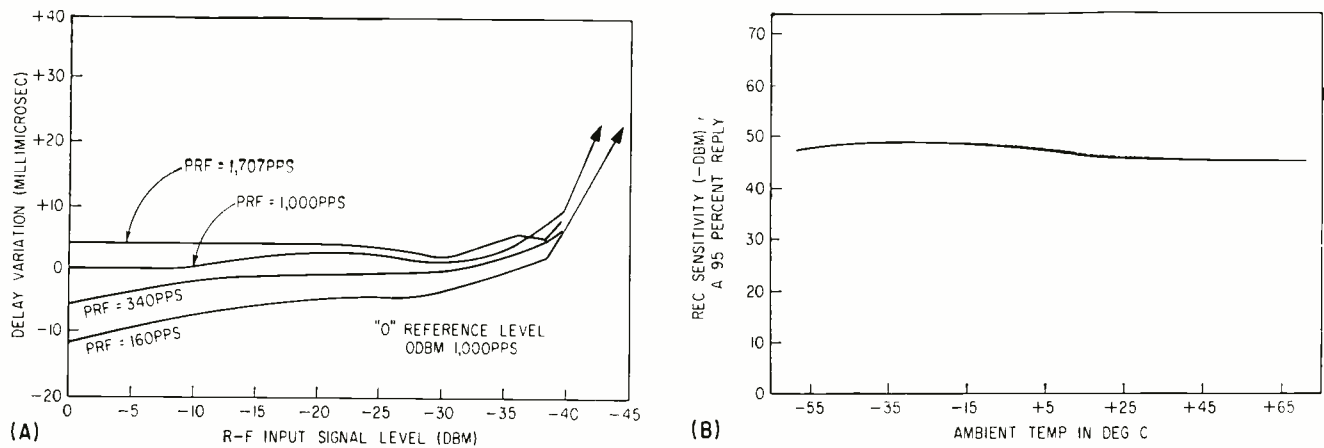


FIG. 4—Delay stability as a function of r-f input signal level for various interrogation rates (A); and receiver sensitivity as a function of temperature (B)

necessary to break these units down to their conducting state. When a video pulse triggers Q<sub>1</sub>, it breaks down and brings the bottom of D<sub>1</sub> to ground potential. The 635 volts of the PFN is then applied across the top three series diodes, D<sub>1</sub>, D<sub>2</sub>, and D<sub>3</sub>. This step voltage change is enough to cause avalanche breakdown of these three diodes and as the entire voltage tries to appear across the bottom diode, D<sub>4</sub>, it also breaks down. The whole action takes place in less than 0.1 microsecond. Output pulse rise time is deliberately lengthened by the characteristics of the PFN to 0.2  $\mu$ sec, the minimum permissible for proper firing of the magnetron. Both the modulator switch and the pulse transformer are capable of faster rise times.

Leakage current of the four-layer diode is a function of temperature; as temperature increases, leakage through the four units in series also increases. To stabilize the modulator switch a bleeder network of four resistors shunts the four diodes. The bleeder network conducts currents in the order of 5 to 10 times greater than the leakage currents of the diodes at any temperature. Thus, the voltage across each diode is determined by the bleeder instead of the diode characteristics. Resistance charging of the pulse forming network is used. This consumes more power than inductance charging but is inherently more suitable for minimizing delay variation. With resistance charging, the voltage across the pulse-forming network charges to the

same value, independent of leakage currents and pulse repetition frequency (PRF), whereas with inductance charging this voltage is a function of PRF, and leakage. Different potentials on the switch diode at the time of trigger results in delay variations since the avalanche breakdown will commence on different portions of the leading edge of the trigger pulse. Thus, resistance charging is considered superior.

The magnetron and d-c to d-c converter are conventional. A feedback type voltage regulator holds the +635 volts to within  $\pm 1$  percent from no load to full load and over a temperature range from -55°C to +85°C.

Figure 4A shows stability of transponder delay as a function of r-f input signal level for various interrogation rates. It will be noted that, for PRF's between 340 and 1,707 pps, for signal levels from zero down to about -38 dbm, delay remains well within  $\pm 6$  millimicroseconds, a range accuracy of about 1 yard.

Results of temperature compensation are shown in Fig. 4B where receiver sensitivity is plotted against temperature. From -46 dbm at 25°C, sensitivity drops only 1 db at the high temperature extreme. A 2 db increase is noted at -25°C, dropping slightly to -47.5 dbm at -55°C.

The silver-zinc alkaline battery provides almost 90 percent additional capacity over that required for normal operation. Cells can be charged and discharged for at least

10 cycles and can be stored in either charged or discharged condition for about 3 months.

Sensitivity of the receiver remains essentially constant as a function of time, changing from -47 dbm to -46.5 dbm in 67 minutes, dropping to -46 dbm at 74 minutes, at which point battery voltage has begun to fall off. Complete discharge is considered to be at 80 minutes, where the voltage at the tap supplying the magnetron filament has fallen from 7.4 to 5.8.

In the completely assembled transponder, the magnetron is provided with a flange, making possible a pressurized mounting scheme that permits tuning from the outside. Preselector tuning and sensitivity adjustments are also accessible.

Removal of the cover exposes the video amplifier and agc circuitry, which are mounted on an easily removable plug-in tray. The open tray can be seen in the test setup photo. Located below the video tray are the magnetron, modulation transformer, preselector and detector mount, and a compartment which houses the modulator and d-c to d-c converter. This is accessible by removal of a metal plate. The modulator and power supply circuit boards are mounted in a silicone rubber potting compound that can be removed.

The battery case, which is not pressurized, may be easily detached from the transponder. Battery power may be applied to the beacon externally through the external power plug.

# Using Off-Balance Bridges for

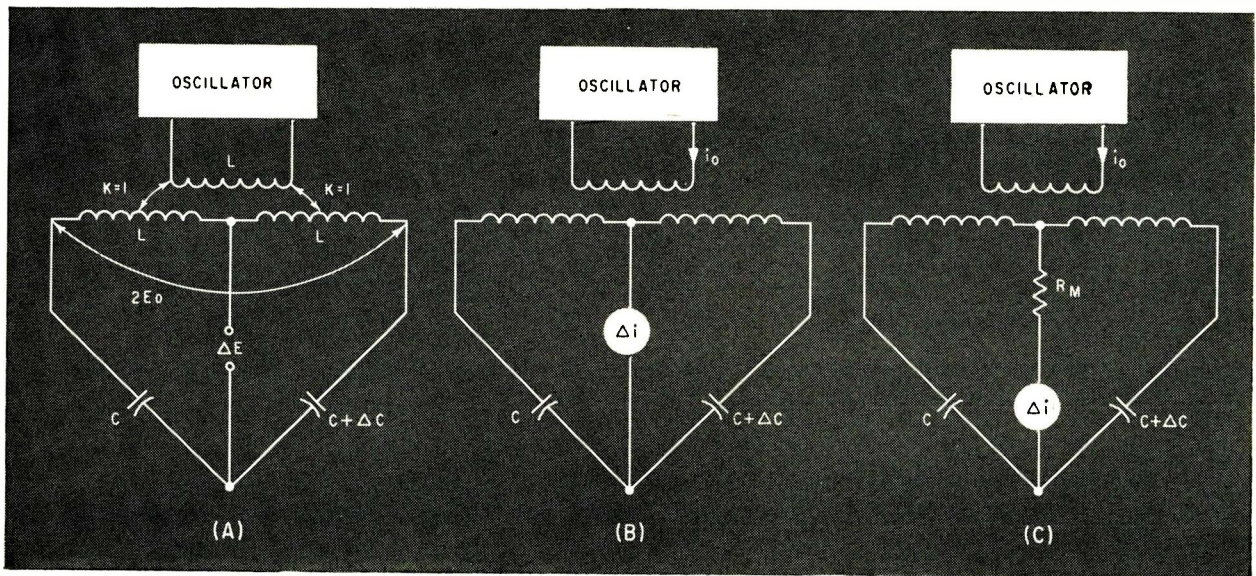


FIG. 1—Basic bridge circuit diagrams for open circuit (A), short circuit (B) and intermediate (C) cases are basis of circuit analysis. Equations for each case are derived in text

*Analysis of off-balance capacitance bridges provides basic design equations. Example shows design of bridge that measures capacitances ranging from 10 to 100 picofarads*

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BALANCED BRIDGES have been widely used for measurements and their behavior extensively analyzed in the past but analysis of off-balance bridges has been almost neglected.

To help fill this gap, the analysis of such networks will be made here. Although the technique used in this analysis can be extended to cover a wide range of off-balance bridges, the method has been applied in detail only to a narrower class, a capacitance measuring bridge.

It will be shown that off-balance bridges are basically nonlinear; that is, the output current is a nonlinear function of the input variable change. However, this nonlinearity can be kept small (1-2 per cent of full scale reading). Noting this fact and taking into account the ruggedness and sensitivity of the design, it is seen that the approach results in a satisfactory instrument.

The bridge analysis is based on the diagrams shown in Fig. 1. Certain assumptions have been made which will simplify the calculations while still allowing certain important conclusions to be drawn. Assumptions under which the following theory will be developed are that all inductances are identical and that they are all high compared to the capacitive impedances involved and that there is unity coupling between all of them.

Under these assumptions it can be shown that unbalancing the bridge by increasing one of the capacitances by the amount  $\Delta C$ , a voltage will appear across the open terminals, as shown in Fig. 1A. This voltage will have the following form

$$\Delta E = E_o \Delta C / (2C + \Delta C) \quad (1)$$

Similarly, by short circuiting these open terminals (Fig. 1B) the current in this short circuit will be of the form

$$\Delta i = i_o \Delta C / (2C + \Delta C) \quad (2)$$

These two cases represent the two

extreme conditions under which the bridge is likely to operate: with no load impedance or with infinite load impedance. In form Eq. 1 and 2 are identical. In fact, they can be expressed in the general form

$$\Delta E / E_o = \Delta i / i_o = \Delta C / (2C + \Delta C) \quad (3)$$

The graphic representation of these two curves is given in Fig. 2A. This shows that the circuit is an inherently nonlinear device; that is, the output voltage or current from the bridge will not be a linear function of unbalance  $\Delta C$ . Then since the two extreme cases are nonlinear in the same way, the intermediate case with a finite meter impedance will have the same type of nonlinearity.

Steps can be taken to correct this nonlinearity, but only to a certain extent. Given an accuracy requirement for the measurements, allowance has to be made for a nonlinearity within that accuracy.

The generalized case for the circuit is where a current-indicating device that has a finite impedance is connected across the output ter-



# Measurement and Control

minals of the bridge. Assume the ohmic resistance of the bridge circuit is included in this impedance and denote this total resistance as  $R_v$ . The circuit for this condition is shown in Fig. 1C. Deriving the expression for the current measured in this current-indicating device as a function of an unbalance  $\Delta C$  gives

$$\Delta i = i_o \frac{\Delta C}{C} \frac{1}{\sqrt{2 + \Delta C/C + 4R_M j \omega C(1 + \Delta C/C)}} \quad (4)$$

This expression reduces to the short circuit current expression, Eq. 2, by equating  $R_v$  with zero. Figure 2B compares the shape of this curve to that for the open circuit or short circuit case. For the loaded case the maximum current is reduced.

An improvement in linearity can be achieved by assuming that  $R_v$  includes a variable inductance  $L_p$ . This inductance (a peaking coil) can be used to improve linearity. Assume  $L_p$  is adjusted to resonate with the total capacitance of the circuit at the value  $\Delta C = 0$ . This occurs when

$$\omega L_p = 2/\omega C \quad (5)$$

Substituting this value into Eq. 4, the current equation is obtained

$$\Delta i = i_o \frac{\Delta C}{C} \frac{1}{- \Delta C/C + 4R_M j \omega C(1 + \Delta C/C)} \quad (6)$$

Similar reasoning applies when inductance is adjusted to resonate with the total capacitance of the circuit at the full scale value of  $\Delta C$ . This occurs at the peaking coil value

$$\omega L_p = (1/\omega C) \frac{2C + \Delta C_{max}}{C + \Delta C_{max}} \quad (7)$$

for which value the output current is

$$\Delta i = i_o \frac{\Delta C}{C} \frac{1}{1 - \frac{1 + \Delta C/C}{1 + \Delta C_{max}/C} + 4R_M j \omega C(1 + \Delta C/C)} \quad (8)$$

Summing up the preceding considerations, these three cases have been analyzed:

(a) the output containing no peaking coil, (b) peaking coil resonated by balance point ( $\Delta C =$  zero) and (c) peaking coil resonated at full scale value ( $\Delta C = \Delta C_{max}$ ). The output current will be different for these three cases. The results have been summed up in Fig. 3 and the table.

From Fig. 3 it can be seen that  $\Delta i$  starts out with small  $\Delta C/C$  values as a linear function; with large  $\Delta C$  values the current tends to become a constant value and both the slope of the linear part and the final constant value will be different for the three cases.

Comparing it to the unpeaked case, the case where the inductance is tuned at balance has a steeper slope with small  $\Delta C$  values, but the final value of the current tends to

the same value as in the unpeaked case. Thus while the sensitivity for small  $\Delta C$  values is higher, the non-linearity is worse.

Again, compared with the unpeaked values, when the resonant coil is tuned to maximum  $\Delta C$ , the slope of the current increase is larger than that of the unpeaked value but the final current value is higher than either of the preceding two cases.

Thus the circuit where the inductance is tuned to be resonant at full-scale value will show a higher sensitivity than the unpeaked case and a better linearity than the circuit peaked at balance.

Therefore, if the requirements are for a high sensitivity with relatively small  $\Delta C_{max}$  values, the circuit should be tuned to resonate at

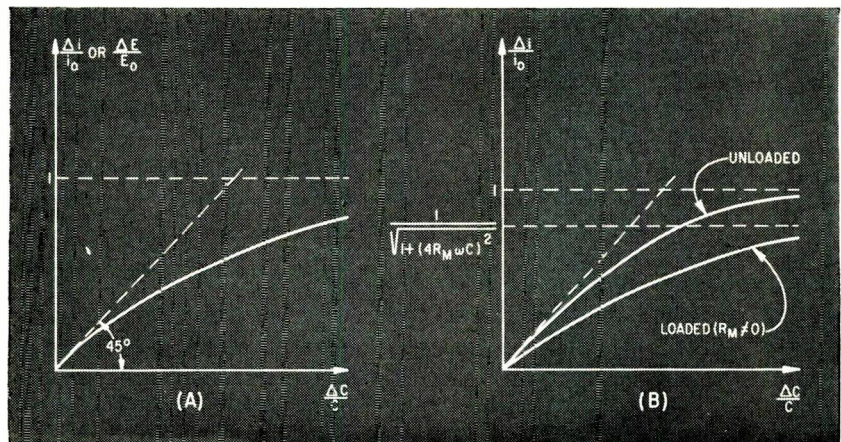


FIG. 2—Curve for no-load and infinite load is shown in (A). Comparison in (B) shows loading effect resulting from meter impedance

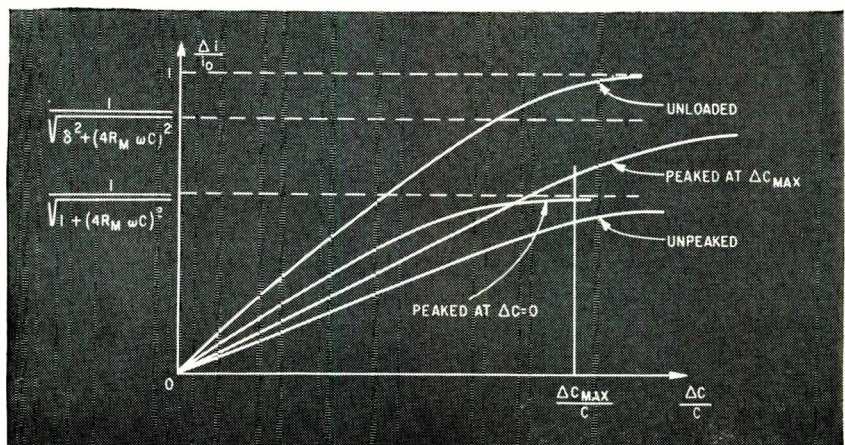


FIG. 3—Effects of loading and peaking on sensitivity and linearity limit design freedom



## IMPORTANT PARAMETERS

| Case                          | Slope at small $\frac{\Delta C}{C}$             | Limit for $\frac{\Delta C}{C} \rightarrow \infty$ | Remarks   |
|-------------------------------|---|---|---|
| Unloaded<br>[ $R_M = 0$ ]     | $\tan 45^\circ = \frac{1}{2}$                   | 1   | ---   |
| Unpeaked<br>[ $L_p = 0$ ]     | $\frac{1}{\sqrt{2^2 + (4R_M \omega C)^2}}$      | $\frac{1}{\sqrt{1 + (4R_M \omega C)^2}}$          | ---   |
| Peaked at<br>$\Delta C = 0$   | $\frac{1}{4R_M \omega C}$                       | $\frac{1}{\sqrt{1 + (4R_M \omega C)^2}}$          | $\gamma = \frac{C_{max}}{C} < 1$ $1 + \frac{\Delta C_{max}}{C} < 1$ |
| Peaked at<br>$\Delta C_{max}$ | $\frac{1}{\sqrt{\gamma^2 + (4R_M \omega C)^2}}$ | $\frac{1}{\sqrt{\delta^2 + (4R_M \omega C)^2}}$   |   |

balance while, if linearity considerations are of primary importance, the circuit has to be tuned at its full-scale value  $\Delta C_{max}$ .

From the preceding analysis of the bridge circuit, the following conclusions can be made and applied to the practical problem of setting up the system:

(1) The current output is always a nonlinear function of the capacitance change and, for each measurement, the nonlinearity permissible has to be determined. It is, however, possible to achieve a linearity within a specified accuracy figure, using certain precautions.

(2) For a given  $\Delta C$  for full-scale reading, the linearity can be improved by increasing the terminal capacitance  $C$  of the network. This means that a fixed capacitor may have to be added across the terminals of the bridge, this fixed capacitance  $C$  being a function of  $\Delta C_{max}$  and the required linearity.

(3) The effect of this padding capacitance is, first, to improve linearity, and second, to reduce the sensitivity of the bridge. In the expressions of the current  $\Delta i$  (Eq. 4, 6 and 8), there is the expression  $4R_M j \omega C$  where  $C$  is the padding capacitance. Since this expression occurs in the denominator, an increase in  $C$  will result in a decrease in  $\Delta i$ , or a decrease in sensitivity.

(4) Such a decrease in sensitivity can be counter-balanced by re-

ducing  $R_M$ . This is done by using a series rheostat in the meter circuit and varying its value, depending upon the full-scale reading required.

(5) If the terminal, or padding, capacitance required is so high as to prevent full-scale reading obtained even with minimum value of  $R_M$ , the frequency can be lowered. An increase in capacitance  $C$  can be counter-balanced by a reduced frequency  $\omega$ .

(6) By using a peaking coil, both linearity and sensitivity can be improved in the following way:

Assume that the circuit is to be tuned at full scale reading  $\Delta C_{max}$ . Let this condition be physically

realized so that the indicator shows full-scale reading. Now, by use of the peaking coil, this reading is increased and this increase counter-balanced by an increase of  $R_M$  (by increasing the resistance of the rheostat). By manipulation of the peaking coil and the sensitivity rheostat, a condition can be achieved where the system indicates full scale at a particular position of the peaking coil and less than full scale on either side of this position. This means that the circuit is now tuned to full scale. In this condition linearity will be optimum and sensitivity unchanged from the unpeaked condition.

To illustrate the method outlined assume the following specifications: Design a bridge capable of giving full-scale indication on a 1-ma meter for capacitance values between 10 and 100 pf. The meter resistance is 100 ohms and the oscillator frequency is 500 Kc.

Using Eq. 8 full-scale current is  $\Delta i_{max} = i_n m / [(1 + m) (4R_M \omega C)]$  where  $m = \Delta C_{max} / C$ . According to the specifications:

$\Delta C_{max} = 10$  to  $100$  pf  $R_M = 100$  ohms and  $\omega = 3.14 \times 10^6$  sec<sup>-1</sup>.

Choose  $C = 500$  pf (fixed padding capacitors), then for the smallest span  $m = 10/500 = 0.02$ ,  $\Delta i_{max} = 0.03 i_n$ , and the oscillator current for  $\Delta i_{max} = 1$  ma is  $i_n = 33$  ma. This measurement has a maximum non-linearity at the 50-percent reading of about 1 percent.

For the widest span ( $\Delta C_{max} = 100$  pf), with  $\Delta i_{max}$ ,  $i_n$  and  $C$  unchanged,  $R_M$  has to be increased to about 1,000 ohms by a rheostat.

The necessary peaking coil in series with the meter is  $\omega L = (2C + \Delta C_{max}) / \omega C (C + \Delta C_{max})$  thus,  $L = 350$  to  $400 \mu H$  (variable).

The oscillator power requirement is about 2 watts. The circuit is shown in Fig. 4.

Capacitance bridges are valuable tools since a wide range of physical variables (such as level, composition or thickness) can be readily converted into changes of capacitance by electrodes.

While balanced bridges need manual setting or expensive electromechanical rebalancing methods, off-balance bridges can be used as a simple, inexpensive indicating or controlling means.

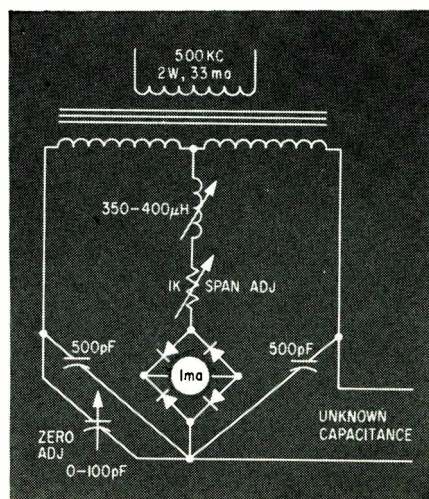


FIG. 4—Resistance of meter in practical circuit shown is 100 ohms



# Transistorized Data Amplifier Has High Gain-Stability

*Circuit refinements and careful design give a data amplifier  
high gain-stability and linearity and low output impedance*

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HIGH ACCURACY d-c amplifiers are inherently more difficult to design and build than a-c amplifiers. As a result, a-c signals are used in measurement applications wherever possible, even sometimes at the sacrifice of a fundamentally simpler and more accurate system.

The primary difficulty in a d-c amplifier is drift, or random change in no-signal output. With conventional amplification techniques, drift can only with difficulty be kept as low as a few millivolts equivalent input, which may be a thousand times too large for low voltage signal devices such as thermocouples. Of the methods to reduce or nullify drift, chopping is successful and widely used. Chopper amplifiers may be designed to have no appreciable change in output with constant input signal, so that drift effects are reduced to a negligible value.

If a chopper amplifier is to be used only as a null device, design problems are minimal. Such amplifiers have long been used with self-balancing potentiometers, for example. If, however, an output strictly proportional to the amplifier input signal is desired, new problems are introduced, their magnitude depending upon the precision of amplification required.

Both experimental and theoretical investigation of the conventional chopper amplifier indicate fundamental limits to its accuracy, beyond which it is impractical to go.

These limitations result in part from the basic nature of such amplifiers, and in part from the natural imperfections of any chopper switch. The first limitation, that of the basic design of the amplifier, shows up in transient errors, evident in response to a step input.

The problem resulting from the chopper itself results primarily from the impossibility of holding chopper dwell times and phase relationships precisely constant. These fluctuations have two effects on the amplifier performance: they change the overall amplification; they introduce ripple at chopper frequency in the amplifier output. While fluctuations in a chopper can be kept to one or two percent, this performance is inadequate if an amplification constancy of a few hundredths of one percent is desired. Furthermore, if there is appreciable ripple at chopper frequency in the output, the ripple must be filtered out; the filter increases the response time of the amplifier. This may not be permissible where rapid response is essential, as in applications where a number of data points are scanned by a single amplifier.

With the chopper output circuit of Fig. 1A, which will be explained in more detail, and with vacuum tubes as amplifying elements, data amplifiers with gain and linearity constant to 0.01 percent over the ambient temperature range from

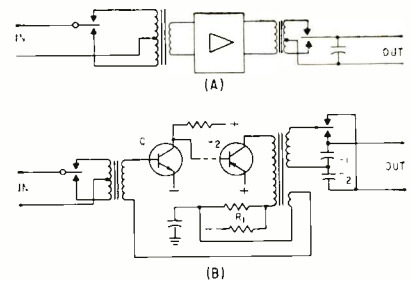


FIG. 1—Conventional chopper amplifier of (A) works well in null type servo but for precise and constant gain, the circuit of (B) is superior

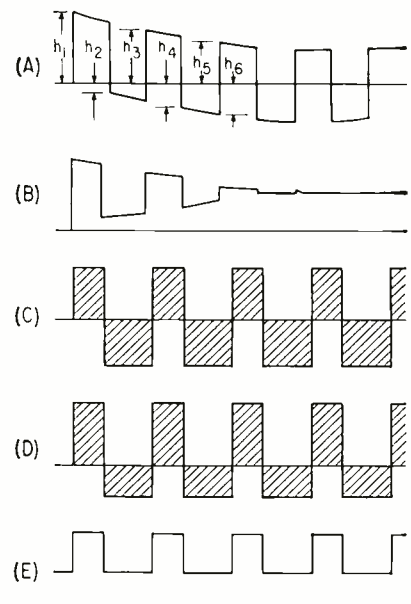
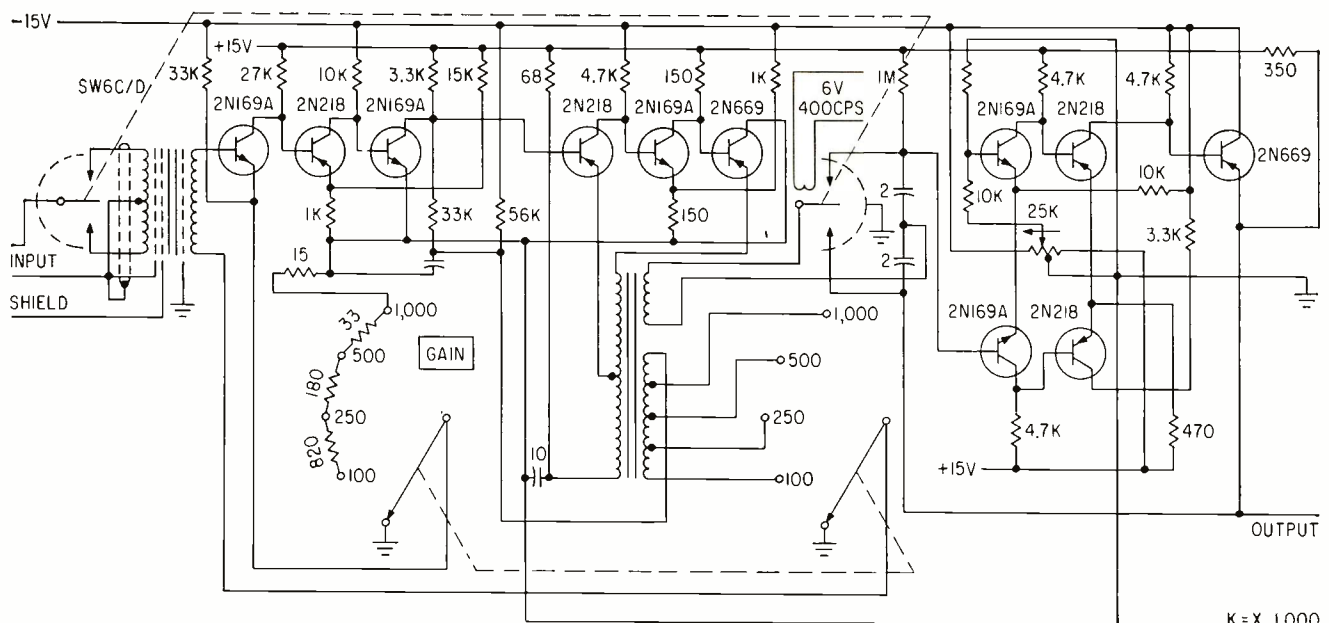


FIG. 2—Transient response of conventional chopper amplifier to a step input (A) is shown in output (B), and the effects of unequal dwell time in (C), (D) and (E)



K-X 1,000

FIG. 3—Transistorized data amplifier has gain stability and linearity of 0.01 percent from 15 to 55 C. Gain is adjusted by changing the amount of feedback

—55 to 85 F have been built. Chopper characteristics can change several percent with practically no change in output.

Where extreme gain constancy is desired, transistors present problems not found in vacuum tubes. These are due primarily to the effects of temperature changes on transistor characteristics. For any type of general use, a data amplifier should operate within its specified accuracy over an ambient range of at least 0 to 40 C. This would permit operation in a non-air-conditioned atmosphere and only require such heating as would be necessary to prevent freeze-up of other equipment. Operation over a wider ambient range might have further advantages in some limited applications, but accuracy should not be compromised over the range stated.

There are three major effects on transistor characteristics from ambient temperature changes.

First, leakage current approximately doubles for each ten degrees C rise. Second, the current amplification factor increases with temperature, an effect troublesome at low temperatures, where current-gain reduction may be serious. Finally base-to-emitter contact potential changes about 2.5 mv per degree C. For a fixed base voltage, this results in a rapid change in collector current with temperature.

All three effects are greatly di-

minished with chopper amplifiers, since the shift in amplifier operating point will not result in any change in the zero-signal output of the amplifier. But temperature change will still cause a change in amplifier gain, and may also cause distortion and limited output if the amplifier operating point shifts too far from its design point.

Techniques to overcome these three parameter variations are illustrated in the simplified block diagram of Fig. 1B. Basically, the circuit is a direct-coupled transistor amplifier with transformer-coupled chopper input and output circuits. The amplifier stability is maintained by two feedback circuits. Operating point feedback (patents granted and pending) is obtained from the voltage drop across  $R_1$ . The d-c voltage across  $R_1$  is fed to the base of  $Q_1$ , holding the voltage across the resistor, and thus the current through the output stage  $Q_2$ , substantially constant. This substantially eliminates the effect of all three parameter changes on amplifier operating point.

The remaining effect of importance is the change in current gain that affects net amplification. This is minimized by using a large amount of inverse feedback, taken from the tertiary winding of the output transformer. Sufficient feedback is employed to hold the gain within the desired accuracy limits.

These techniques of amplifier stabilization have been found superior to the use of compensation circuits, in which, for example, thermistors are used to cancel the change of transistor parameters. The latter requires that the compensation circuits be matched to the individual transistors; thus production matching, as well as field replacement, become major problems.

Of particular interest is the output chopper circuit (Fig. 1B) which overcomes the deficiencies of the conventional circuit of Fig. 1A. This circuit uses a single secondary winding and center-tapped capacitors. The conventional chopper output circuit, in contrast, uses a single capacitor and a center-tapped transformer. The new circuit eliminates initial switching transients, greatly reduces ripple and gives extremely constant gain. The reasons for this improvement will be made clear by Fig. 2. Figure 2A shows the waveform at the secondary of the output transformer following the application of a sustained d-c to the input of the amplifier. There is an initial transient term that dies out exponentially, leaving a square wave varying symmetrically about the zero line (assuming a balanced input chopper). The output chopper circuit of Fig. 1A flips the bottom halves of the waves up, producing the wave-form shown in Fig. 2B.



The oscillatory form of the initial transient is apparent.

Now consider the action of the circuit in Fig. 1B. On the first half of the cycle, capacitor  $C_1$  is charged to the voltage of the first half of the first wave,  $h_1$ . On the second half of the cycle  $C_2$  is charged to the voltage  $h_2$ , the amplitude of the lower half of the first wave. Thus after one complete cycle the output is the total top-to-bottom distance (voltage) of the square wave. But this distance,  $h_1 + h_2$ , is practically the same as  $h_3 + h_4$ , or  $h_5 + h_6$ , etc. Thus the output rises after a single chopper cycle to its full value and remains there unchanged, with no oscillation or overshoot.

The above discussion assumed that a symmetrical square wave existed after the initial transient. Now assume that the input chopper has unequal dwell times on the two sides. Figure 2C shows the waveform at the primary of the input transformer for a chopper with only half the dwell time on one side as on the other; the upper wave has only half the width of the lower. After passing through the input transformer the d-c component of this wave is eliminated, as the transformer cannot transmit d-c. Therefore, the waveform at the secondary of the output transformer must have equal areas up and down; since the duration of the up-wave is one-half the down, its amplitude must be double, as shown in Fig. 2D. For the conventional chopper output circuit of Fig. 1A, the output will have 50 percent ripple as shown in Fig. 2E. But the circuit of Fig. 1B again gives an output equal to the total height,  $h_1 + h_2$ ,  $h_3 + h_4$ , etc. independently of dwell time. Again, this height is constant and, ideally at least, there will be no ripple.

It will similarly be seen that while the individual height of the up-and-down-waves depends critically on chopper adjustment, the total top-to-bottom height does not, and therefore amplifier gain with the modified circuit is fundamentally independent of chopper adjustment, and no output filtering is required to obtain low output ripple and critically damped response.

For a given accuracy of amplification, the improved circuit pro-

vides much more rapid response. Typically, a conventional 400-cps chopper amplifier would require about one-twentieth of a second to come to 99.7 percent of full step-function response (based on 0.1 percent ripple). The improved circuit responds in one chopper cycle — 1/400 second.

The complete circuit of the transistorized data amplifier is shown in Fig. 3. The basic amplifier has five direct coupled stages, employing alternate *pnp* and *npn* transistors; d-c feedback is used for operating-point stabilization. Gain is controlled by switching the number of turns used in the tertiary feedback winding. At the same time, an emitter resistor is varied in one stage to hold the loop gain approximately constant, to preserve stability.

If appreciable load is drawn from the output capacitors, ripple will

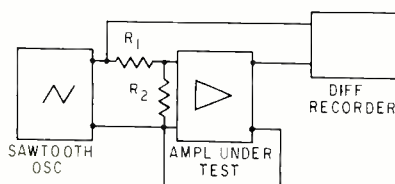


FIG. 4—In test circuit, amplifier makes up gain loss of input network to give straight line output

be introduced into the output. To permit a low impedance load to be used, an output buffer amplifier of unity gain is employed. The amplifier has an extremely constant gain and does not measurably affect the over-all gain stability. It does, however, provide the possibility of some zero-point shift with ambient temperature. This is minimized by the balanced design. The output voltage for zero input will under most conditions not vary more than a fraction of a millivolt, equivalent to a fraction of a microvolt input error at a gain of 1,000. Output impedance is less than 1/100 ohm.

These amplifiers are designed primarily for fixed installations where space is not at a premium. Primary consideration is accessibility. Two channels are mounted on each plug-in chassis; 16 channels can be mounted in 8 $\frac{1}{2}$  in. of 19-in. rack space.

With the input of the amplifier transformer coupled, it has fundamentally zero response to common-mode (in-phase) signals. This complete rejection of common-mode signals is easily realized at d-c. Maintenance of high rejection of common-mode a-c signals requires careful attention to shielding. The input transformer, for example, requires three shields between primary and secondary, the intermediate shield being connected when required in the now-familiar guard ring manner. Rejection at 60 cps is readily kept better than a million to one, or 120 db.

Gain stability of the amplifier for long-term operation (1,000 hours) is within 0.01 percent from 15 to 35 C; linearity is equally precise for the normal output range of  $\pm 10$  volts. Measurement of amplifier performance to such precision requires care. It may be performed in a bridge circuit, in which the difference between the amplifier output and input is recorded, as illustrated in Fig. 4. The low frequency saw-tooth oscillator is set to give an output voltage equal to the maximum desired from the amplifier.

The direct-writing oscillograph with true differential input records the difference between the oscillator and amplifier outputs. The ratio  $(R_1 + R_2)/R_2$  is varied to give as flat a trace as possible. Then the above ratio is the amplifier gain. The departure of the trace from a straight line measures the non-linearity; its change with time gives the amplifier gain stability.

For the range from 0 to 55 C, the gain of the transistorized data amplifier remains within 0.02 percent. Low temperatures tend to have a greater effect on the standard model amplifier, particularly because of the aluminum electrolytics; performance can be improved by substituting tantalum capacitors. However, it does not appear practical to achieve the same independence of amplifier gain from ambient temperature with transistors as with vacuum tubes.

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TABLE I — NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

| Type                           | Resistance Range at 25 deg C | Max. Rating | Dissipat'n Constant at 25 deg C | Max. Operat. Temp. | Temp. Coef.  | Time Constant | Dimensions           | Primary Applications  |
|--------------------------------|------------------------------|-------------|---------------------------------|--------------------|--------------|---------------|----------------------|---|
|                                | ohms                         | watts       | mw/deg C                        | deg C              | %/deg C      | sec           | in.                  |   |
| Glass-coated Bead              | 100-12 M <sup>a</sup>        | 0.2         | 0.09-0.8                        | 500 <sup>c</sup>   | -3.1 to -5.2 | 0.5-3         | 0.006-0.110 diam     | wind velocity, temp., gas analysis liquid level, power control          |
| Bead in container <sup>b</sup> | 100-5.3 M <sup>a</sup>       | 0.2         | 1                               | 500                | -3.1 to -5.1 | 1-25          | 0.1 diam, 1/2-3 long | time delay, medical probe, voltage control, very low temp.              |
| Disc                           | 1 to 10 K <sup>d</sup>       | 4           | 3-800                           | 150 <sup>e</sup>   | -3.8 to -4.4 | 2-200         | 0.1-1.1 diam         | temp. comp., fire alarms, osc. ampl. stab'zn., temp. control            |
| Rod                            | 2 K-100 K <sup>d</sup>       | 2           | 2.5-6                           | 150 <sup>e</sup>   | -3.8 to -4.4 | 20-95         | 1/4-2 long           | filament protection, volt. control and reg., meteorological temp. meas. |
| Washer                         | 10-1,100                     | 10          | 100-850                         | 150                | -3.8 to -4.4 | 1-21          | 1/2-1 diam           | higher-power temp. comp., surge suppression                             |
| Wafer                          | 10-1 M <sup>a</sup>          | 0.5         | 2.5-7.8                         | 150                | -3.9 to -6.8 | 7-35          | 1/16-1/2 sq          | temp. meas. & control, high-temp. alarm                                 |

(a) M equals 10<sup>6</sup>; (b) Container is glass probe or bulb; (c) Special units go to 1,200 C; (d) K equals 10<sup>3</sup>; (e) 125 C with soldered leads

TABLE II — POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS

| Type                | Resistance Range at 25 deg C | Max. Rating | Max. Operat. Temp. | Temp. Coef. | Time Constant | Dimensions           | Primary Applications                    |
|---------------------|------------------------------|-------------|--------------------|-------------|---------------|----------------------|---|
|                     | ohms                         | watts       | deg C              | %/deg C     | sec           | in.                  |   |
| Rod                 | 100-1,000                    | 1/4         | 100                | +0.7        | 35-51         | 0.4-0.6 long         | Transistor temp. comp., temp. meas.     |
| Scaled <sup>a</sup> | 100-1,000                    | 1/8         | 125                | +0.7        | 51            | 0.350 diam,          | Transistor temp. comp. in high-humidity |
| Metal Case          |                              |             |                    |             |               | 0.215 long           | ambients                                |
| Glass Probe         | 100-1,000                    |             | 200                | +0.7        | 9             | 0.078 diam, 0.5 long | Temp. meas. and control                 |

(a) Hermetically sealed

# Survey of Thermistor Characteristics

*Breakdown of thermistors into two basic types and several categories under each type. A convenient way to look up thermistor characteristics and applications*

By JAMES VAN DOVER  
NORMAN F. BECHTOLD

U. S. Army Signal Research  
and Development Laboratory,  
Fort Monmouth, N. J.

INDUSTRY is finding more and more uses for thermistors. Increased demands of reliability, extreme environments and a high degree of measurement accuracy have accelerated techniques for their use and stimulated their production. To make electronic circuits reliable, thermistors compensate for temperature changes, regulate current or voltage and control remote circuits. In the medical, meteoro-

logical and mechanical fields, thermistors are used for accurate measurement of temperature, pressure and liquid levels. With increased production capabilities, quality and cost have become more favorable to the potential user.

These thermally-sensitive resistance elements are of two basic types, having negative- and positive-temperature-coefficients (NTC and PTC). The NTC thermistors (Table I) are more varied and have seen considerable service in the applications listed; these thermistors are made primarily from a composition of oxides of nickel, manganese and cobalt. PTC types

(Table II), whose production was stimulated by the need for temperature compensation of semiconductor circuitry, are more limited in number and scope. Present commercial PTC thermistors are made from single-crystal silicon. Performance ranges shown in the tables are representative of readily available off-the-shelf thermistors.

Although semiconductor temperature compensation with both NTC and PTC thermistors is a potential area for wide use, especially in military applications, matching of the thermistor resistance/temperature characteristics with the particular semiconductor involved has



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(Left) Lifting up top  
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Illustration above shows plug and socket without cap and with hinge action in place prior to closing. Cap assembly with alternate lock and cable clamp shown below. Standard units are supplied with General Purpose insulation and cadmium plated contacts. However for more severe conditions of temperature and humidity glass filled Diallyl-phthalate insulation (Type GDI-30 per Mil. M-19833) can be supplied with contacts having gold plate over silver. Contact tails will take either conventional solder wiring or AMP "78" series Taper Tab receptacles. The Cinch "H" series is made in 20 to 100 contacts in multiples of 10 contacts.

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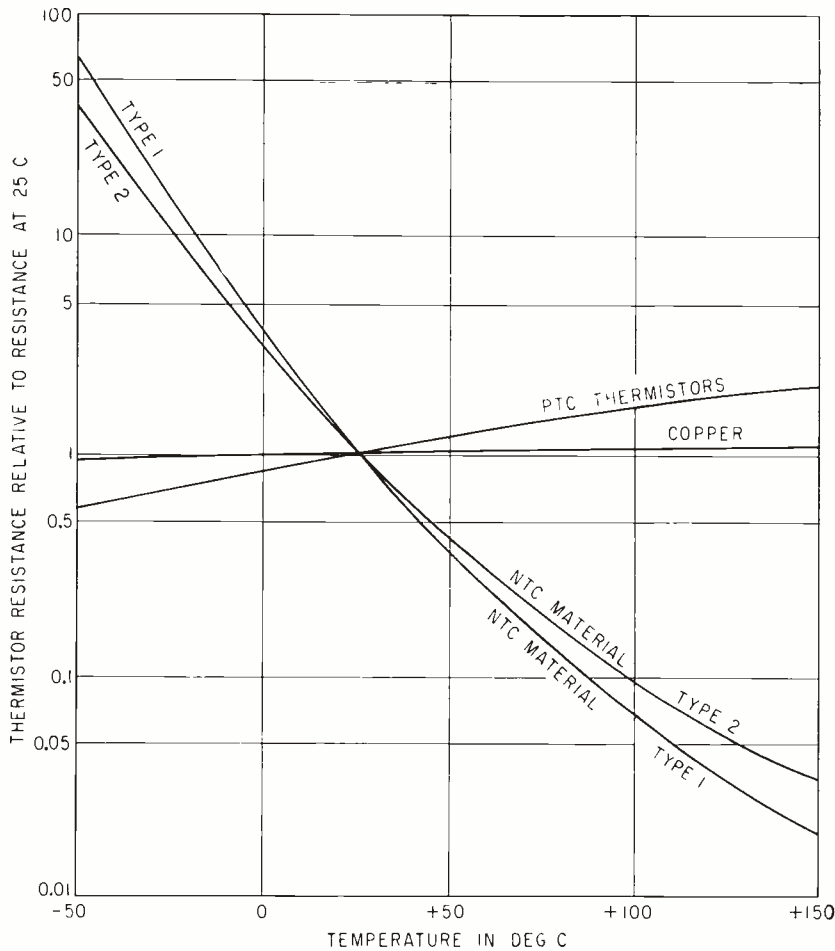


FIG. 1—Variation of thermistor resistance with temperature

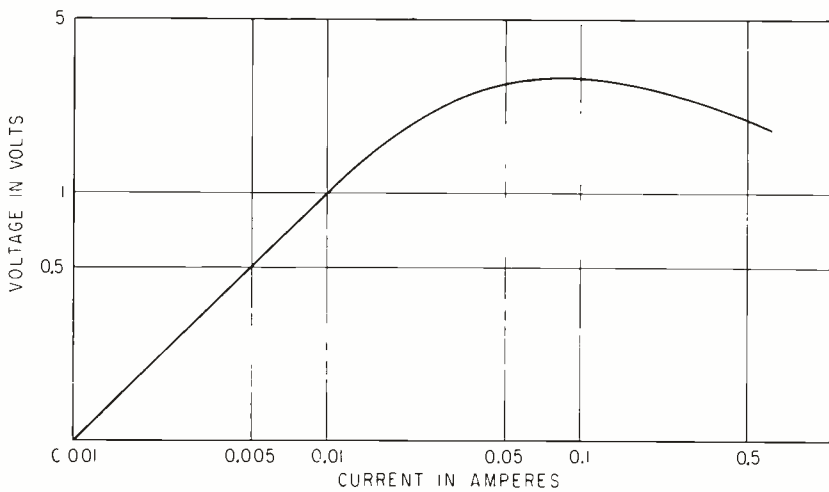


FIG. 2—Static V/I characteristic for typical NTC disk thermistor

become a problem of considerable concern. To eliminate deterioration of amplifier gain with increasing temperature, the PTC types can be connected in series with the base or collector of a transistor and the NTC types connected in shunt. In both cases, the thermistor is often used as part of a network with con-

ventional linear resistors, the specific design depending upon total allowable resistance, operating temperature range, and degree of compensation required. An effort is currently underway within the USASRD to develop a family of preferred compensating devices to include these variables. The non-

uniformity of transistor characteristics within the same batch is the problem of most concern.

The curves of Fig. 1 demonstrate typical resistance properties of the various thermistor types. Curves may be matched or fitted to specification, but any radical departures from those shown require special design considerations. Higher values of resistance ratio are available in the NTC than in the PTC types. Increased resistance-change rates promised by new materials and techniques will produce greater temperature sensitivity and faster response times; it is even possible that an effective solid-state thermal switch might be developed.

Figure 2 shows a typical voltage-current characteristic of a disk-type NTC thermistor. Ohmic properties are maintained at low currents where negligible heat is generated within the element. As self-heating begins, a critical operating point is reached beyond which the characteristic goes into the negative-resistance range. This knee is more pronounced in the characteristics of smaller units because of faster thermal-dissipation properties; see the *Dissipation Constant* column in Table I.

In addition to the types noted in the tables, special mounting assemblies may be obtained for higher wattage dissipation, uhf power measurement and liquid-level detectors. Built-in filaments are available for indirect-heating applications and matched pairs are sold for accurate measurement in bridge circuits.

Figure 3 shows a simple application.

Although no coordinated standards are presently available, industry and the armed services are devoting effort toward agreement on preferred types.

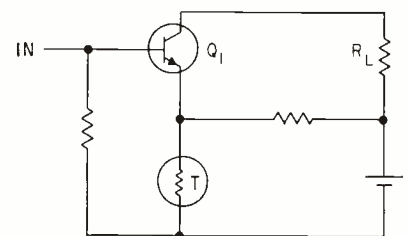


FIG. 3—Temperature compensation with a PTC thermistor



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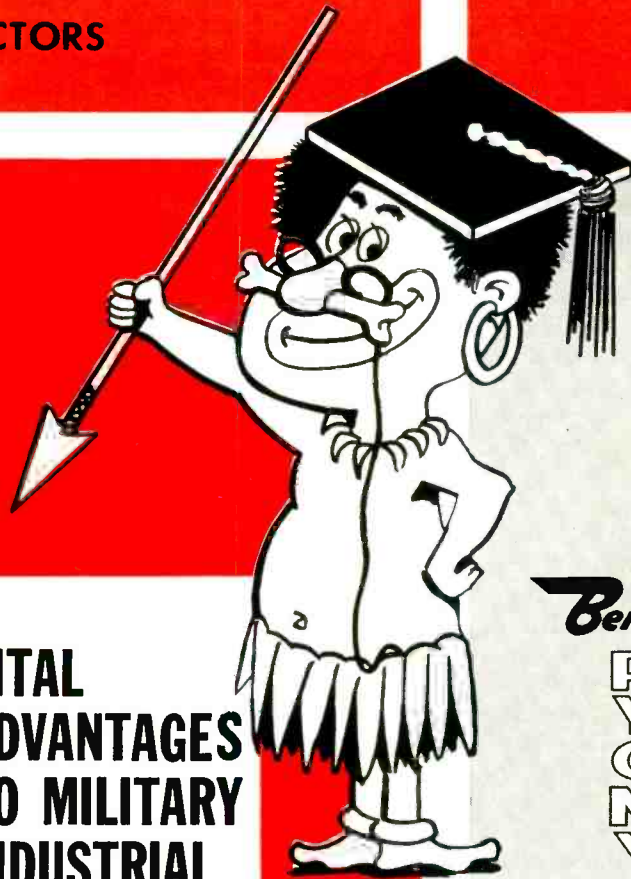
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# Tests Show Control Is Key to Timer Accuracy

BY FRED W. KEAR, Lytle Corp., Albuquerque, N. M.

COMPARATIVE tests were made of crystal-controlled oscillator timers and precision electrical timers for measurements within the resolving capabilities of the timers. No appreciable differences resulted in those time runs requiring no greater accuracy than 0.01 percent. The key to obtaining this accuracy from electrical timers lies in the method of controlling the on and off signals to the timers.

Start-stop control of most timers is accomplished by magnetic clutches, which may be operated with either a-c or d-c power. Timers using d-c clutches that can be readily controlled by transistors are more advantageous for accurate timing circuits. Reset and timing motors are normally operated from 117 v a-c because of the amount of current needed and the liberal timing requirements.

The circuit in Fig. 1 was designed to control four precision timers in a test setup for accurate simultaneous measurement of the time interval of four integrating circuits. Functions of the circuits to be tested were integrating digital information, converting it to analog form and providing a single positive output pulse. Time between

the first digital output pulse and firing of the circuit had to be determined within about 0.01 percent. The same start pulse was used for all four circuits but stop pulses varied over a wide range.

The positive output pulse of the circuit under test was used to saturate an *npm* transistor capable of handling heavy currents. Saturation of the transistor grounds the external start input of Fig. 1. By grounding this point, power is supplied through  $Q_2$  to all control transistors and to the start clutches of the timers. The accumulated delays in the transistors and clutches constitute total error of the circuit. Stop signals ground points 1 through 4 in Fig. 1, energizing control relays  $K_1$  through  $K_4$ . When a control relay is energized, it cuts off the associated transistor.

Comparative readouts from digital display equipment and from the precision timers revealed that very little error was induced into data derived from the precision timers because of the type of readout. The timers used with this circuit operated at one revolution per second, and times could be read with little difficulty to the nearest millisecond. A second hand allowed timing runs

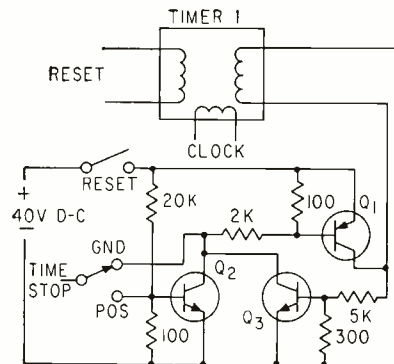


FIG. 2—Transistor switching replaces relays and either polarity start or stop pulses can be used

up to several minutes without circuit changes.

Cost considerations for multiple or simultaneous timing of the nature described would in most cases prohibit use of conventional timers with crystal-controlled time bases and digital displays. The cost of the circuit in Fig. 1 is modest considering the results obtained. Simplicity contributes advantages of low maintenance costs and savings in rack space.

It is desirable to provide these timers with polarity switching on both start and stop timer circuits. The switches would connect the relay coils to either the positive or the ground bus so that either positive or negative pulses could be used to control the timer. Such a switching arrangement is illustrated in Fig. 2, which also shows the use of transistor stop switching instead of the relays used in Fig. 1. Transistor  $Q_3$  forms a clamping circuit for use where the stop pulse is of short duration making readout difficult. The circuit is useful for many applications where repetitive testing is not required.

## Time Delay for Nuclear Reactor Simulation

MAJOR problem in designing and operating nuclear reactors is to determine how the coolant circuits

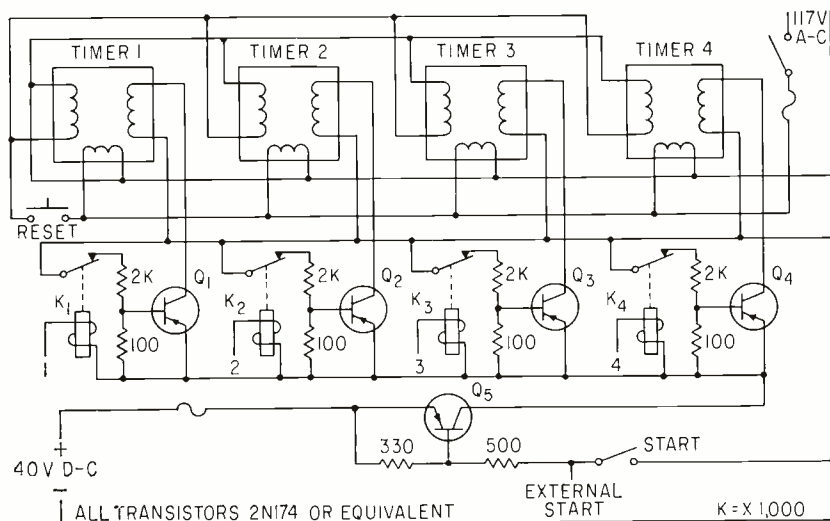
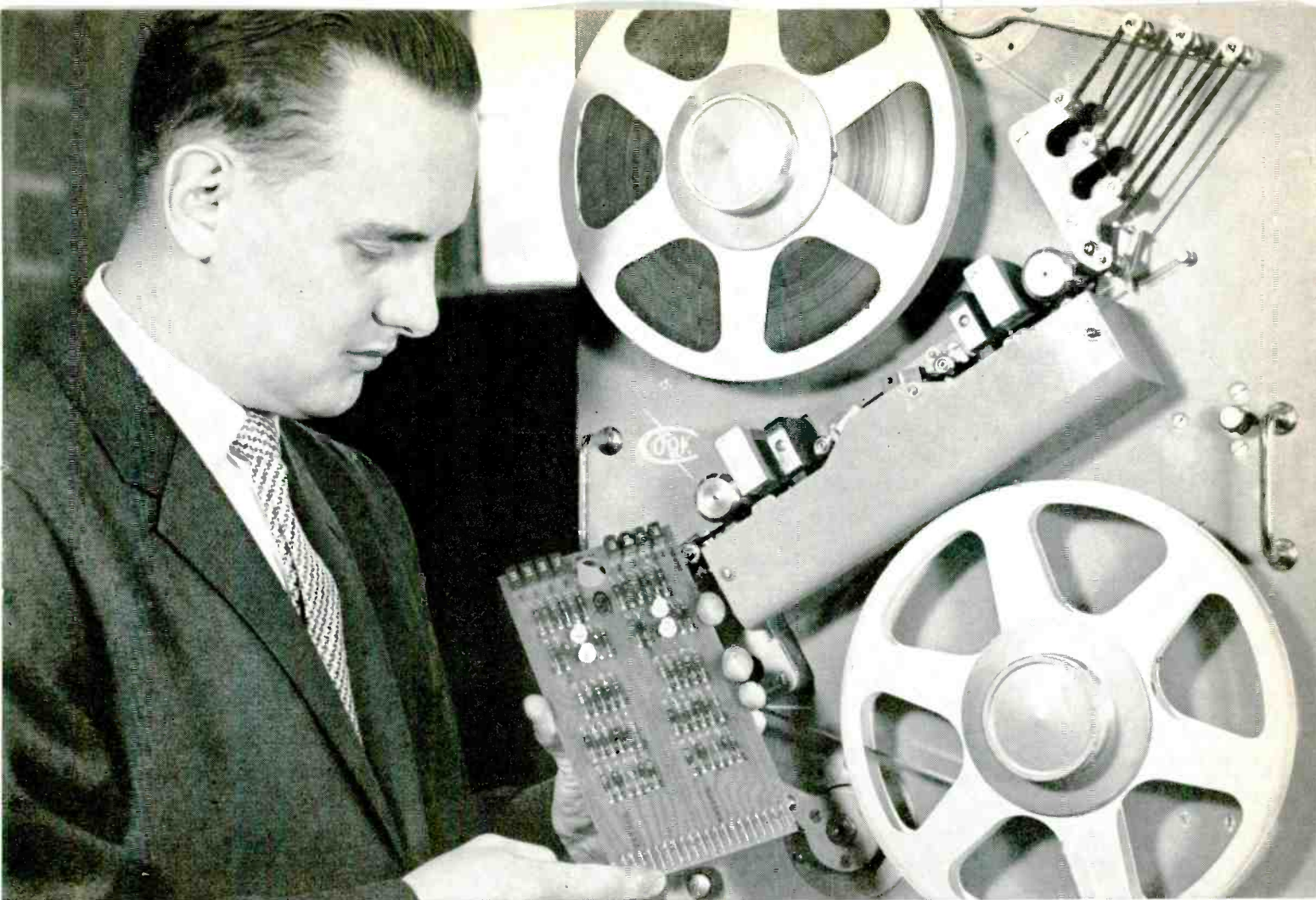


FIG. 1—Four simultaneous measurements are provided by transistor control of precision electrical timers





## Tung-Sol transistors handle critical switching in **COOK ELECTRIC** high speed tape transport

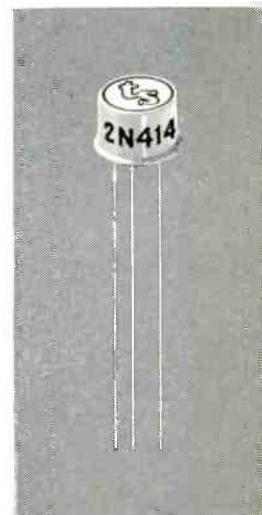
Cook Electric's Model 59 Digital Tape Transport embodies the design know-how gathered by Cook during its 12 years of active participation in missile programs which include the Atlas, Polaris and Titan missiles. It was built to fulfill the demands of modern industry for reliable, high-speed data processing and storage equipment. This tape transport is a direct adaptation of the equipment originally developed to provide unattended, 45-day documentation of the Polaris Missile system.

Gratified with the superior performance demonstrated by Tung-Sol switching transistors in the Polaris version, Cook assigned Tung-Sol units to these critical tasks in the industrial model. Tung-Sol's 2N414 germanium high-speed switching transistors serve in the flip-flop and logic circuits. Here's how Cook engineers evaluated the Tung-Sol semiconductors: "Tung-Sol transistors meet our exacting demands for performance and reliability"

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would behave under unusual conditions like sudden failure of the circulating pumps. Pump failure could seriously damage the reactor if control arrangements were not adequate.

These potentially dangerous conditions can not be studied on the reactor, but design information can be obtained from an analog computer used as a simulator. The most difficult problem is electronic simulation of variable transport lags. E. M. I. Electronics, Ltd., supplied to the Centro di Studi Nucleari di Ispra Milan a variable time delay unit that is said to solve the problem more accurately than previously possible.

Data can be delayed a continuously variable amount determined by voltage applied to a delay control input. This unit controls speed of a loop of magnetic tape that passes prepositioned record and playback heads. Total delay range is 0.1 to 10 seconds in three pre-selected ranges. Two separate information channels are provided.

Using a recording system with precision pulse-width modulation based on other analog computers of the company, delay is made variable with tape speed. Amplitude distortion that could arise with other recording methods is eliminated. Full use is made of the information capacity of magnetic tape with high accuracy and useful bandwidth provided.

The new unit is suitable for study of nuclear reactor control problems involving variable time lags. The choice of input and output levels make the time delay compatible with standard analog computers.

The 100-inch loop of 1-in. wide tape is driven by a servo amplifier and a-c capstan drive motor. Accurate control of tape speed is obtained with d-c tachometer feedback, which also provides precision clipping in the data playback channels. Two separate tracks are recorded and delayed outputs taken from a dual-track playback head selected for one of the three available ranges.

About 80 inches of the magnetic tape loop are active in the unit. Tape speeds range from about 8 to 40 inches per second.

## High-Fidelity High-Power Audio for Medical Study

HIGH-INTENSITY acoustical system has been developed that provides high-fidelity output. It generates undistorted sound throughout the 11-octave range of normal audibility from the threshold of hearing to a maximum volume that would damage the human ear at close range.

The system was developed by Stromberg-Carlson division of General Dynamics for the Aerospace Medical Division of the Wright Air Development Center. It will be used in studies of physiological effects of high-intensity sound.

The system includes an assembly of 480 loudspeakers mounted in 32 separate baffles for maximum flexibility in arrangement and control. Each baffle has three low-frequency and 12 high-frequency speakers. All transducers are specially designed to deliver high-fidelity sound at high acoustical power for sustained operating periods.

The system console provides four possible inputs—sine wave, white noise, tape recordings of jet engine, missile or other noise, or an external source. Preamplifiers can be adjusted to establish a specified line level, which is indicated by a meter. The fixed line level is then fed into a mixer that accepts any or all four inputs, which can be mixed in any desired proportion. Mixer output goes to a line amplifier that is also adjustable to provide a specified output level.

After passing through a master attenuator, the signal goes into the main audio power equipment, which consists of two pairs of audio amplifiers. One pair is for low-power use only, with each amplifier providing an output of 200 watts. Each of the pair of high-power amplifiers delivers an output of 7,000 watts. The system frequency response is flat from 20 to 20,000 cps.

To avoid unintentional exposure of subjects to high-intensity sound, the operator at the control console must first set the controls at the low-power position. Only after this operation can energy be supplied to the high-power amplifiers.

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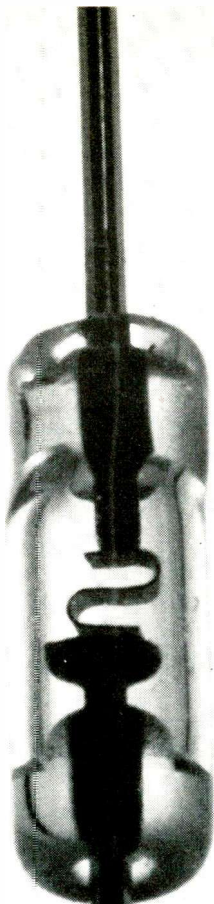




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### MAXIMUM RATINGS (25°C)—(Note 1)

|                  |  |                |
|------------------|--|----------------|
| WIV              | Working Inverse Voltage                                | 150 V          |
| $I_o$            | Average Rectified Current                              | 100 mA         |
| $I_f$            | Forward Current Steady State D.C.                      | 150 mA         |
| $I_{rf}$         | Recurrent Peak Forward Current                         | 300 mA         |
| $i_f$ (surge)    | Peak Forward Surge Current Pulse Width of 1 sec.       | 500 mA         |
| $i_f$ (surge)    | Peak Forward Surge Current Pulse Width of 1 $\mu$ sec. | 2000 mA        |
| P                | Power Dissipation                                      | 250 mW         |
| P                | Power Dissipation                                      | 100 mW @ 125°C |
| T <sub>A</sub>   | Operating Temperature                                  | -65 to +175°C  |
| T <sub>stg</sub> | Storage Temperature, ambient                           | -65 to +200°C  |

## Fast Silicon Planar Diode

### ELECTRICAL SPECIFICATIONS (25°C unless noted)

| SYMBOL               | CHARACTERISTICS                         | MIN.  | TYPICAL    | MAX.        | TEST CONDITIONS                                    |
|----------------------|---|-------|------------|-------------|--|
| $V_f$                | Forward Voltage                         |       |            | 1.0 V       | $I_f = 100$ mA                                     |
| $I_R$                | Reverse Current                         |       |            | 0.1 $\mu$ A | $V_R = 150$ V                                      |
| $I_{R(150^\circ C)}$ | Reverse Current (150°C)                 |       |            | 100 $\mu$ A | $V_R = 150$ V                                      |
| BV                   | Breakdown Voltage                       | 200 V |            |             | $I_R = 100$ $\mu$ A                                |
| $t_{rr}$ (Note 2)    | Reverse Recovery Time                   |       |            | 50 nsec     | $I_f = 30$ mA<br>$I_R = 30$ mA<br>$R_L = 150$ Ohms |
| $C_o$ (Note 3)       | Capacitance                             |       |            | 5.0 pF      | $V_R = 0$ V<br>$f = 1$ mc<br>$f = 100$ mc          |
| RE (Note 4)          | Rectification Efficiency                | 35%   |            |             |  |
|                      | Forward Voltage Temperature Coefficient |       | -1.8 mV/°C |             |  |

### NOTES:

- (1) Maximum ratings are limiting values above which life or satisfactory performance may be impaired.
- (2) Recovery to 1.0 mA.
- (3) Capacitance as measured on Boonton Electronic Corporation Model No. 75A-S8 Capacitance Bridge or equivalent.
- (4) Rectification Efficiency is defined as the ratio of D.C. load voltage to peak rf input voltage to the detector circuit, measured with 2.0 V r.m.s. input to the circuit. Load resistance 5 K ohms, load capacitance 20 pF.

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# Thin Film Extends Mesa Performance

## REDUCES SWITCHING TIME AND COLLECTOR RESISTANCE

A CONVENTIONAL MESA transistor has a collector region that is required to attain low capacitance and high voltage breakdown. But this region is much thicker than it need be electrically. And this very thickness is what puts a limit on the switching time and collector resistance of the device.

For faster switching, it would be highly desirable to construct a thin film collector of lightly doped, highly resistive material. Ideally this region should be about 0.1 mil thick, which is a factor of about 30 thinner than normally used.

But up to now no one has shown us how to form a very thin film collector on a low resistive single crystal substrate.

On June 13, at a joint IRE AIEE Solid State Device Research Conference held in Pittsburgh, H. H. Loar of Bell Laboratories presented a solution to this problem to top research men in the semiconductor field. And the Bell answer was received by experts as a major development that is expected to have far reaching implications in both the fabrication and application of semiconductor devices.

For example, in two similar silicon transistor structures, one conventional and the other using the Bell fabrication process, switching time in a typical circuit has been reduced from 200 to 20 nano seconds. Further, collector series resistance of the new transistors was reduced by a factor of more than ten and was comparable to that of conventional devices 15 times larger.

Bell calls these new devices epitaxial diffused transistors. And the diagram shows the new structure (B) compared to the conventional mesa (A).

The key to the new structure is the lightly doped epitaxial film grown on and supported by a low resistivity substrate that gives the desired combination of electrical properties and mechanical strength.

The word epitaxy is defined as an oriented *intergrowth* between two solid phases. The surface of one crystal provides, through its lattice structure, preferred positions for the deposition of the second crystal. And the epitaxial film is a direct extension of the single crystal structure of the substrate wafer.

Experiments with germanium indicate that use of epitaxial layers will extend the frequency response of germanium transistors well beyond that of the 2Gc device recently described by Bell.

Although exact techniques for fabrication are not revealed due to proprietary rights, fabrication is something like this: Single crystal wafers of heavily doped material are first cut and polished. These wafers are introduced into a hot environment. Into this furnace is also introduced a silicon compound. By gaseous deposition, a layer of the correct resistivity is deposited on the base wafer as a thin film, 0.1 mil thick. The lightly doped

silicon grows onto it in homogeneous crystalline arrangement. This film provides the desired thin, lightly doped collector region. From this point on, standard techniques to fabricate mesas are used. Only the epitaxial stage is new. But this is what really makes the difference in mesa performance.

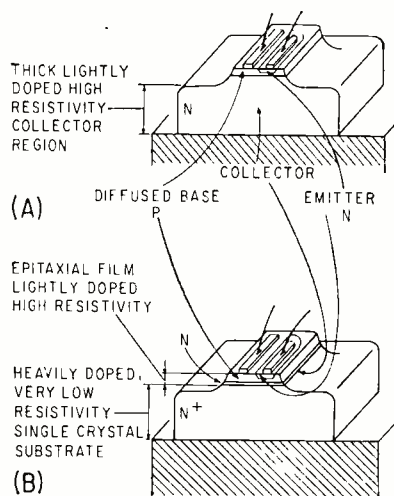
Silicon epitaxials are posited as high-frequency switches. The germanium models are usable at frequencies higher than 2,000 Mc as amplifiers.

The use of this new technique not only results in major improvements in switching time and collector resistance, but in addition simplifies the design and understanding of transistor devices and brings them closer to ideal forms, such as *npin* structures. Further, the addition of the epitaxial film technique to the well established diffusion technology provides the design engineer with an extra degree of design freedom which should result in new devices difficult or impossible to achieve by older techniques.

## High-Melting Powders

METHODS of producing ultra-fine metal powders of such high melting point metals as tantalum, molybdenum and niobium are now under investigation by scientists at National Research Corporation. The study on these refractory metals is being conducted for the Bureau of Naval Weapons.

More than a year ago the company announced discovery of a process for making metal powders with particles only one-millionth of an inch in diameter—a thousand times smaller than any previously obtainable. Lower melting metals which lend themselves to NRC techniques include aluminum, iron, nickel, copper, silver, cobalt, manganese, lead, gold, zinc and the alkaline earths. Under the new

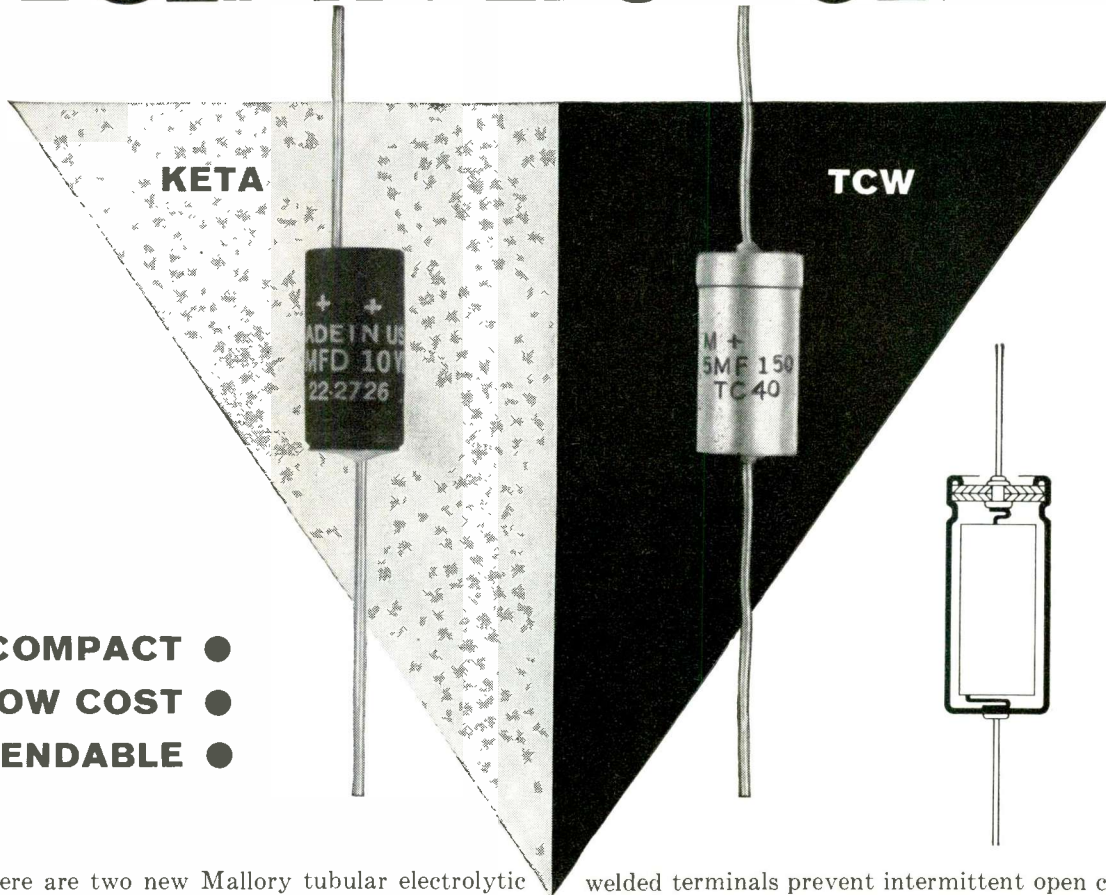


The usual mesa transistor construction (A) is compared to the epitaxial diffused transistor construction (B). In the latter, the lightly doped collector region has been minimized by using an epitaxial film grown on and supported by a heavily doped, low resistivity substrate



*For transistorized circuits...*

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Here are two new Mallory tubular electrolytic capacitors you can use in your low voltage transistorized circuit designs. Their small size, high capacity per unit size, excellent performance characteristics and long life fit the exacting demands of these space-squeezed applications.

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welded terminals prevent intermittent open circuits and noise which often plague low voltage circuits when capacitor connections are crimped or riveted.

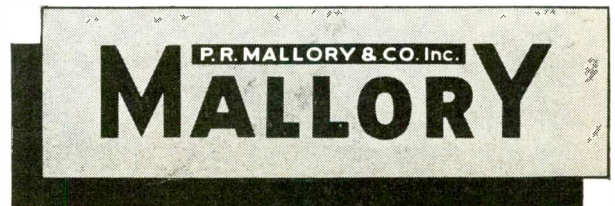
Both the TCW and the KETA exhibit exceptionally low leakage current characteristics—an indication of their reliability, long life and high temperature capability.

| Type | Capacity Range | WVDC    | Temperature Range | Case Diameter Range | Case Length Range |
|------|----------------|---------|-------------------|---------------------|-------------------|
| TCW  | 2-750 mfd.     | 150-3v. | -40 to +85°C      | 3/8"-5/8"           | 5/8"-1 13/16"     |
| KETA | 1-1400 mfd.    | 50-3v.  | -30 to +65°C      | 3/16"-5/8"          | 5/8"-2"           |

Type KETA available in dual ratings, in 1/2" and 5/8" diameter cases; and in non-polarized ratings of approximately one-half the above capacitance values.

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Navy contract, the process is now being directed toward the high temperature metals.

For powder metallurgy development, the ultra-fine powders may offer new, exact composition alloys with superior physical properties, company metallurgists indicate. Possible electronic applications include additives for plastics to alter dielectric properties, magnetic circuitry and suspensions in liquids to produce non-ionic-conducting liquids. Other potential applications appear in the catalytic chemical process field.

### Watertight Servos

PROVIDING servo response up to 15 cps, moving freely inside the housing, and impervious to sea water was a packaging problem solved by Lear, Inc., Santa Monica, California. The problem was presented by elevator and aileron servo actuators, a portion of the radio-controlled Q2C jet target drone automatic flight control system. A magnetic powder clutch provides control surface torque proportioned to command and stabilization signal.

Requirements called for the servos to withstand a pressure build-up during a 3,000 ft-per-minute drop from 60,000 ft to sea level, violent shock on impact with water, total submersion in water and a rapid temperature change on immersion, with attendant contraction of the metal.

The servos withstand one atmosphere pressure differential (approx. 14 psi), vibrations of 10 G's, shocks measuring 25 G's, and absolute impregnability during submersion for 1½ hours.

### Spaceship Control

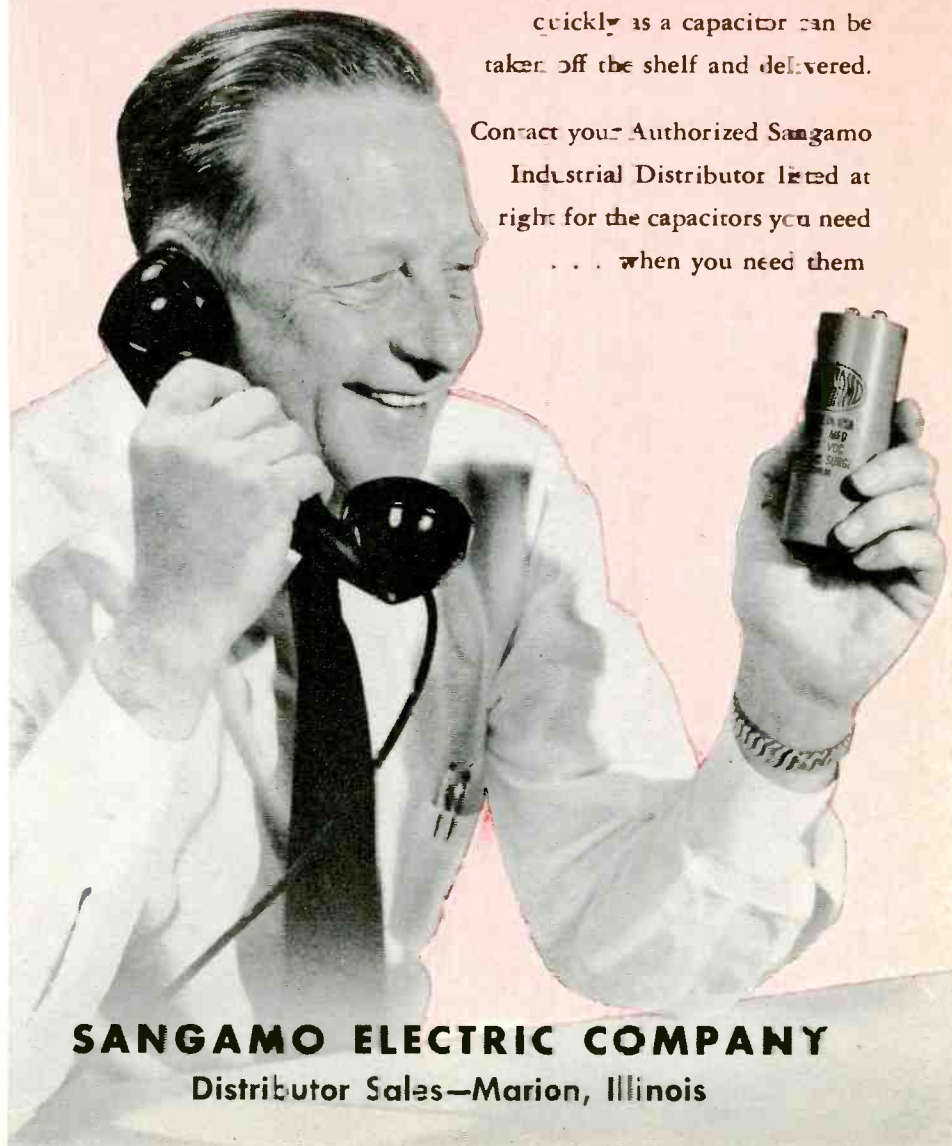
A RELATIVELY simple gyroscope system, developed by Chance Vought, will control the attitude of space vehicles. The twin-gyroscope controller consists of two identical gyroscopes mounted in tiltable rings inside a common frame. Three such controllers would be installed in each space vehicle to keep it from rolling, pitching or yawing.

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electronics • JULY 1, 1960

gyroscopes require little power. They could be driven by energy from the sun.

The Vought gyroscope system serves as the control units and actually carry out the attitude corrections in response to the reference system.

Current systems for controlling the attitude of space vehicles consist of reaction jets or of motor-driven inertia wheels which create corrective torque and spin when an attitude adjustment is indicated.

Vought's controller was conceived by Donald R. Sellers, supervisor of the Electronics Division's Space-Vehicle Control Group.

### Wire for 1,000 F

A FLEXIBLE ceramic insulated wire, claimed to be suitable for operating continuously at 1,000 F and to withstand 1,700 F for short periods, has been introduced under the name CERAMICITE by Wandleside Cable Works, Garrett Lane, London SW 18.

This ceramic insulated wire has space factor comparable with enamel wire and can be used for winding magnet coils since it has a high degree of flexibility. Insulation strength is nearly 600 volt/mil at room temperature and insulation resistance at 1,000 F of 2 megohm 100 ft for a wall thickness of 0.35 mils.

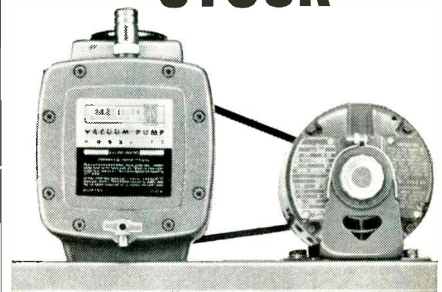
Although insulation resistance falls if exposed to a humid temperature, and it is not recommended for such conditions, the company is working on a waterproof coating. The CERAMICITE coating is formed on a nickel-clad copper conductor and gives a coating claimed to have excellent abrasion-resistant properties.

Wandleside Cable Works also manufactures TEFBOND, a bondable cable.

### Two-Gap Klystrons

INCREASED bandwidth for equivalent output is attained by two-gap, double tuned cavities which have been built by Litton Industries, San Carlos, Calif., and Eitel-McCullough, San Bruno, Calif.

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View of line from unloading station. Long length of conveyor permits heated epoxy to set before the tube and shield assembly is transferred

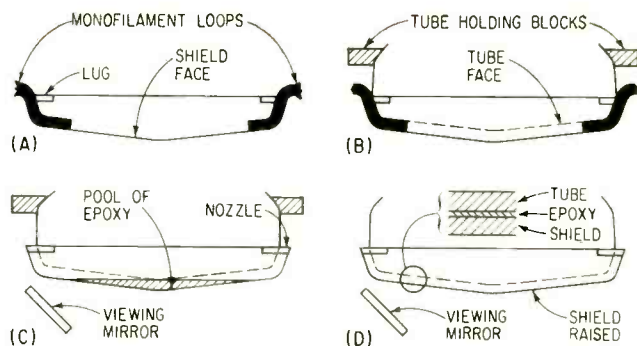


FIG. 1—Fixture provides space between tube and shield. After bonding resin is inserted, shield is raised to complete lamination

## Closing Space Spreads Bonding Resin

PRESSED GLASS, wrap-around implosion shields are laminated with epoxy resin to some types of tv picture tubes. A major production problem is placing an adequate, uniform amount of liquid resin between the glass parts at a speed consistent with volume production.

To mechanize its production of this type (Bonded Shield) of tube, Sylvania Electric Products, Inc., devised methods which differ considerably from experimental methods previously reported (ELECTRONICS, p. 128, Oct. 10, 1958). Mechanized lines are in operation at Seneca Falls, N. Y., for 19-inch and 23-inch tubes, and at Ottawa, Ohio, for 23-inch tubes.

Similar techniques can also be applied to industrial and military cathode ray tubes. Laminated shields, according to the firm, are practical when reticles must be used for marking and improve safety, visibility and dirt protection.

Each production line has a loading station, preheat oven, resin filling and spreading stations, curing section and unloading station. The conveyors are of the indexing, endless chain type with fixtures returned under the conveyor frame. Cleaned and pretested picture tubes are delivered to the lines on overhead conveyors. They differ from conventional tubes only in the envelope, which is designed for the shield. Shields are cleaned and inspected, then placed on a moving



Shields are inspected and cleaned on light tables

belt conveyor. At Seneca Falls, both conveyors supply 2 bonding lines, so tube and shield sizes alternate on each supply conveyor.

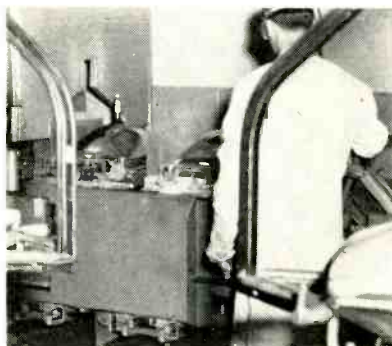
Fixtures are designed to hold a shield and tube in alignment and at the correct separation for insertion of the epoxy. The shield, placed in the fixture with its cavity up, rests on 4 lugs or mounting ears at each corner of the shield. Small blocks swing over the lugs to lock the shield in position.

After the shield is positioned, the

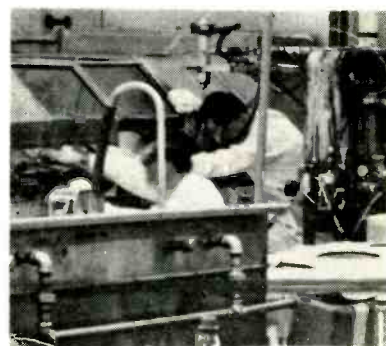
operator places a frame on the fixture and loads the tube. The frame is equipped with spacers to provide the necessary lateral spacing of the parts and the space between the tube face and shield. A slippery monofilament (Fig. 1A) pulls out, leaving a free air space between shield and tube (Fig. 1B). The space is slightly larger than the space between tube and shield in the finished assembly.

The conveyor then passes through the preheat oven. The assembly is heated to 200-250 F and resin temperature is 200 F, to facilitate curing. Resin is DER 741-A and hardener is DEH 61 (Dow Chemical Co.), at present.

Resin and hardener are piped from supply tanks in an adjoining room and mixed by an automatic dispenser at the filling station. The compound is delivered to a nozzle which fits between the tube and the



Fixture loading. Assemblies are seen entering preheat oven through the port at left



Resin dispensing and spreading stations. Operators are looking down into mirrors



## "FREON"-TF SOLVENT



This magnet wire was exposed to "Freon" solvent liquid. The "Glyptal" coating on this wire is completely unaffected by "Freon"-TF.

## ORDINARY CHLORINATED SOLVENT



This "Glyptal"-insulated wire was exposed to ordinary chlorinated solvent for the same length of time as the one on the left. The solvent dissolved the resin binder and softened the olkyd finish.

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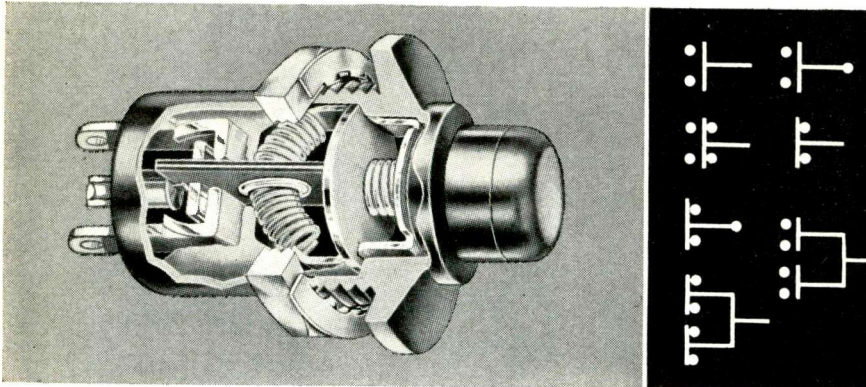
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lip of the shield (Fig. 1C). A hand control at the nozzle permits the operator to control flow of compound and also to clear the nozzle of partially cured resin should there be a delay in its use. The charge of resin fills about half the space. The operator watches the filling action through a mirror under the conveyor. Resin should appear as a clear, circular pool.

At the next station, the shield is raised slightly toward the tube by means of a handwheel, screw and cams in the fixture. As the operator watches in another mirror, the resin pool spreads until it completely fills the space (Fig. 1D). The layer must have a uniform, minimum thickness of 0.060 inch.

Both filling and spreading operations are critical. If either operator notices any gas bubbles or imperfections in the resin, the tube and shield are immediately removed from the fixture. The parts are cleaned with solvent and returned to stock.

The epoxy cures as it travels the remainder of the conveyor. The tubes are reloaded onto the overhead conveyor for subsequent finishing, inspecting, labeling and packaging. Among the finishing steps is a spray coat of lacquer which protects the joint between shield and tube.

## Grinder Bonds Solder To Difficult Materials

DIFFICULT-TO-SOLDER materials can readily be prepared for soldering by coating the surface of the material with a solder-loaded abrasive wheel. Strong coatings are obtained on metals which quickly oxidize, ceramics, carbides, glass, thermosetting plastics and wood. Connections made to ceramic, for example, by soldering wire to the coating were found to be stronger than the wire. Flux is not used.

The wheel is prepared by rubbing it with a bar of coating metal while the wheel is rotating. The loaded wheel is then rubbed against the surface to be coated, while the wheel is rotating at high speed. If the base material is a metal such as aluminum, the abrasive burnishes the surface while applying the

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metal. Lower speeds (about 250 rpm) are used for nonmetals and care must be taken not to char wood or plastics.

A recommended production method is to place the wheel in a drill press and press it down on the surface to be coated. A spot the diameter of the wheel is covered. Hand grinders, hand drills, emery paper or sandpaper can also be used.

An alternate method is to lay a thin sheet of the coating material over the surface to be covered and bear down on it with an unloaded wheel. If high-temperature solder is to be used, the wheel or the base material should be heated to the melting point of the solder or slightly higher.

Wheels with 100 grit abrasive are satisfactory for most materials. A coarser, 75 grit wheel is best for aluminum. A variety of fusible alloys can be used, including lead-tin solders, bismuth-lead-tin-cadmium-indium solders, tin-indium, tin-cadmium and indium. Gold and silver will coat if the temperature is raised. Wood's metal is best for aluminum. Once the initial coating is applied, additional coatings and solder can be applied by conventional methods.

Details of the technique are described in a patent (2,914,425) assigned to the U. S. Atomic Energy Commission by J. C. Maguire. The patent was recently made available to industry by the AEC.

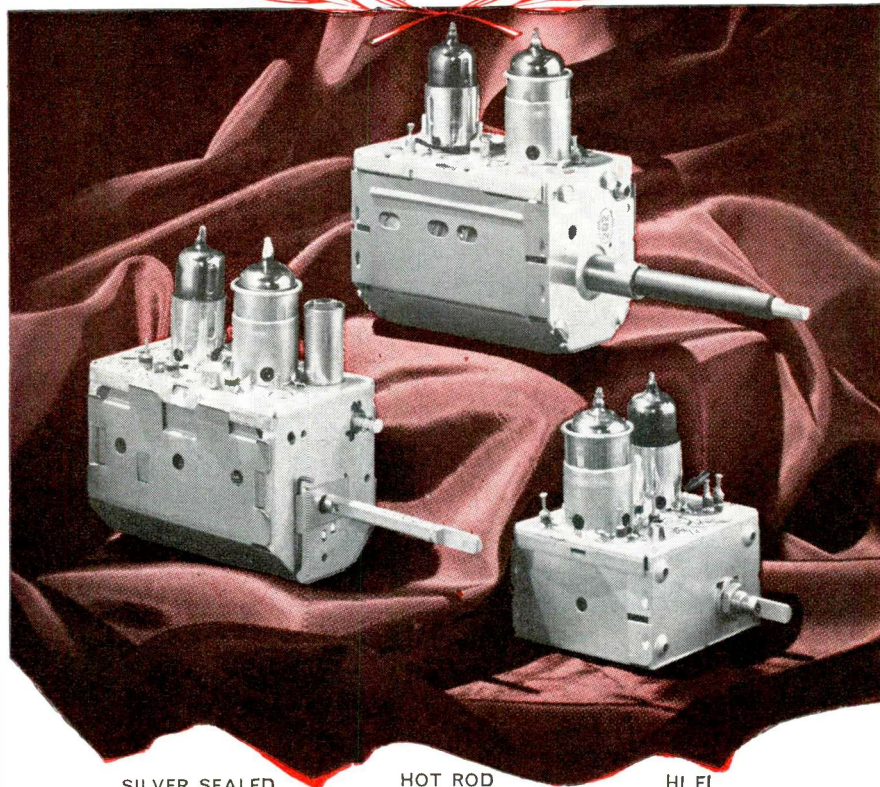
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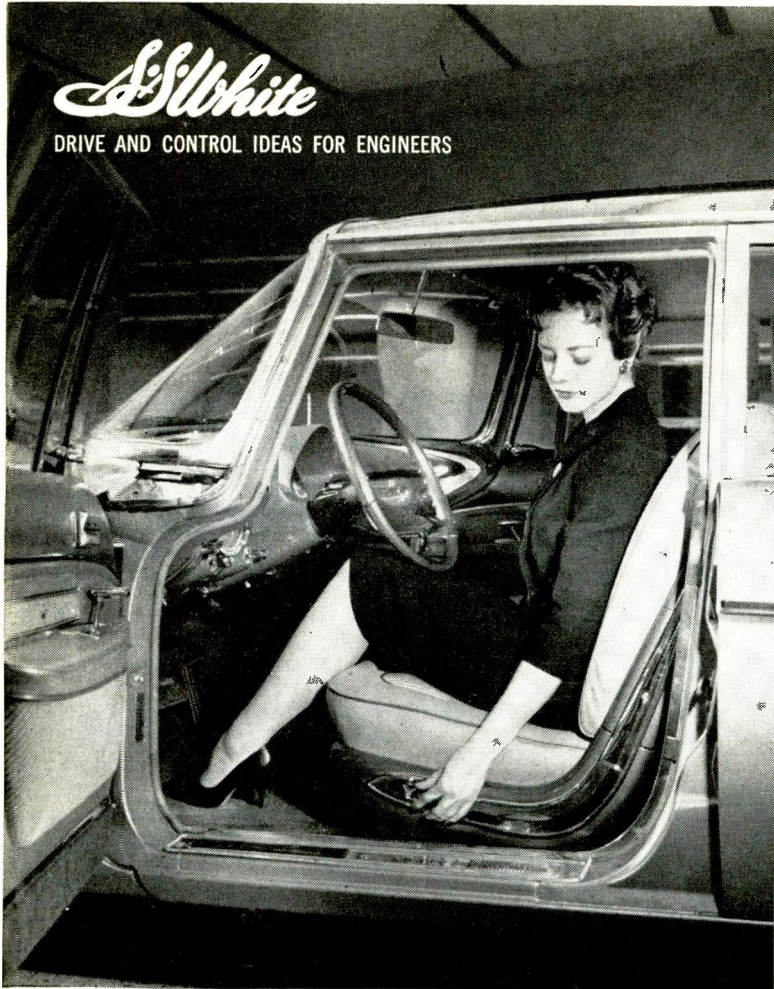


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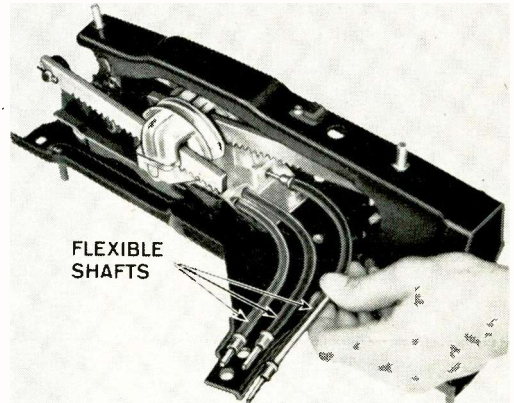
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## Flexible Shafts Solve Space Problems in Chrysler Power-Seat

Chrysler Corporation faced a design challenge in its power-operated seat adjuster. Six-way motion was called for: fore and aft, up and down, and tilt. Yet there was limited space under the seat for the mechanism. After much Chrysler testing and development, a design submitted by subcontractor Ferro Stamping Company was approved, utilizing flexible shafts.

According to Chrysler, the decision to go to flexible shafts was based on the following advantages:

**1. SPACE ECONOMY...** "flexible shafts provided means to transmit power from a single elec-

tric motor, without compromising seat design."

**2. REDUCED STRESSES...** "flexible shafts act as torsion bars to reduce motor armature stresses induced when the mechanism was stopped or stalled suddenly."

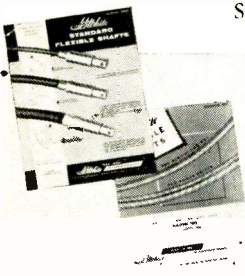
**3. RELIABILITY...** "not a single shaft fatigue failure reported from the field to date."

**4. LOW COST...** "flexible shafts definitely represented savings without sacrificing design advantages."

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Items for which the page reference is marked RD, CM and PT are editorial material published in Research and Development, Components and Materials, and Production Techniques departments, respectively. Designation ERS indicates item is an Electronics Reference Sheet. Designations BE, EN, BTW, MR and PC stand for Business Feature, Electronics Newsletter, Business This Week, Market Research and Picture-with-Caption items respectively.

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| Triangular waveguide antenna is more rigid and easier to construct than large slotted waveguide cross sections   | RD64  | Feb 19 | Electronics R&D in aviation in Australia  | SR75  | Feb 12 | Boats, transistorized gear for stars at National Motor Boat Show   | BF30  | Jan 22 |
| Using graphical extension of transform techniques to find spectrum of radar return in presence of antenna scan modulation  | TF68  | Apr 1  | FAA orders test monitoring control equipment to check out VORTAC air navigation system  | EN11  | Feb 26 | Bolometer using tiny platinum wire developed by Japanese to measure microwave power                                      | CM88  | Apr 1  |
| Antisubmarine telemetering system (Subroc) is given reliability check-out  | PC78  | Jan 29 | FAA reports five additional megacycles for use of air traffic control systems have been allotted                                      | EN11  | Apr 29 | Bonding components to circuit boards with two newly introduced fast-hardening adhesives                                  | CM116 | Jun 24 |
| Arithmetic cell using 27 tunnel diodes demonstrates all basic logic circuits including dynamic storage   | TF55  | Jan 29 | FAA rules out British Decca Mark X hyperbolic system for navigation   | BTW11 | Jan 22 | Bridge, balanced, and semiconductor diode circuits for one-tube oscillator-mixers in lv and f-m tuners                   | TF76  | Jan 15 |
| Armatures, bridge circuit measures pulse response of to pinpoint faults during production runs   | TF70  | Jun 10 | Federal spending on aircraft for coming fiscal year to increase over last year  | BF32  | Jan 29 | Bridge circuit measures pulse response of armatures to pinpoint faults during production runs                            | TF70  | Jun 10 |
| Astracon, a small light amplifier tube, increases light-gathering ability of telescopes, permits viewing of high-energy particle tracks                                  | PC82  | Jun 10 | Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector                | TF58  | Feb 19 | <b>BROADCASTING</b> (See also Communications)  |       |        |
| Ataxiometer, electronic, for measuring involuntary bodily movement   | RD78  | Jun 10 | Ground-velocity indicator using c-w Doppler radar developed for helicopters   | EN11  | Jan 8  | A-m-a-m method of stereo broadcasting announced  | EN11  | Feb 5  |
| <b>ATMOSPHERIC STUDIES</b> (See also Meteorology)  |       |        | How to determine whether to use visual, infrared or radar aircraft detection in fog or rain   | TF64  | Jan 29 | Britain and U.S. government agencies coordinate their time and frequency signal broadcasts                               | RD81  | Jun 10 |
| Atmospheric duct which traps and propagates radio waves at low loss discovered   | BTW11 | Feb 5  | Japanese to emphasize development of aviation electronics   | EN11  | Feb 12 | British multiplex system for bilingual broadcasts or convention stereophonic transmissions                               | TF87  | Jun 3  |
| Cosmic rays in upper atmosphere to be recorded by 800-lb block of film carried in Project Skyhook balloons   | RD94  | Jan 15 | Mobile antenna radiating facility for aircraft flight-line testing (RADFAC)   | PC96  | Jan 15 | FCC announces status of broadcasting at end of 1959  | EN11  | Jan 15 |
| Eliminating communication blackout resulting from plasma sheath formation during vehicle reentry using sufficiently high frequency                                       | TF105 | May 27 | Navy begins test on UDOFT (Universal Digital Operation Flight Trainer) used to simulate complicated jet flight conditions             | BF44  | Apr 15 | FCC to evaluate industry groups stereophonic f-m broadcast tests   | BF48  | Jun 3  |
| Galactic noise measured by four-stage sounding rocket  | EN11  | Jan 8  | Plane and vehicle movements monitored by tv system  | BF44  | Mar 25 | FCC year-end report shows more than 1 1/2 million transmitters now on air in more than 50 services                       | BF33  | Jan 22 |
| Instrumented low-cost Arcas and Loki weather rockets slated for daily firing   | BF43  | Apr 29 | Plug-in type tantalum capacitors for electronic stall control system  | CM98  | Jan 1  | Future of stereophonic radio broadcasting to be determined by Washington this week                                       | BF37  | Jan 1  |
| Radar telescopes detects micrometeorites, determines meteor showers are more frequent than previously suspected  | RD106 | May 20 | Portable current-path verifier for aircraft applications identifies individual wires  | PC51  | Jan 15 | Ghana orders \$1.68 million worth of shortwave broadcast equipment from British firm                                     | EN11  | Jan 1  |
| Signal transmission through natural ionized layers and ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions | TF81  | May 20 | Probes make patterns of airflow around missile nose cone inside hypersonic wind tunnel in color                                       | BF52  | Feb 26 | NAB convention to discuss stereophonic and station automation equipment  | BF48  | Apr 1  |
| Study of atmospheric noise needed to develop long-range vlf navigation systems   | RD78  | Apr 8  | Radiation-operated fuel gage for missiles and aircraft  | RD117 | Apr 29 | National Stereophonic Radio Committee suspends activities  | BF63  | Mar 11 |
| Two Operation Skyhook balloons will study cosmic rays at 18 to 22 mi altitudes   | EN11  | Jan 1  | Radioisotope density altimeter is designed for missiles and fast new aircraft   | BF37  | Jan 8  | New developments in broadcasting center around increased station automation  | TF159 | Mar 11 |
| <b>AUDIO</b> (See also Stereophonic)   |       |        | Selective calling system for aircraft data links removes necessity of continuously monitoring a communication channel                 | TF108 | Apr 29 | Red China gives 50-kw shortwave broadcasting station to Cambodian government   | EN11  | Jun 3  |
| AF studies affect of high intensity sound on human physiological reactions   | PC46  | Jun 24 | Sixteen colleges in six midwestern states designated as communications network for Midwest Program on Airborne Television Instruction | BF59  | May 20 | Red China tops U.S. in global broadcasting   | BF35  | May 27 |
| Dental anesthetic device using stereo sound placed in production   | EN11  | May 27 | System for lying flight simulator into remote standard ground-controlled intercept radar  | TF86  | May 13 | Regular stereophonic broadcasting to be initiated in Canada  | BF45  | Jan 15 |
| Four-track stereo tape recorder and miniature 7-transistor 45-rpm radio-phonograph shown at Japanese Industrial Trade Fair   | EN11  | Apr 29 | Technical aid in civil aviation given to United Arab Republic by FAA  | EN11  | Jan 8  | Remote transmitter generates control pulses during vertical blanking interval to control TV receiver                     | TF79  | May 13 |
| German's market binaural tape for stereo equipment   | BF49  | May 13 | Transistorized radio beacon designed to function as aircraft crash position indicator   | TF54  | Jan 22 | Six-month shakedown of instantaneous audiometer used to rate viewing habits in New York City completed                   | BF44  | Apr 8  |
| Hearing aid sales rise 11 percent  | MR28  | Mar 18 | Use of commercial uhf tv sets for reception of tv signals from aircraft for educational purposes discussed at winter meeting of AIEE  | BF28  | Feb 19 | Status of broadcasting industry in Japan   | SR53  | May 27 |
| Japanese to market stereo four-channel tape recorder in U.S.   | EN11  | Jan 22 | Voice-visual aircraft communications system (DISCOM) book message transmitted by digital methods scheduled for delivery               | BTW11 | Mar 25 | Stereo stimulates f-m broadcasters; FCC says standards may be established by fall 1960                                   | BF30  | Apr 22 |
| Manufacturers expect continued increase in tv and audio market   | BF39  | Feb 5  | Axis-crossing intervals, digital sampler for measurement of for design of weak signal detectors                                       | TF88  | Jun 3  | Technique for checking calibration of f-m and tv transmitter percentage-of-modulation monitors                           | TF67  | Apr 15 |
| Miniature capacitor microphone with 15-Kc bandwidth for measurement use, and tv and moving picture studios   | RD80  | May 6  |   |       |        | Voice of America gets new \$25-million site in North Carolina  | BF34  | Feb 19 |
| National Stereophonic Radio Committee suspends activities  | BF63  | Mar 11 |   |       |        | Buffers, non-uniform gain, functions for   | TF82  | May 13 |
| New developments in determining unique characteristics of sound  | TF159 | Mar 11 |   |       |        | <b>BUSINESS</b>  |       |        |
| Portable transistorized sound level meter for measuring noise  | TF64  | Jun 17 |   |       |        | (See also Exports, Foreign Electronics, Government, Imports, Management, Marketing, and Market Research)                 |       |        |
| Silicon photoceles used as detectors in projector optical sound track pickup   | PC68  | Jan 8  |   |       |        | American and Japanese firms agree to share techniques of design and manufacture of diodes                                | BF32  | Apr 8  |
| Sound-canceling microphone makes ordinary voice communication possible in 150-db areas   | PC41  | Apr 22 |   |       |        | Business data processor reads records prepared in standard business terminology  | EN11  | May 13 |
| Transistor audio volume compressor for interview tape recorders  | TF62  | Jan 8  |   |       |        | Changing electronics market develops new patterns of doing business  | SR49  | Jan 1  |
| Transistorized high-power sound generating system used to replace technical siren  | TF70  | Apr 15 |   |       |        | Components manufacturers say total sales were up 23 percent for the year   | BF35  | Jun 24 |
| Wireless eyeglass hearing aid developed  | PC43  | May 27 |   |       |        | Computers and closed-circuit television are bringing office automation to Mideast banks and oil firms                    | EN11  | Jul 1  |
| Australia, research and development currently underway in  | SR75  | Feb 12 |   |       |        | Data processor built around two RCA 501 computers installed in bank  | EN11  | Feb 5  |
| Autocorrelator compares echoes from over-the-horizon radar missile warning system using magnetic-drum receivers  | BF28  | Feb 5  |   |       |        | Detroit area fast becoming important to electronics industry, particularly in R & D                                      | BF42  | Mar 18 |
| <b>AUTOMOBILE ELECTRONICS</b>  |       |        |   |       |        | Electronic Manufacturers Association formed in Israel includes also government and local scientific institutions         | BF53  | May 6  |
| Auto company tests energy absorption of materials by measuring impact of steel ball of surface   | PC30  | Jun 17 |   |       |        | Electronics industry will probably get 17 percent of defense budget in ten years   | BF53  | Apr 1  |
| Columbia University studies use of electronic controls in auto traffic safety  | BF60  | Mar 11 |   |       |        | Electronics to be third largest U.S. industry by 1965  | MR24  | Jun 17 |
| Electroluminescent devices find expanded market in automotive applications   | BTW11 | Jan 29 |   |       |        | Florida's new industrial lure: plant-and-house package   | BF30  | Jun 10 |
| Electronic highway control using wire loops, guidance cable and transistorized detector demonstrated   | BF40  | Jun 17 |   |       |        | Guide for measuring new product success records affecting health and behavior in space, submarines and department stores | BF45  | Feb 26 |
| Generator-regulator for autos uses only semi-conductors and resistors  | TF52  | Feb 19 |   |       |        | Manufacturers give increased attention to developing small computers for small businesses                                | BF39  | Apr 8  |
| Interest in printed motors mounts as electric auto talk is revived   | BTW11 | Apr 22 |   |       |        | NASA gives \$30-million contract for worldwide tracking and communications net for Project Mercury                       | BTW11 | Feb 5  |
| Multi-junction drift-field transistor simplifies design of portable and auto radios  | CM82  | Apr 22 |   |       |        | New business data processing system offers sophistication at moderate price  | BTW11 | Apr 15 |
| NBS' Boulder Labs. mobile field unit to measure interference from generators, power lines, spark plugs and other electrical gear   | BF52  | Jun 24 |   |       |        | New data processing system for small business announced  | EN11  | Apr 22 |
| Silicon solar cells power automobile   | PC52  | Jun 24 |   |       |        | New IBM solid state business data processor ordered by Southern Railway  | EN11  | Feb 12 |
| Solar-powered call system gives drivers choice of emergency highway service  | PC53  | Jun 3  |   |       |        | New Mexico's electronics industry now in multi-million dollar bracket through missile development, R&D                   | BF41  | Apr 15 |
| Soviet remote-controlled farm tractors scheduled to start large-scale tests next year  | EN11  | Feb 26 |   |       |        | New trends in finding funds to promote growth of electronic companies  | BF30  | Feb 19 |
| Telemetry technique for studying car behavior developed  | BF42  | Mar 18 |   |       |        | Position of U.S. Government and industry on Japanese imports   | SR53  | May 27 |
| Transistorized automobile ignition system uses surface-gap spark plugs   | RD82  | Mar 25 |   |       |        | Self-help plan involving team bidding and establishment of trade association speed industrial growth on Long Island      | BF38  | May 6  |
| <b>AVIATION</b>  |       |        |   |       |        | Tunnel diode factory production announced by U.S. and Japanese firms   | BTW11 | Feb 12 |
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| Airborne early warning blimps to carry largest radar and electronic equipment complex  | EN11  | Jan 15 |   |       |        | Wall Street delicatener to be opened in March  | EN11  | Jan 1  |
| Aircraft identification system used specialized transponders   | PC37  | Jan 8  |   |       |        | Washington, D.C. is where firms go to seek an inside track for R & D   | BF34  | Apr 22 |
| Airliner life rafts being equipped with rescue beacons   | PC52  | May 20 |   |       |        | What exhibitors are saying about forthcoming IRE International Show and Convention                                       | BF30  | Mar 11 |
| Automatic surveying system uses lightbeam projector and profile measuring device to measure airport runway roughness   | TF54  | Jun 17 |   |       |        | Will debate over military policy mean orders or cutbacks?  | BF26  | Mar 4  |
| Automatic weather station can be air-lifted to normally inaccessible areas by helicopter   | BF43  | May 6  |   |       |        | Butterworth low-pass filter transfer functions   | TF82  | May 13 |
| C-w Doppler radar ground velocity system for helicopter permits sonar dunking operations   | PC35  | May 27 |   |       |        |  |       |        |
|  |       |        | Backward-wave oscillator tubes, what's new in   | SR55  | Apr 29 |  |       |        |
|  |       |        | Bandpass measurement, two-tube circuit provides accurate, stable intensity range for oscilloscope over 8 to 22 Mc frequency range for | TF108 | Jun 24 |  |       |        |
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|  |       |        | Batch process sequencing and dispensing controls—good progress in Britain   | BF52  | May 13 |  |       |        |
|  |       |        | <b>BATTERIES</b> (See also Power Sources and Supplies)  |       |        |  |       |        |
|  |       |        | BASIC design considerations of silicon solar cells for use as power supplies on satellites  | TF167 | Mar 11 |  |       |        |
|  |       |        | Lighter, smaller silver-cadmium portable tv battery capable of more than 2,000 operating hours available                              | CM87  | Apr 15 |  |       |        |
|  |       |        | Performance ratings of secondary batteries  | TF60  | Feb 19 |  |       |        |
|  |       |        | Solar battery used to power Japanese lighthouse has operated successfully for six months  | BF57  | May 13 |  |       |        |
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|  |       |        | Beacon, elliptically polarized X-band horn antenna with 3-db and 6-db beamwidths of 140 degrees used in                               | TF50  | Mar 4  |  |       |        |
|  |       |        | Beacon, transistorized radio, designed to function as aircraft crash position indicator   | TF54  | Jan 22 |  |       |        |
|  |       |        | Beacon, uhf transponder, in Tiros 1 improves radar data quality, provides horizon-to-horizon coverage                                 | RD96  | May 13 |  |       |        |
|  |       |        | Beacons, rescue, airliner life rafts being equipped with rescue beacons   | PC52  | May 20 |  |       |        |
|  |       |        | Beam-pattern design for modern microwave antennas   | SR67  | Jun 24 |  |       |        |
|  |       |        | Bearings, ceramic gas, in new gyro reduces drift for space guidance applications  | CM76  | Jun 17 |  |       |        |
|  |       |        | Bilingual multiplex system, british, for European broadcasts or conventional stereophonic transmissions                               | TF87  | Jun 3  |  |       |        |
|  |       |        | <b>BIOPHYSICS</b> (See also Medical Electronics)  |       |        |  |       |        |
|  |       |        | Biocurrents in human cells being studied by Soviet Scientist with microelectrode  | EN11  | Mar 4  |  |       |        |
|  |       |        | Biological radiation equipment being researched by Syracuse University  | BF53  | Feb 12 |  |       |        |
|  |       |        | Computer applications of future will be in retrieving information and studying biological systems                                     | TF55  | Jan 29 |  |       |        |
|  |       |        | Computer calculates turbidimetric assays in automatic microbiological testing   | RD67  | Jan 8  |  |       |        |
|  |       |        | Ions affect health and behavior in space, submarines and department stores  | BF45  | Feb 26 |  |       |        |
|  |       |        | Mark I perceptron demonstrates ability to learn the alphabet  | BF43  | Jun 24 |  |       |        |
|  |       |        | Blood pressure meter, photoelectric, developed by Russians  | RD75  | Jun 17 |  |       |        |
|  |       |        | BMEWS detection and communication system, prime contractor get contract awards  | EN11  | Feb 26 |  |       |        |
|  |       |        | BMEWS radar to be augmented by Project Midas' heat-seeking missile defense satellite  | BF42  | Apr 1  |  |       |        |
|  |       |        | BMEWS rearward communications provided by submarines cable from Greenland to north of North Circle                                    | BF42  | Feb 5  |  |       |        |
|  |       |        | BMEWS to get three maneuverable dish radars to scan and track ballistic missiles  | BF47  | Mar 18 |  |       |        |
|  |       |        | Boat loaders, automatic alloy, boost transistor production  | PT122 | Jun 24 |  |       |        |

**B**

**C**



|   |       |        |   |       |        |   |       |        |
|---|-------|--------|---|-------|--------|---|-------|--------|
| Frame of radiation beams provides nondestructive, continuous method of testing cable insulation                                     | PT135 | May 27 | Chrominance circuits for compatible color tv system featuring sequential transmission and using one-line memory in receivers  | TF57  | May 6  | Navy experimental moon-relay communications system demonstrated   | EN11  | Feb 5  |
| Ions detect pinholes in wire and cable insulation   | PT77  | Feb 5  | Circotron is crossed-field amplifier using magnetron as negative-resistance element   | TF71  | Jan 15 | NBS' Boulder Labs. mobile field unit to measure interference from generators, power lines, spark plugs and other electrical gear  | BF52  | Jun 24 |
| Molding cable junctions, connectors and terminations with cast-in-place solid elastomers  | PT90  | Apr 1  | Circuits breakers, solid-state static power, using silicon-controlled rectifiers have contact rating from milliwatts to kilowatts                                       | TF114 | May 27 | New AF-operated facility uses computers and complex communications system to coordinate space surveillance, catalog everything in orbit                                 | BF34  | Mar 4  |
| Precision winding machine for submarine cable and capacitor manufacturing   | PT86  | Jun 10 | Circulators for modern microwave applications   | SR67  | Jun 24 | New developments in communications  | TF159 | Mar 11 |
| Properties of representative liquid polymers for cold-molding cable systems   | TF67  | May 6  | Citizens radio, crackdown on Class D looms if users don't toe the line  | BF28  | Jan 8  | New look in data processing to emphasize information transmission by common carrier between computers   | BF38  | May 27 |
| R-f cables and connectors for military applications (See p42, Dec 25, 1959 issue for 1st part of this article)                      | TF90  | Jan 1  | Citizens radio, self-policing by industries of class D Citizens' Radio being studied  | BF29  | Feb 5  | New radar and communications system guard Korea against surprise invasion   | BF40  | May 20 |
| Submarine cable provides rearward communications for BMEWS from Greenland to north of Arctic Circle                                 | BF42  | Feb 5  | Classifier, tape target, trains land-based sonar student operators  | TF65  | Mar 25 | Optical-electronic active system for communications, navigation, and tracking and acquisition applications  | TF71  | Jan 15 |
| Work has started on submarine telephone cable between Britain and Sweden  | EN11  | Jun 17 | Clock, atomic, and quartz crystals are subjects of major interest at 14th annual Frequency Control Symposium  | BF38  | Jun 24 | Pioneer V will be transmitting information over distance of 50 million miles in August, 1960  | BF49  | Mar 25 |
| Cadmium sulfide photoresistor based on combination of photo-conductor and electret reported at 1960 Solid-State Circuits Conference | TF39  | Mar 4  | Coaxial magnetron oscillators, what's new in Codan (carrier-operated antineutrino circuit) of advanced types feature simple design, low power drain, high dependability | SR55  | Apr 29 | Propagation of electromagnetic waves through subsurface of earth being studied for AF   | BTW11 | Mar 4  |
| Calibration circuit for self-powered transistor oscilloscope  | TF80  | Mar 18 | Code circuit, transistorized, for high-power sound generating system used to replace mechanical sound alarms  | TF70  | Apr 15 | Public facsimile research spreads, faster transmission and privacy are goals  | BF51  | Apr 8  |
| Camera tubes, what's new in   | SR55  | Apr 29 | Coder, eight-function, for remote pulse-coded fault alarm used in multihop microwave systems  | TF82  | Jan 1  | Rearward communications for BMEWS provided by submarine cable from Greenland to north of Arctic Circle  | BF42  | Feb 5  |
| Cans of odd shapes made of easily-formed metal by filling simple die with Neoprene plug   | PT91  | Apr 15 | Coding circuit for recording output of tv system tracking eye focus points and movements  | TF57  | Apr 22 | Remote Communications Complex (RCC) for SAC's Automatic Combat Control System (SACCS)   | BF36  | Mar 25 |
| Capacitance, measurement engineers cite need for better measurement standards of  | BF53  | May 20 | Coil induction heating, opens capsules in predetermined area of dog's gastro-intestinal tract   | PC29  | Jan 1  | Satellite astronomical observatory with 50-inch telescope and data communicating systems planned by NSF and NASA  | BTW11 | Mar 18 |
| <b>CAPACITORS</b>   |       |        | Coil, low-Q, simple and effective means of measuring inductance of  | TF112 | Apr 29 | Selective calling system for aircraft data links removes necessity of continuously monitoring a communication channel   | TF108 | Apr 29 |
| British approaches to producing capacitors for microminiaturization   | TF71  | Jan 1  | Cold-cathode gas-filled tubes, what's new in  | SR55  | Apr 29 | Selective paging system uses coded transmission for voice intercommunications with up to 45 stations  | TF68  | Feb 26 |
| Capacitors with plastic wire electrodes and sputtered metal conductors give high temperature advantages                             | CM86  | Apr 15 | Collector unit sorts ions in double-focusing mass spectrometer  | RD74  | Jan 29 | Signal transmission through natural ionized layers and on shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions | TF81  | May 20 |
| Characteristics of precision r-f fixed capacitors   | TF79  | Mar 18 | Color picture tubes, what's new in  | SR55  | Apr 29 | Sixteen colleges in six midwestern states designated as communications network for Midwest Program on Airborne Television Instruction                                   | BF59  | May 20 |
| Characteristics of semi-precision paper and plastic film capacitors   | TF78  | Mar 25 | <b>COMMUNICATIONS</b> (See also Broadcasting)   |       |        | Sound-canceling microphone makes ordinary voice communication possible in 150-db areas  | PC41  | Apr 22 |
| Dielectric absorption in capacitors   | RD78  | Jun 10 | Advent active communications satellite should have space relay station in operation by 1962, be totally operational by 1964   | EN11  | Jun 24 | Space communications plans outlined at Armed Forces Communications and Electronics Association's 14th Convention  | BF42  | Jun 10 |
| Experimental current-measuring technique for determining dielectric absorption in capacitors  | RD90  | Mar 18 | AF is investigating X-rays as possible means of space communications  | BF45  | Feb 12 | Subsurface propagation of electromagnetic waves being studied   | PC30  | Apr 22 |
| Ferroelectric capacitor tuning devices for frequency synthesizer gives stable, high-accuracy receiver and transmitters              | RD122 | Feb 12 | Applications of modern microwave equipment in radar, communications, computer, remote control and cooking   | SR67  | Jun 24 | Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv  | TF70  | Apr 8  |
| Miniature capacitor microphone with 15Kc bandwidth for measurement use, and tv and moving picture studios                           | RD80  | May 6  | Atmospheric duct which traps and propagates radio waves at low loss discovered  | BTW11 | Feb 5  | Transistorized high-power sound generating alarm system can also carry voice communications   | TF70  | Apr 15 |
| More use of tantalum and columbium for capacitors seen at Electrochemical Society meeting   | EN11  | May 20 | Automated submarine uses electronic data processing and display to give ship, engineering, communications, weapons, and environmental control                           | BF28  | Jan 29 | Transistorized multiplex single-sideband suppressed carrier system capable of handling 600 voice channels announced   | EN11  | Feb 19 |
| Nominal characteristics of electrolytic and general-purpose ceramic capacitors  | TF173 | Mar 11 | BMEWS detection and communication system prime contractors get contact awards   | EN11  | Feb 26 | Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications  | BF36  | Feb 26 |
| Plug-in type single-ended tantalum foil capacitors give more capacitance in less space  | CM98  | Jan 1  | Broadband data link designed to handle information from airborne radar mapper announced   | EN11  | Apr 1  | Use of sun as huge reflector to relay radio signals between distant points described  | RD115 | Jun 24 |
| Precision winding machine for submarine cable and capacitor manufacturing   | PT86  | Jun 10 | Broadband log-periodic antennas for monitoring and signal interception, direction finding, satellite tracking, radio astronomy and h-f communications uses              | TF58  | Jun 17 | Voice of America gets new \$25-million site in North Carolina   | BF34  | Feb 19 |
| Recent advances in preparing thin film ceramic dielectrics for microminiature capacitors  | CM96  | Jan 1  | Communications nucleus of Japanese electronics industry   | SR53  | May 27 | Voice-visual aircraft communications system (DISCOM) using canned book message transmitted by digital methods scheduled for delivery                                    | BTW11 | Mar 25 |
| Self-compensating fixture tests 24 capacitors at a time in an environmental test chamber  | PT72  | Jan 22 | Communications with Polaris submarines not big problem many people think  | BF32  | Apr 15 | Comparator, amplitude, for noise suppression factor display unit  | TF55  | Feb 5  |
| Semiconductor resistors and capacitors for microcircuits  | TF69  | May 13 | Data communications systems linking distant computers use magnetic tape equipment   | BF44  | Jun 17 | Comparator used in automatic fault-finding system for testing battery control center of Hawk Weapons System   | TF60  | Jun 17 |
| Tantalum capacitor manufacturers look for 20 percent sales increase over 1959 level   | MR24  | Jun 19 | Delivery of new single-sideband communications systems for military and commercial market reported  | BTW11 | Mar 18 | Compatible color tv system (French) features sequential transmission of chrominance, uses one-line memory in receiver   | TF57  | May 6  |
| What's new in built-in capacitor-type picture tubes   | SR55  | Apr 29 | Designing for space and weight saving with rotary solenoids   | CM66  | Mar 4  | COMPONENTS (See also specific components)   |       |        |
| Cathode bowing under severe shock reduced by new cathode base metal   | CM79  | Jun 17 | Double-sideband suppressed carrier modulation technique saves power, permits exalted-carrier detection  | TF47  | Feb 5  | Approaches to design and fabrication of microminiaturized digital computer for space applications   | TF95  | Apr 29 |
| Cathode ray tubes, monoscope-camera system converts computer data into visual form on microfilm                                     | BF11  | Feb 26 | Electronics R&D in communications in England, France, Italy and Sweden  | SR75  | Feb 12 | Avoidance of physical connection between components stressed at Electronic Components Conference  | BF35  | May 27 |
| Cathode ray tubes, Soviet automatic control system checks mass-produced parts using crt scanning technique                          | EN11  | Jan 15 | Eliminating communication linkout resulting from plasma sheath formation during vehicle reentry using sufficiently high frequency                                       | TF105 | May 27 | British approaches to microminiaturization  | TF71  | Jan 1  |
| Cathode ray tubes, what's new in  | SR55  | Apr 29 | End-fire arrays of high-dielectric ceramic rods give low silhouette and high vertical resolution in uhf region  | TF60  | Feb 5  | Central organization may be set up to administer program for control over design and procurement of military components   | EN11  | May 27 |
| Cathode temperature of commercial tube measured by using magnetic field parallel to retarding potential                             | RD80  | Apr 15 | Experimental progress towards transoceanic communication by means of passive earth satellites reported  | BTW11 | Apr 8  | Component development in electronics industry of Japan  | SR53  | May 27 |
| Cauer parameters used at specific stopband attenuations makes Zobel filter design procedures straightforward                        | TF96  | May 20 | FAA reports five additional megacycles for use of Air Traffic control systems have been allotted  | EN11  | Apr 29 | Components highlighted at 1960 IRE International Show and Convention  | BF47  | Apr 1  |
| Cavity-diode amplifier for modern microwave applications  | SR67  | Jun 24 | FAA to use total of 32 direct air-ground communication channels in 1960   | BF40  | Feb 12 | Components manufacturers say total sales were up 23 percent for the year  | BF35  | Jun 24 |
| Cells, human, bio-currents is being studied by Soviet scientist with microelectrode   | EN11  | Mar 4  | FCC plans to spend \$2 million to find out whether or not uhf can be rejuvenated  | BF32  | Jun 3  | Components market for 1960  | SR49  | Jan 1  |
| <b>CERAMICS</b>   |       |        | Georgia Institute of Technology creates division to study radar and communications  | BF53  | Feb 12 | Components overlooked in R&D aspects of reliability   | BF39  | Jan 29 |
| Ceramic-based microminiature adder for ballistic missile computer   | PC96  | Jan 1  | High power pulsed S-band klystron for long-range radar or troposcatter communications   | CM82  | Feb 26 | Contour extruded aluminum tubing is being considered for waveguide components with integral flange  | PT104 | Jun 3  |
| Ceramic capacitors, electrolytic and general-purpose, nominal characteristics of  | TF173 | Mar 11 | Hiring in communications equipment industry up 13 percent   | MR26  | Mar 11 | Designing for space and weight saving with rotary solenoids   | CM66  | Mar 4  |
| Ceramic filters improve selectivity of multiband communications-type receiver   | CM84  | Feb 26 | Instruments, controls, electron microscopes, advanced communications are features of British Exhibition in New York   | BF46  | Jun 24 | Dielectric diodes and triodes to control large amounts of current using thin insulating crystals of cadmium sulphide being developed                                    | BTW11 | Jan 22 |
| Ceramic gas bearings in new gyro reduces drift for space guidance applications  | CM76  | Jun 17 | International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations   | BF33  | Feb 19 | Dollar value of plastics parts produced by electronics companies in 1959 is \$250 million, double 1958's \$125 million  | MR24  | Jun 24 |
| End-fire arrays of high-dielectric ceramic rods give low silhouette and high vertical resolution in uhf region                      | TF60  | Feb 5  | Irradiation effects on communications-type systems  | TF69  | Apr 22 | Drop-feeding and unloading of workpieces on centerless grinder steps up production of synchro shafts  | PT74  | Jan 22 |
| Four basic research programs underway to develop ductile ceramic and ionic crystals   | CM100 | Jan 15 | Japanese-made tropospheric scatter communications system used by U.S. forces in Japan   | EN11  | Jan 29 | Erasers clean component leads   | SR75  | Feb 12 |
| NBS discovers a series of ceramic materials that exhibit simultaneously both ferroelectric and ferrimagnetic properties             | CM128 | Feb 12 | Mid-continent link in Army's worldwide communications network now operational   | BF35  | Mar 4  | Fit of mating glass parts can be accurately determined by methods known as the water drop and fringe pattern  | PT106 | Jun 3  |
| Practicality of using small ceramic receiving tubes in thermionic integrated modular circuits (TIMMS)                               | CM82  | Jun 10 | Military Affiliate Radio System (MARS) considers regular amateur activities   | BF48  | Feb 12 | Government may set minimum wage next year for workers making functional components  | BTW11 | Apr 15 |
| Recent advances in preparing thin film ceramic dielectrics for microminiature capacitors  | CM96  | Jan 1  | Million-watt transmitter to be completed by year's end for Navy   | BF41  | Jan 29 | High-thrust propulsion systems to shift critical emphasis in satellite development to component and instruments   | BF48  | Apr 29 |
| Report on high-temperature ceramics   | CM116 | Jun 24 | NASA gives \$30-million contract for worldwide tracking and communications net for Project Mercury  | BTW11 | Feb 5  | Japanese Electronics Parts Show indicates trend of manufacturers stepping up efforts to make components   | BTW11 | Mar 18 |
| Cesium cell converter working at high temperatures produces significant amounts of a-c electricity                                  | CM78  | Jan 29 | Nassau terminus of 186-mile over-the-horizon troposcatter link to Bahamas completed   | PC39  | Feb 5  |   |       |        |
| Cesium diodes with efficiencies of 15 to 20 percent are expected to be available in two years                                       | TF159 | Mar 11 | NATO's 4,000-mile tropospheric scatter system Project Ace High to connect all major radar outposts and operational headquarters in Europe                               | BF38  | Apr 29 |   |       |        |
| Cesium-stream ion engine being contracted for by NASA   | EN11  | Jun 17 |   |       |        |   |       |        |
| Changemaking machine operates by magnetic sensing   | EN11  | Jun 10 |   |       |        |   |       |        |
| Character generator, solid-state, for VIDAC (Visual Information Display and Control) system   | TF55  | Jun 10 |   |       |        |   |       |        |
| Charts normalized for frequency provide a rapid solution to twin-T network parameters   | ERS67 | Jun 17 |   |       |        |   |       |        |
| Check handling data processor built around two RCA 501 computers installed in bank  | EN11  | Feb 5  |   |       |        |   |       |        |
| Chokes, low-Q iron, simple and effective means of measuring inductance of   | TF112 | Apr 29 |   |       |        |   |       |        |
| Chopper for precision phasemeter used for c-w and pulsed uhf  | TF54  | Mar 4  |   |       |        |   |       |        |

|   |       |        |  |       |        |   |       |        |
|---|-------|--------|--|-------|--------|---|-------|--------|
| Labor Department to rule on minimum wages for tube and semiconductor production workers   | BF31  | Jan 8  | Electronics R&D in computers in France, Italy, Sweden, Israel and Japan  | SR75  | Feb 12 | Status of computer industry in Japan  | SR53  | May 27 |
| Microminiature modules (MICRAM) with component densities of 2 million units per cu ft being marketed                              | BW11  | Mar 25 | Expandable random-access solid-state memories operate over 15 to 55 C temperature range, require only 3 percent supplies   | TF164 | Mar 11 | STRETCH-class computer capable of completing 100 billion computations a day is announced  | EN11  | May 6  |
| Microwaves components study of 1958 production issued by Commerce Department's Business and Defense Services Administration       | MR24  | Apr 8  | FAA installs computers in air traffic control centers  | BF40  | Feb 12 | Superconductors to find use as components for high-speed switches and memory systems  | BF32  | Feb 5  |
| Minuteman's guidance and control systems need reliable components for underground storage lasting years                           | BF39  | Jun 17 | Four solid-state computers to form heart of air traffic control data processing central  | BF28  | Apr 8  | Test circuit shows how to accurately measure gain and phase angle characteristics of closed-loop synchro, resolver and computer amplifiers                      | ERS88 | May 13 |
| Missiles and space continue to account for much government money spent in guidance and component research area                    | EN11  | Jun 3  | GE sponsors investigation into computer uses of tunnel diodes at University of Arizona   | BF60  | Mar 11 | Transistorized digital computer for open-loop control in processing operations  | BW11  | Feb 19 |
| Mobile controller-recorder programs temperatures to test missile components   | PC34  | Jun 17 | Generation, detection and transmission of millimicrosec transients being studied at University of Kansas under Navy grant for Project Jayhawk                                    | BF60  | Mar 11 | Transistorized function generator eliminated need for d-c amplifier   | TF75  | Mar 25 |
| Modern microwave components   | SR67  | Jun 24 | Grant given Polytechnical Institute of Brooklyn to set up high speed computer facility   | BF53  | Feb 12 | Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications  | BF36  | Feb 26 |
| Plastic skin packaging for electronic components, wire and circuit board assemblies and electromechanical parts                   | PT82  | Jan 29 | Half-amp silicon diodes with 0.3 usec recovery time in volume production for computers   | CM105 | Jan 15 | Two study programs investigate the use of SAGE computer in air traffic control systems  | EN11  | May 6  |
| Response of electronic system components and materials to irradiation from nuclear-powered aircraft                               | TF69  | Apr 22 | Half-inch cube modules holding 12 to 18 components used in reconnaissance drone guidance system, commercial and military computers   | CM123 | Apr 29 | Varactor diodes available in experimental quantities, used for high-efficiency subharmonic oscillators in microwave computers                                   | CM131 | May 27 |
| R-f cables and connectors for military applications (See p42, Dec 25, 1959 issue for 1st part of this article)                    | TF90  | Jan 1  | High-speed repetitive-operation analog computers permit continuous plot displays   | EN11  | Feb 19 | West Berlin's Institute for Nuclear Research gets new transistorized computer   | BF31  | Jun 10 |
| Respective merits of tubes and transistors discussed at winter meeting of AIEE  | BF28  | Feb 19 | High-speed transistor switch for computer logic circuit performs at micro-energy levels  | CM98  | May 13 | Conductivity determination of in evaluating three-element semiconductor materials   | TE103 |        |
| Selecting R-C values for filters characterized by no output at infinity frequency or zero frequency                               | TF82  | May 13 | Japanese develop new computer logic - high speed parallel adder-accumulator and shifter  | BF36  | Apr 15 | Conductivity of various chemicals to be studied at University of Cincinnati   | BF60  | Mar 11 |
| Services need inventions in component, transistor, antenna and instrument areas   | BF39  | Jan 22 | Large-scale digital computer permits Navy high degree of realism in simulating mock submarine battles  | BF35  | Jun 24 | Conductors, British approaches to producing for microminiaturization  | TF71  | Jan 1  |
| Simple steps for speeding inspection of small lots of components  | PT72  | Feb 19 | Long-range radar, computer with high reliability key units in ground-controlled satellite guidance system  | BF43  | May 27 | CONFERENCES (See also Conventions and Meetings)   |       |        |
| Slip ring assemblies become major electronics components market, sales rise 25 percent yearly                                     | MR30  | May 13 | Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics | RD104 | May 20 | Avoidance of physical connection between components stressed at Electronic Components Conference  | BF35  | May 27 |
| Solid-State Circuits Conference indicates components may be eliminated by microelectronics  | BF36  | Feb 12 | Magnetic noncontact shaft-position disk encoder offers high rotational speeds and reliability for computer, control and data logging uses  | RD114 | Apr 29 | Control systems, solid-state electronics and electromagnetics featured at Seattle's 7th Regional IRE Conference   | BF39  | Jun 10 |
| Specifications for components in millimeter band Stackable small parts bins being made of molded plastic                          | PT89  | Jun 10 | Magnetic thin film dots for computer memories  | PC184 | Mar 11 | Eastern Joint Computer Conference indicates computers are heading for 1,000-Mc operation and microminiaturized circuits   | TF55  | Jan 29 |
| Thermoelectric cooling modules for electronic components in R&D stages  | RD68  | Feb 5  | Manufacturers give increased attention to developing small computers for small businesses  | BF39  | Apr 8  | Electronics firms urged at EAI Industrial Electronics Conference to sell systems instead of hardware to industrial customers                                    | MR22  | Jan 22 |
| Three-dimensional x-rays diagnose component failures more readily   | PT74  | Jan 22 | Manufacturers look for quadrupled digital computer sales over next five years  | MR24  | Jun 3  | Electronics probes the universe is theme of 12th Annual National Aeronautical Electronics Conference  | BF45  | May 20 |
| Transistorized subaudio swept signal generator for testing servos and related equipment and components                            | TF67  | Apr 22 | Micrologic elements promise computer miniaturization according to paper given at 1960 Solid-State Circuits Conference  | TF39  | Mar 4  | Emphasis at Third International Instrument Electronics and Automation Show in Britain is on industrial controls, digital building blocks                        | BF34  | Jun 17 |
| Two fast-hardening epoxy adhesives introduced for bonding components to circuit boards  | CM116 | Jun 24 | Micron-thick permalloy plated onto copper basis of new film logic and memory devices developed in Japan  | EN11  | Apr 1  | Emphasis on basic scientific progress and discoveries in Conference on Electronic Conductivity in Organic Solids  | RD127 | May 27 |
| What designers should know about performance of missile components in dynamic environments  | TF102 | Apr 29 | Modification of intercept and target computers to lie flight simulator into remote standard ground-controlled intercept radar  | TF86  | May 13 | Fortcoming Solid-State Circuits Conference indicates R & D labs are in tunnel diode race  | BF32  | Jan 1  |
| Wheel-shaped component carrier in oven makes 150 C tests of silicon diodes  | PT130 | Feb 12 | Monoscope-camera system converts computer data into visual form on microfilm   | BF11  | Feb 26 | International Federation of Automatic Control Conference to open in Moscow next week  | BF34  | Jun 24 |
| Compressor, transistor audio volume, for interview tape-recorders   | TF62  | Jan 8  | Monoscope tube generates characters for direct readout on a cro or on paper of digital computer output   | TF117 | Feb 12 | International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations   | BF33  | Feb 19 |
| COMPUTERS   | Logic |        | Navigation for hypersonic or space craft aided by computer-directed map projection system under development  | EN11  | Jun 3  | Microelectronics to get special attention at 1960 Solid-State Circuit Conference  | EN11  | Jan 29 |
| (See also Data Processing, Digital Techniques, Circuits, Memories and Registers)  |       |        | NBS studies automatic computation methods for determining best possible frequencies for radio transmitters used as road markers on air lanes                                     | RD72  | Jun 17 | Microminiaturization discussions dominate Electronic Components Conference  | BF46  | May 27 |
| Applications of modern microwave equipment in radar, communications, computer, remote control and cooking                         | SR67  | Jun 24 | New AF-operated facility uses computers and complex communications system to coordinate space surveillance, catalog everything in orbit  | BF34  | Mar 4  | Micro-sized vacuum tubes encapsulated in a solid block reported at 1960 Western Joint Computer Conference   | CM100 | Jun 3  |
| Approaches to design and fabrication of microminiaturized digital computer for space applications                                 | TF95  | Apr 29 | New developments in computers - tunnel triodes and learning systems  | TF159 | Mar 11 | New trend towards circuit synthesis rather than circuit analysis noted at Conference on Active Networks and Feedback Systems                                    | BF44  | May 20 |
| Automated transistor assembly systems turns out npn alloy junction transistors for computers at rate of 1,800 per hour            | BW11  | Feb 19 | New look in data processing to emphasize information transmission by common carrier between computers  | BF38  | May 27 | Passive, reversible, distributed-coupling transducer introduced at 3rd International Congress on Acoustics  | CM73  | Feb 5  |
| Ballistic missile computer to be delivered for Sky Bolt guidance system   | EN11  | May 6  | Noise suppression factor display unit computes and automatically displays ratio of two time-varying quantities   | TF55  | Feb 5  | Quartz crystals and atomic clocks are subjects of major interest at 14th annual Frequency Control Symposium   | BF38  | Jun 24 |
| Biasing techniques permit small-area junction germanium diodes to switch microwaves in waveguides or transmission lines           | TF85  | Jan 15 | Oscilloscope check operation of memory drum used in air-traffic control system   | TF92  | May 20 | Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference  | TF39  | Mar 4  |
| Binary transceiver permits computers to talk to each other at 2,400 bits per sec over phone lines                                 | EN11  | Jun 3  | Parallel-sequential single-address, binary synchronous computer used in UDOFT (Universal Digital Operation Flight Trainer)   | BF44  | Apr 15 | Russia to host First International Congress on Automatic Control in June  | BF31  | Jun 10 |
| British and U.S. computermakers step up sales, promotional and service activities in Europe                                       | BF34  | Jan 8  | Parameter logic, register, adder, counter, translator and converter circuits for digital computers   | TF73  | Jun 3  | Solid-State Circuits Conference indicates microelectronics is moving rapidly out of research phase  | BF36  | Feb 12 |
| Ceramic-based microminiature adder for ballistic missile computer   | CM96  | Jan 1  | Permanent magnet memory unit (Twistor) ready for mass production   | BW11  | Jan 29 | Solid-state computer drawing only 100 watts big news at Western Joint Computer Conference   | BF35  | May 27 |
| Computer and automatic control uses in chemical, petroleum, railroad and broadcast industries discussed at winter meeting of AIEE | BF28  | Feb 19 | Precision turning device for finishing outer-diameters of memory drums   | PT126 | Apr 29 | Talks on high-frequency standards and calibrations to highlight technical sessions during 1960 Conference on Standards and Electronic Measurements              | BF53  | Jun 3  |
| Computer applications in SAC's Automatic Combat Control System (SACCS)  | BF36  | Mar 25 | Preview of computer sessions for forthcoming IRE International Show and Convention   | BF32  | Mar 11 | Technique for growing ribbon crystals of semiconductor material described at Solid-State Circuits Conference  | BF36  | Feb 12 |
| Computer calculates turbidimetric assays in automatic microbiological testing   | RD67  | Jan 8  | Reciprocal circuit gives output which is inversely proportional to input for use with analog computers and control systems   | TF92  | May 20 | Technique of vapor-growing high resistivity collector films on a low-resistivity substrate (revealed at IRE-AIEE conference) may have far reaching implications | EN11  | Jun 24 |
| Computer controlled processes still exploratory in Britain  | BF52  | May 13 | Rice Institute develops 8,192-word grid tube memory, expect expansion to 32,000 words  | BF59  | May 20 | Connectors for military applications (See p42, Dec 25, 1959 issue for 1st part of this article)   | TF90  | Jan 1  |
| Computer market opens for electroluminescent devices which perform logic and memory functions                                     | BW11  | Jan 29 | Russia's Setun computer using magnetic amplifiers operates on ternary rather than binary code  | BF11  | Feb 26 | CONSUMER PRODUCTS (See also specific product)   |       |        |
| Computer system for nuclear radiation alarm   | TF43  | Jan 22 | Sampling oscilloscope permits measurement of computer diode recovery times down to 500 picosec   | TF59  | Apr 8  | American-made all-transistor 8-m/f-m portable radio being test-marketed   | EN11  | Jun 10 |
| Computer technique of patent searching being tested by U.S. Patent Office   | RD124 | Feb 12 | Selecting power transistors to give required switching speed gain and current-carrying capacity in computer switching applications   | TF44  | Mar 4  | British tv and radio manufacturers break all sales records  | EN11  | Jan 15 |
| Computers and closed-circuit television are bringing office automation to Midwest banks and oil firms                             | EN11  | Jul 1  | Shaft-position disk encoder design eliminates positional ambiguities   | TF62  | Apr 22 | Commerce department forecasts \$2.2-billion consumer market in 1960   | BW11  | Jan 22 |
| Controlled-rectifier switch called Transwitch for computers turned off by small negative pulse                                    | TF71  | Jan 15 | Simulator for selecting best possible target among all in-range attackers  | RD76  | Jan 29 | Consumer electronics market for 1960  | SR49  | Jan 1  |
| Data communications systems linking distant computers use magnetic tape equipment   | BF44  | Jun 17 | Six ways to use magnetic core shift register elements  | TF80  | Jan 15 | Electronic oven uses microwave technique for assembly line production of pre-frozen meals in Holland  | BF47  | Jun 10 |
| Data processor built around two RCA 501 computers installed in bank   | EN11  | Feb 5  | Solid-state computer drawing only 100 watts big news at Western Joint Computer Conference  | BF35  | May 27 | F-m radio set sales to show gain of 50 percent over last year   | MR26  | Feb 12 |
| Digital and analog computermakers seek wide marketing through pricing and design flexibility                                      | BW11  | Mar 18 | Solid-state computer (STRETCH class) capable of completing 100 billion computations a day is announced   | EN11  | May 6  | Germans cut prices of radio and tv sets through improved production techniques  | BF49  | May 13 |
| Digital computer for industrial control functions being marketed  | EN11  | Jan 8  | Solid state high-speed printer-plotter prints and plots from computer-prepared magnetic tape   | EN11  | May 20 | India has decided to mass-produce cheap radio receivers (under \$25)  | BF52  | Jun 24 |
| Digital computers will soon control synthetic-rubber production   | BF35  | Jun 10 | Solid-state Univac III has processing speed nine times faster than Univac II   | EN11  | May 20 | Japan Electronics Parts Show featured new consumer products   | BW11  | Mar 18 |
| Drive-sampling core generators precisely defined strobes to give high s/n ratio in digital computer memories                      | TF72  | Mar 25 | Soviet semiconductor and computer production rates increase  | EN11  | Jan 29 | Japan reopens transistor radio exports under official controls  | EN11  | Jan 3  |
| Dutch market their first electronic computer which uses transistors and ferrite cores   | BW11  | Feb 12 | Spiral magnetic paths (Twistor) used in digital computer memory  | CM84  | Mar 25 | Japanese company signs contract with U.S. importer for \$1.4 million worth of consumer electronic products  | BF30  | Jun 17 |
| East Germans show Robotron R-12 electronic computer   | BF37  | Mar 18 |  |       |        | Japanese Industrial Trade Fair feature consumer items for U.S. market   | EN11  | Apr 29 |
| Eastern Joint Computer Conference indicates computers are heading for 1,000-Mc operation and microminiaturized circuits           | TF55  | Jan 29 |  |       |        | Japanese manufacturers fear their Government will set quota for export of transistor radio to U.S.  | BF48  | May 6  |
| Electron tube tester automatically prepares test data in digital form for computer analysis                                       | PT74  | Feb 5  |  |       |        | Japanese radios bought by appliance chain for sale in U.S.  | EN11  | Jan 1  |
| Electronic equivalent of neuron discussed at winter meeting of AIEE   | BF28  | Feb 19 |  |       |        |   |       |        |



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|---|-------|--------|------|--------|
| Japanese tv set sales increase rapidly  | EN11  | Jan 15 |      |        |
| Japan's electronics industry concentrating on production of color tv sets   | EN11  | Jun 24 |      |        |
| Manufacturers expect continued increase in tv and audio market  | BF39  | Feb 5  |      |        |
| Multi-junction drift-field transistor simplifies design of portable and auto radios   | CM82  | Apr 22 |      |        |
| Radio and TV production rise in Austria   |       |        |      |        |
| Radioholograph weighing 2.8 lb developed by Japanese  | EN11  | Jan 15 |      |        |
| Soviets plan to triple tv set production by 1965  | BF    | Jan 15 |      |        |
| Status of consumer products industry in Japan   | SR53  | May 27 |      |        |
| Transistorized tv receiver with 19-in. screen and rechargeable battery announced  | EN11  | Jun 3  |      |        |
| Transistorized tv set to be marketed by Japanese firm during 1960   | EN11  | Jan 8  |      |        |
| U. S. demand for f-m transistor radios boosts Japanese exports  | EN11  | Jan 29 |      |        |
| <b>CONTROL CIRCUITS AND SYSTEMS</b> (See also Servomechanisms)  |       |        |      |        |
| Applications of modern microwave equipment in radar, communications, computer, remote control and cooking                                     |       |        | SR67 | Jun 24 |
| Automated submarine uses electronic data processing and display to give ship, engineering, communications, weapons, and environmental control | BF28  | Jan 29 |      |        |
| Automatic control and supervisory system for gas compression station  | EN11  | Jun 10 |      |        |
| Automatic control holds voltage across weld constant  | PT102 | Jan 1  |      |        |
| Automatic control unit for operating dielectric strength testers  | PT88  | May 6  |      |        |
| Automatic fault-finding system for testing battery control center of Hawk Weapons System  | TF60  | Jun 17 |      |        |
| Computer and automatic control uses in chemical, petroleum, railroad and broadcast industries discussed at winter meeting of AIEE             | BF28  | Feb 19 |      |        |
| Control systems, solid-state electronics and electromagnetics featured at Seattle's 7th Regional IRE Conference                               | BF39  | Jun 10 |      |        |
| Control using voltage constraint and NOR logic improves consistency and reliability of spot welds   | TF48  | Feb 19 |      |        |
| Designing for space and weight saving with rotary solenoids   | CM66  | Mar 4  |      |        |
| Digital computer for industrial control functions being marketed  | EN11  | Jan 8  |      |        |
| Digital computers will soon control synthetic-rubber production   | BF35  | Jun 10 |      |        |
| Digital programmer automatically adjusts and controls furnace temperature during preparation of high purity materials                         | RD122 | May 27 |      |        |
| Electronics R&D in industrial and automatic controls in France, Italy and Japan   | SR75  | Feb 12 |      |        |
| Emphasis at Third International Instrument Electronics and Automation Show in Britain is on industrial controls, digital building blocks      | BF34  | Jun 17 |      |        |
| Five-transistor line voltage regulator uses Zener diodes  | TF64  | Feb 5  |      |        |
| Ground based missile roll control system uses photosensitive or infrared detectors  | RD80  | Mar 25 |      |        |
| Instruments, controls, electron microscopes, advanced communications are features of British Exhibition in New York                           | BF46  | Jun 24 |      |        |
| International Federation of Automatic Control Conference to open in Moscow next week  | BF34  | Jun 24 |      |        |
| Low-priced tape-controlled position system with nominal electrical accuracy of one part in 400,000 shown                                      | EN11  | May 13 |      |        |
| Magnetic noncontact shaft-position disk encoder offers high rotational speeds and reliability for computer, control and data logging uses     | RD114 | Apr 29 |      |        |
| Minuteman inertial guidance and flight controls get \$115-million boost   | EN11  | Jan 8  |      |        |
| Minuteman's guidance and control systems need reliable components for underground storage lasting years                                       | BF39  | Jun 17 |      |        |
| Multiplex circuits control robot which performs jobs in dangerously radioactive areas   | TF46  | Jan 22 |      |        |
| Pre-punched tape directs numerical machine tool control equipment automatically   | PC37  | Mar 18 |      |        |
| Production line tester for checking for contact chatter of electromagnetic relays uses thyatron timing circuit                                | TF94  | May 20 |      |        |
| Reciprocal circuit gives output which is inversely proportional to input for use with analog computers and control system                     | TF92  | May 20 |      |        |
| Remote control system for operating balloon-borne TV in Stratoscope I   | TF49  | Jun 17 |      |        |
| Remote transmitter generates control pulses during vertical blanking interval to control TV receiver  | TF79  | May 13 |      |        |
| Rugged ultrasonic transducer with novel vibrating system for indoor and outdoor remote control applications                                   | CM128 | May 27 |      |        |
| Russia to host First International Congress on Automatic Control in June  | BF31  | Jun 10 |      |        |
| Shaft-position disk encoder design eliminates positional ambiguities  | TF62  | Apr 22 |      |        |
| Solid state combustion control system for furnace developed using magnetic amplifiers   | EN11  | Jan 15 |      |        |
| Solid-state light dimmer weighing 1 1/2 pounds promises to cut industrial power bills by 30 percent   | BF39  | May 27 |      |        |
| Soviet automatic control system checks mass-produced parts using CRT scanning technique   | EN11  | Jan 15 |      |        |
| Steering transistor circuits control reversible decade counter generating error signals   | TF86  | Jan 1  |      |        |
| Stepping relay controls operation of lazy susan used to pace electronic assemblies  | PT76  | Feb 5  |      |        |
| Survey of United Kingdom's progress in industrial controls  | BF52  | May 13 |      |        |
| Thyatron control a milling machine by driving step motors in response to signals from a programmed tape                                       | TF174 | Mar 11 |      |        |
| Transistorized camera control circuit for rocket sled tests   | TF63  | Apr 1  |      |        |
| Transistorized circuits for guiding Able series space exploration probes  | TF60  | Jan 29 |      |        |
| Underwater camera flash and film-rewind circuits control picture taking at depth of 6 miles   | TF62  | Apr 8  |      |        |
| Controlled rectifier used in adjustable counting and timing circuits operating primarily as frequency dividers                                | TF61  | May 6  |      |        |

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| <b>CONVENTIONS</b> (See also Conferences and Meetings)   |        |        |
| Completely passive, balance modulator circuits using thin permalloy film described at 1960 Winter Convention on Military Electronics         | RD78   | Feb 26 |
| Highlights of 1960 IRE International Show and Convention - components, microminiaturization, instruments and production equipment            | BF47   | Apr 1  |
| How to see the IRE International Show and Convention   | BF47   | Mar 11 |
| IRE International Show and Convention gives U. S. Firms chance to check activities of foreign competitors                                    | BF36   | Mar 18 |
| NAB convention to discuss stereophonic and station automation equipment  | BF48   | Apr 1  |
| Preview of technical sessions for forthcoming IRE International Show and Convention  | BF32   | Mar 11 |
| Record registration expected for 1960 IRE International Show and Convention, also more technical and applications emphasis                   | BTW11  | Mar 11 |
| Space communications plans outlined at Armed Forces Communications and Electronics Association's 14th Convention                             | BF42   | Jun 10 |
| Sun-position sensor for establishing coordinate reference system on space vehicle reported at 1960 Winter Convention on Military Electronics | RD62   | Mar 4  |
| What exhibitors are saying about forthcoming IRE International Show and Convention   | BF30   | Mar 11 |
| <b>CONVERTERS</b>  |        |        |
| Americans study Soviet-built heat-to-electricity converter   | BF48   | Apr 1  |
| Analog-to-digital converter grown from pool of molten semiconductor materials  | BTW11  | Jan 29 |
| Cesium cell converter working at high temperatures produces significant amounts of a-c electricity   | CM78   | Jan 29 |
| Continued emphasis shown on analog-to-digital converters and readouts at IRE Show  | BF47   | Apr 1  |
| Converter for final indicator in noise suppression factor display unit   | TF55   | Feb 5  |
| Data reduction speeded using transistorized pulse-height-to-digital signal converter   | TF58   | Jan 8  |
| Experimental converter using tunnel diodes reported at 1960 Solid-State Circuits Conference  | TF39   | Mar 4  |
| Linear circuits used to obtain precise voltage regulation of output of transistorized d-c to a-c inverter                                    | TF61   | Apr 15 |
| Monoscope-camera system converts computer data into visual form on microfilm   | BF11   | Feb 26 |
| New developments in direct conversion of heat to electric power without using moving parts   | TF159  | Mar 11 |
| Parallel-to-serial converter for solid-state character generator used in VIDIAC (Visual Information Display and Control) system              | TF55   | Jun 10 |
| Parametron converter circuits for digital computers  | TF73   | Jun 3  |
| Saturating-core multivibrator used as power converter in portable battlefield radar  | TF67   | Mar 18 |
| Single-transistor circuit forms efficient photoflash power converter   | TF57   | Jan 22 |
| Thermoelectric generator built which delivers 5 Kw by direct conversion of heat into electricity without major moving parts                  | RD96   | Jun 3  |
| Transistorized command converter for attitude-control system in Able series space exploration probes   | TF60   | Jan 29 |
| Transistorized pulse height-to-time converter for earth satellite telemetry system   | TF82   | Jan 15 |
| Transmission line analogy for propagation in sandwiches of dielectric sheets and conducting films or grids used in polarization converters   | ERS100 | May 20 |
| What's new in image converters   | SR55   | Apr 29 |
| Convolution integrals, review of and graphical extension of  | TF68   | Apr 1  |
| <b>COOLING TECHNIQUES</b>  |        |        |
| Battelle Memorial Institute to research cooling techniques   | CM78   | Jun 17 |
| Beryllium oxide heat sink solves problem of heat removal from tube anode in r-f telemetry power amplifier                                    | CM110  | May 20 |
| Low-pressure air most efficient method to cool components during manual soldering of printed circuits  | PT104  | May 13 |
| Thermoelectric cooling materials with figure of merit between 4 and 5 expected to be available in two years                                  | TF159  | Mar 11 |
| Thermoelectric cooling modules for electronic components in R&D stage  | RD68   | Feb 5  |
| Thermoelectric cooling now possible using new semiconductor materials  | CM85   | Feb 26 |
| Thermoelectric transistor cooler using Peltier effect gives wide-range temperature control   | TF71   | Jan 15 |
| <b>CORES</b>   |        |        |
| Current pulse generator for testing ferrite memory cores   | TF80   | Jan 1  |
| Dutch market their first electronic computer which uses transistors and ferrite cores  | BTW11  | Feb 12 |
| Micro-sized Ferrite-core memory array for data processing system operates under environmental extremes                                       | CM98   | May 13 |
| Multi-aperture configuration simplifies core winding   | CM70   | Jan 8  |
| Six ways to use magnetic core shift register elements  | TF80   | Jan 15 |
| Corner reflector antenna offers high-gain, broad frequency response, narrow beam bandwidth and low back radiation                            | RD82   | May 6  |
| Correlators, polarity coincidence multiplier used as Cosmic rays at 18 to 22-mi altitudes to be studied by two operation Skyhook balloons    | EN11   | Jan 1  |
| Cosmic rays in upper atmosphere to be recorded by 800-lb block of film carried in Project Skyhook balloons                                   | RD94   | Jan 15 |
| Countermeasures, chart helps determine effectiveness of radar in presence of jamming   | TF76   | May 6  |
| Countermeasures, elliptically polarized X-band horn antenna has 3-db and 6-db beamwidths of 140 degrees for                                  | TF50   | Mar 4  |
| Countermeasures, invisible electronic shield for baffling radar and radar-guided missiles is reported  | EN11   | May 6  |
| Countermeasures, new applications of modern micro-waves in   | SR67   | Jun 24 |
| <b>COUNTERS</b>  |        |        |
| Adjustable counting and timing circuits operate primarily as frequency dividers using a controlled rectifier and saturable reactor           | TF61   | May 6  |

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|---|-------|--------|
| Battery-powered transistorized scale of 64-counter for measuring radioactive tracers improves reliability, reduces cost and weight            | TF74  | May 6  |
| Binary counter made by British using microminiaturization techniques  | TF71  | Jan 1  |
| Cold-cathode ring-counter drives numerical indicator  | TF80  | Apr 1  |
| Electronic methods for boosting conventional electromechanical counter speed  | TF112 | Feb 12 |
| Gas-filled stepping tubes   | TF46  | Feb 19 |
| Parametron counter circuits for digital computers   | TF73  | Jun 3  |
| Semiconducting industrial diamonds may find application as counters of radioactivity  | RD76  | Apr 22 |
| Small BEAM-X switch tube may claim extended market  | CM126 | Feb 12 |
| Steering transistor circuits control reversible decade counter generating error signals   | TF86  | Jan 1  |
| Transistor 7-stage binary counter for pulse-height-to-digital signal converter  | TF58  | Jan 8  |
| Typical semiconductor binary counter for microcircuits  | TF69  | May 13 |
| Tunnel diodes used in binary counters   | TF55  | Jan 29 |
| What's new in counting tubes  | SR55  | Apr 29 |
| Crash position indicator, aircraft, transistorized radio beacon designed to function as   | TF54  | Jan 22 |
| <b>CRYOGENICS</b>   |       |        |
| Cryogenic gyro under development; broad capabilities inherent in low-temperature devices spur further studies                                 | BF32  | Feb 5  |
| Cryostat development spurred with increased interest in cryogenic engineering   | BF32  | Feb 5  |
| Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference  | TF39  | Mar 4  |
| Superconductive gyro called feasible; use seen in subs and space vehicles   | BTW11 | Jan 29 |
| Superconductivity symposium disclosed basic work is still concentrating on cryotron, major problem is fabrication                             | EN11  | May 27 |
| Switching and storage circuits are made from crossed film cryotrons deposited on insulating superconductors                                   | TF55  | Jan 29 |
| Transistorized test set for measuring critical current in superconducting contacts of cryogenic circuits                                      | TF52  | Jan 22 |
| Crystal-controlled carrier-operated antinoise circuits for receivers feature simple design, low power drain, high dependability               | TF113 | May 27 |
| Crystal specifications for millimeter band  | CM68  | Feb 19 |
| Crystals, quartz, and atomic clocks are subjects of major interest at 14th annual Frequency Control Symposium                                 | BF38  | Jun 24 |
| Crystals, vhl quartz, improved lapping, polishing and base-plating developed for  | PT84  | Apr 22 |
| <b>D</b>  |       |        |
| Dacom, a monoscope-camera system for converting computer data into visual form on microfilm is announced                                      | BF11  | Feb 26 |
| Damping, built-in, controls violent motion imposed by vibration   | CM186 | Mar 11 |
| <b>DATA PROCESSING</b>  |       |        |
| (See also Computers & Information Retrieval)  |       |        |
| Automated submarine uses electronic data processing and display to give ship, engineering, communications, weapons, and environmental control | BF28  | Jan 29 |
| Binary data transceiver permits computers to talk to each other at 2,400 bits per sec over phone lines  | EN11  | Jun 3  |
| Business data processor reads records prepared in standard business terminology   | EN11  | May 13 |
| Data communications systems linking distant computers use magnetic tape equipment   | BF44  | Jun 17 |
| Data gathering and logging system monitors nuclear radiation levels and weather conditions  | RD64  | Jan 22 |
| Data processor built around two RCA 501 computers installed in bank   | EN11  | Feb 5  |
| Data reduction speeded using transistorized pulse-height-to-digital signal converter  | TF58  | Jan 8  |
| Electronics R&D in data processors in Sweden  | SR75  | Feb 12 |
| Expandable random-access solid-states memory for small digital computer used in business applications   | TF164 | Mar 11 |
| Experimental simulation of air traffic control data processing central for New York underway  | BF28  | Apr 8  |
| Fivefold increase in data processing sales for 1965   | BTW11 | Feb 19 |
| High-speed digital plotter cuts time for reducing telemetered data  | TF41  | Jan 8  |
| Indicator triode has fluorescent anode whose illumination is controlled by grid potential for direct data readout                             | TF52  | Feb 5  |
| Lab model thermoplastic recording system has radar, ir, information retrieval and data processor applications                                 | EN11  | Jan 22 |
| Magnetic noncontact shaft-position disk encoder offers high rotational speeds and reliability for computer, control and data logging uses     | RD114 | Apr 29 |
| Manufacturers give increased attention to developing small computers for small businesses   | BF39  | Apr 8  |
| Mark I perceptron demonstrates ability to learn the alphabet  | BF43  | Jun 24 |
| Match-head size tunnel diode holds great promise for missile, satellite and ultra-high-speed data processing applications                     | PC69  | Mar 4  |
| Micro-sized ferrite-core memory array for data processing system operates under environmental extremes  | CM98  | May 13 |
| Monoscope-camera system converts computer data into visual form on microfilm  | BF11  | Feb 26 |
| New business data processing system offers sophistication at moderate price   | BTW11 | Apr 15 |
| New data processing system for small business announced   | EN11  | Apr 22 |
| New IBM solid-state business data processor order by Southern Railway   | EN11  | Feb 12 |
| New look in data processing to emphasize information transmission by common carrier between computers   | BF38  | May 27 |
| Noise suppression factor display unit computes and automatically displays ratio of two time-varying quantities                                | TF55  | Feb 5  |

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|--|-------|--------|--|--------|--------|---|-------|--------|
| Selective calling system for aircraft data links removes necessity of continuously monitoring a communication channel                                    | TF108 | Apr 29 | Dielectric conductivity of materials increases as function of gamma dose rate  | TF69   | Apr 22 | Disk encoder, shaft-position, design eliminates positional ambiguities of   | TF62  | Apr 22 |
| Shaft-position disk encoder design eliminates positional ambiguities   | TF62  | Apr 22 | Dielectric diodes and triodes to control large amounts of current using thin insulating crystals of cadmium sulphide being developed   | BTW11  | Jan 22 | <b>DISPLAYS</b><br>(See also Indicators, Monitors, Readout Devices, Registers & Storage Devices)<br>Automated submarine uses electronic data processing and display to give ship, engineering, communications, weapons, and environmental control | BF28  | Jan 29 |
| Six ways to use magnetic core shift register elements  | TF80  | Jan 15 | End-fire arrays of high-dielectric ceramic rods give low silhouette and high vertical resolution in uhf region   | TF60   | Feb 5  | Cold-cathode ring-counter drives numerical indicator  | TF80  | Apr 1  |
| Small BEAM-X switch tube converts information rapidly from one form to another   | CM126 | Feb 12 | High-purity silicon dielectric for potting transistors is nonmelting and greaselike  | CM84   | Apr 15 | Continued emphasis shown on analog-to-digital converters and readouts at IRE Show   | BF47  | Apr 1  |
| Solid-state character generator (VIDIAC-visual information display and control) for data processing system developed                                     | EN11  | Apr 29 | Recent advances in preparing thin film ceramic dielectrics for microminiature capacitors   | CM96   | Jan 1  | Electroluminescent devices find expanded market in general informational display applications   | BTW11 | Jan 29 |
| Traffic Control Center (TCC) and Data Processing Subsystem (DPSS) for SAC's Automatic Combat Control System (SACCS)                                      | BF36  | Mar 25 | Temperature-insensitive solid-state dielectric diodes and triodes  | TF59   | Feb 26 | Ferroresonant storage and switching circuits combined with alpha-numeric indicator form electroluminescent typewriter   | TF49  | Jan 22 |
| Wall Street datacenter to be opened in March   | EN11  | Jan 1  | Transmission line analogy for propagation in sandwiches of dielectric sheets and conducting films or grids used in antennas  | ERS100 | May 20 | Gas-filled stepping tubes   | TF46  | Feb 19 |
| Decoder, eight-function, for remote pulse-coded fault alarm used in multihop microwave systems   | TF82  | Jan 1  | <b>DIGITAL TECHNIQUES</b><br>(See also Computers, Data Processing, Logic Circuits, Memories, Pulse Techniques & Registers)<br>Data reduction speeded using transistorized pulse-height-to-digital signal converter | TF58   | Jan 8  | High-speed repetitive-operation analog computers permit continuous plot displays  | EN11  | Feb 19 |
| Decoder, transistorized, for selective calling system used with aircraft data links  | TF108 | Apr 29 | Digital oscilloscope for direct readout of amplitudes and waveforms announced  | EN11   | Feb 5  | Indicator triode has fluorescent anode whose illumination is controlled by grid potential for direct data readout   | RD52  | Feb 5  |
| Decoding and deflection circuit for monoscope tube character generator used as digital computer readout device   | TF117 | Feb 12 | Digital programmer automatically adjusts and controls furnace temperature during preparation of high-purity materials  | RD122  | May 27 | Monoscope tube generates characters for direct readout on a cro or on paper of digital computer output  | TF117 | Feb 12 |
| Deflection and decoding circuit for monoscope tube character generator used as digital computer readout device   | TF117 | Feb 12 | Digital sampler for measurement of axis-crossing intervals for design of weak signal detectors   | TF88   | Jun 3  | Noise suppression factor display unit computes and automatically displays ratio of two time-varying quantities  | TF55  | Feb 5  |
| Delay devices for modern microwave applications  | SR67  | Jun 24 | Digital system for controlling robot which performs jobs in dangerously radioactive areas  | TF46   | Jan 22 | Small BEAM-X switch tube may claim extended market  | CM126 | Feb 12 |
| Demerinalizer, recirculating, for making water virtually free of particulate matter, dissolved solids and gases  | PT132 | May 27 | Electron tube tester automatically prepares test data in digital form for computer analysis  | PT74   | Feb 5  | Solid-state character generator (VIDIAC-visual information display and control) for data processing system developed  | EN11  | Apr 29 |
| Demodulator, transistorized, for selective calling system used with aircraft data links  | TF108 | Apr 29 | Emphasis at Third International Instrument Electronics and Automation Show in Britain is on industrial controls, digital building blocks, High-speed digital plotter cuts time for reducing telemetered data       | BF34   | Jun 17 | Solid-state character generator for VIDIAC (Visual Information Display and Control) System  | TF55  | Jun 10 |
| Demodulator, transistorized f-m, for tape target classifier used to train land-based sonar student operators   | TF65  | Mar 25 | Monoscope tube generates characters for direct readout on a cro or on paper of digital computer output   | TF41   | Jan 8  | Visual display system for SAC's Automatic Combat Control System (SACCS)   | BF36  | Mar 25 |
| Demodulators for linear differential transformers  | ERS92 | Jun 3  | Navy begins test on UDQFT (Universal Digital Operation Flight Trainer) used to simulate complicated jet flight conditions  | BF44   | Apr 15 | What's new in cathode-ray, storage, counting tubes  | SR55  | Apr 29 |
| Demodulators, transistorized, for attitude-control system in Able series space exploration probes  | TF60  | Jan 29 | Oscilloscope with direct digital readout of amplitude and duration of pulse signals reduce operator errors, cut measurement time   | BF30   | Mar 4  | Distance measuring equipment, use of selective calling system for data link in high-density traffic   | TF108 | Apr 29 |
| Dental anesthetic device using stereo sound placed in production   | EN11  | May 27 | Polarity coincidence multiplier detects weak low-frequency signal in high-noise background   | TF67   | Jan 29 | Distributed-constant semiconductor R-C networks for microcircuits   | TF69  | May 13 |
| Depth indicator, portable transistorized, for locating fish doesn't need crt   | TF50  | Feb 5  | Sampling attachment for conventional oscilloscopes can resolve rise times of 1/3 nanosec with repetition rates up to 50 Kc   | TF96   | Jun 24 | Distributor circuits, electronic, for teleprinter developed in Japan and India  | BF31  | Jun 10 |
| Destriau effect, definition of   | TF71  | Feb 26 | Thyatron control a milling machine by driving step motors in response to signals from a programmed tape  | TF174  | Mar 11 | Distributors place in 1960 electronics sales market   | SR49  | Jan 1  |
| <b>DETECTORS</b>   |       |        | Transistorized slicer measures amplitude probability density functions   | TF70   | Jan 29 | Dividers, designing frequency-independent current types   | ERS74 | Apr 8  |
| Automatic gas-fume detector alarms Loran, radio-telephones, direction finders, and depth sounder fish finders make up new \$10-million small boat market | BF30  | Jan 22 | Voice-visual aircraft communications system (DISCOM) using canned book message transmitted by digital methods scheduled for delivery   | BTW11  | Mar 25 | Doppler principles involved in designing portable radar for detecting enemy movements during battle-field deployment  | TF67  | Mar 18 |
| Cadmium sulfide field-effect transistor used experimentally as radiation detector  | BF42  | Mar 18 | <b>DIODE CIRCUITS</b><br>Balanced-bridge and semiconductor diode circuits for one-tube oscillator-mixers in tv and f-m tuners  | TF76   | Jan 15 | Dosimetry, needle glass fluoresces in proportion to radiation received  | TF74  | Mar 18 |
| Cadmium sulphide field-effect phototransistors used successfully in oscillator, multivibrator, amplifier and radiation detector circuits                 | EN11  | Feb 26 | Biasing techniques permit small-area junction germanium diodes to switch microwaves in waveguides or transmission lines  | TF85   | Jan 15 | DPSS (Data Processing Subsystem) for SAC's Automatic Combat Control System (SACCS)  | BF36  | Mar 25 |
| Characteristics of thermal, photoconductive photovoltaic and photoelectromagnet infrared detectors   | TF72  | Apr 1  | Magnetic shift resistor current-operated voltage-controlled and wide-width core-diode elements   | TF80   | Jan 15 | Drafting procedures being streamlined to expedite R&D production  | PT98  | Mar 18 |
| Digital sampler for measurement of axis-crossing intervals for design of weak signal detectors   | TF88  | Jun 3  | Tunnel diode logic circuits—modes of operation and effect of circuit component tolerances  | TF103  | Jun 24 | Drilling, electron beam metalworking equipment for Driver for expandable random-access solid-state memory   | PT86  | Feb 26 |
| Electronic highway control using wire loops, guidance cable and transistorized detector demonstrated   | BF40  | Jun 17 | <b>DIODES</b><br>Accurate and stable pulse height discriminator uses forward-biased shunt diode in input circuit   | TF89   | May 20 | Earth, propagation of electromagnetic waves through subsurface of earth being studied for AF  | BTW11 | Mar 4  |
| Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector                                   | TF58  | Feb 19 | American and Japanese firms agree to share techniques of design and manufacture of diodes  | BF32   | Apr 8  | Earth, rotation of measured by precision Atlas guidance system  | EN11  | Jun 17 |
| Ground based missile roll control system uses photosensitive or infrared detectors   | RD80  | Mar 25 | British approaches to producing flat-plate diodes for microminiaturization   | TF71   | Jan 1  | <b>EDUCATION</b> (See also Manpower)<br>Company combats shortage of semiconductor engineers by giving series of in-depth, 13-week courses   | BF44  | Jun 17 |
| How to determine whether to use visual, ir or radar detection in fog or rain   | T64   | Jan 29 | Cesium diodes with efficiencies of 15 to 20 percent are expected to be available in two years  | TF159  | Mar 11 | Doctoral program in engineering and physical sciences to be developed at Arizona State University   | BF53  | Feb 12 |
| Phase detector for precision phase meter used for c-w and pulsed uhf   | TF54  | Mar 4  | Color code standards for designating semiconductor diode and rectifier types adopted   | CM83   | Apr 22 | Electronics R&D in education in Italy and Switzerland   | ST75  | Feb 12 |
| Photo cell detection circuit for inspecting transistors assembled by fully automatic electro-mechanical machine  | TF57  | Mar 25 | Gallium arsenide diodes with low noise figures at 10, 16 and 24 kmc and upper operating temperature of 300 C developed   | EN11   | Jan 1  | Engineering education discussed at winter meeting of AIEE   | BF28  | Feb 19 |
| Polarity coincidence multiplier detects weak low-frequency signal in high-noise background   | TF67  | Jan 29 | Gallium phosphide diodes and switching devices withstand 1,500 C   | CM71   | Jan 8  | Guggenheim Fellowship winner works in Britain's Atomic Energy Research Establishment  | PC39  | Jun 24 |
| Principle of proximity detectors used in electronic wire gage for nondestructive measurement of wire thickness   | TF109 | Feb 12 | Germanium diffused base transistor with open circuit base connection serves as inductive negative resistance diode in microcircuits  | TF60   | Apr 22 | Minnesota governor indicates expanding universities, skilled manpower and favorable financial climate stimulates area's growth  | BF30  | Jun 17 |
| Probe-type detector for checking for presence of gas shown at IRE Show   | BF47  | Apr 1  | Half-amp silicon diodes with 0.3 usec recovery time in volume production for computers   | CM105  | Jan 15 | Project Vanguard annual graduate fellowship established at Johns Hopkins  | BF59  | May 20 |
| Rapid scan spectrometer detects and analyzes infrared energy radiated during power flight portions of missile trajectory                                 | TF86  | May 20 | Sampling oscilloscope permits measurement of computer diode recovery times down to 500 picosec   | TF59   | Apr 8  | Sixteen colleges in six midwestern states designated as communications network for Midwest Program on Airborne Television Instruction   | BF59  | May 20 |
| Sensitive flaw detector system overcomes noise problem of photomultipliers to find defects of paper  | TF64  | Apr 15 | Temperature-insensitive solid-state dielectric diodes and triodes  | TF59   | Feb 26 | Stanford give financial aid to support Stanford solid-state research  | BF45  | Jan 1  |
| Servo detector for automatic survey system used to measure roughness of airport runways  | TF54  | Jun 17 | Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications   | BF36   | Feb 26 | Two-ton magnetic unit studied by members of JETS (Junior Engineering Tech Society)  | PC48  | May 6  |
| Silicon photo cells used as detectors in projector optical sound track pickup  | PC68  | Jan 8  | Use of gallium phosphide in point-contact devices points to development of gallium phosphide diodes  | CM108  | May 20 | Use of commercial uhf tv sets for reception of tv signals from aircraft for educational purposes discussed at winter meeting of AIEE  | BF28  | Feb 19 |
| Silicon pn junctions used as particle detectors  | RD74  | Apr 22 | Varactor diodes available in experimental quantities, used for high-efficiency subharmonic oscillators in microwave computers  | CM131  | May 27 | Electret combined with photoconductor form photo-rectifier according to paper given at 1960 Solid-State Circuits Conference   | TF39  | Mar 4  |
| Solid-state radiation detector made of doped silicon gives new speed and accuracy to particle analysis   | BTW11 | Feb 5  | Wheel-shaped component carrier in oven makes 150 C tests of silicon diodes   | PT130  | Feb 12 | Electrical, magnetic and optical properties of solid state phenomena to be studied in RCA's proposed research laboratory in Japan   | EN11  | Jun 24 |
| Step-van truck with instruments for measuring air pollution developed  | PC48  | Feb 12 | Direction finders, together with automatic gas-fume detector alarms, Loran, radiotelephones, and depth sounder fish finders make up new \$10-million small boat market   | BF30   | Jan 22 | Electroacoustics R&D in Switzerland   | SR75  | Feb 12 |
| Three infrared and visual detectors under development may change design concepts in advanced military and industrial equipment                           | EN11  | May 27 | Direction finding, broadband log-periodic antennas for   | TF58   | Jun 17 | Electrode effects on the conductivity of organic hydrocarbons reported at Conference on Electronic Conductivity in Organic Solids   | RD127 | May 27 |
| Transistorized boxcar detector for portable battle-field radar   | TF67  | Mar 18 | DISCOM (digital selective communications) for sending canned messages from aircraft scheduled for delivery   | BTW11  | Mar 25 | <b>ELECTROLUMINESCENT DEVICES</b><br>(See also Displays)<br>Electroluminescent device output to increase for a wide variety of military and civilian markets  | BTW11 | Jan 29 |
| Transistorized peak amplitude detector for tape target classifier used to train land-based sonar student operators                                       | TF65  | Mar 25 | Discriminator, accurate and stable pulse height, uses forward-biased shunt diode in input circuit  | TF89   | May 20 | Ferroresonant storage and switching circuits combined with alphanumeric indicator form electroluminescent typewriter  | TF49  | Jan 22 |
| Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches preset level in nuclear-powered Navy vessels                         | TF43  | Jan 22 | Discriminator circuit measures carrier frequency deviation caused by wow and flutter in tape recorder  | TF100  | Jun 24 | Increased production, marketing activity forecast for electroluminescent devices  | BTW11 | Apr 1  |
| Uncoated indium-antimonide photoelectromagnetic detector responds to long infrared wavelengths   | TF62  | Mar 25 | Disk encoder, magnetic noncontact shaft-position disk, offers high rotational speeds and reliability for computer, control and data logging uses   | RD114  | Apr 29 | Power amplifiers using electro-optical effects handle various combination of electric, radioactive and thermal power  | TF71  | Feb 26 |
| Undersea oil lines detected by metal locator which generates electromagnetic field   | BF57  | Jan 15 |  |        |        |   |       |        |
| What's new in radiation detecting tubes  | SR55  | Apr 29 |  |        |        |   |       |        |
| X-ray detector being built to find troubles in high-voltage mercury-arc tubes  | RO87  | Mar 25 |  |        |        |   |       |        |
| DEW line, radar target simulator to train operators for  | PC64  | Jan 8  |  |        |        |   |       |        |
| <b>DILECTRICS</b>  |       |        |  |        |        |   |       |        |
| Automatic control unit for operating dielectric strength testers   | PT88  | May 6  |  |        |        |   |       |        |
| British approaches to producing conductors for microminiaturization  | TF71  | Jan 1  |  |        |        |   |       |        |
| Dielectric absorption in capacitors  | RD78  | Jun 10 |  |        |        |   |       |        |
| Dielectric absorption in capacitors determined by experimental current-measuring technique   | RD90  | Mar 18 |  |        |        |   |       |        |



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|--|-------|--------|---|-------|--------|--|-------|--------|
| What's new in electroluminescent displays for cathode ray tubes  | SR55  | Apr 29 | Ferries, magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics | RD104 | May 20 | French compatible color tv system features sequential transmission of chrominance, uses one-line memory in receiver                        | TF57  | May 6  |
| Electrolytic recording used in high-speed digital plotter  | TF41  | Jan 8  | Ferrites, micro-sized ferrite-core memory array for data processing system operates under environmental extremes  | CM98  | May 13 | French President DeGaulle impressed with range of test instruments made by manufacturer  | EN11  | May 13 |
| Electromechanical assembler of alloy-junction transistors is fully automatic   | TF57  | Mar 25 | <b>FERROELECTRIC AND FERROMAGNETIC DEVICES</b><br>Completely passive, balance modulator circuits using thin permalloy film described at 1960 Winter Convention on Military Electronics    | RD78  | Feb 26 | French President DeGaulle impressed with range of test instruments made by manufacturer  | PC37  | May 13 |
| Electrometer and photomultiplier measure fluorescence of glass dosimetry needle to determine radiation exposure in human body  | TF74  | Mar 18 | Electronics R&D in ferromagnetism in Israel   | SR75  | Feb 12 | German Industries Fair of 1960 shows German electronics comes of age   | BF49  | May 13 |
| Electron beam device accurately drills small holes in evaporating masks used in microminiaturization   | TF71  | Jan 15 | Ferroelectric capacitor tuning devices for frequency synthesizer gives stable, high-accuracy receiver and transmitters  | RD122 | Feb 12 | Ghana orders \$1.68 million worth of shortwave broadcast equipment from British firm   | EN11  | Jan 1  |
| Electron beam metalworking equipment for use in surface treating, welding, milling or drilling   | PT86  | Feb 26 | NBS discovers a series of ceramic materials that exhibit simultaneously both ferroelectric and ferrimagnetic properties   | CM128 | Feb 12 | Guggenheim Fellowship winner works in Britain's Atomic Energy Research Establishment   | PC39  | Jun 24 |
| Electron bombardment used to make plastic type transistors by Soviet scientist   | EN11  | Jan 1  | Ferrous-oxide storage and switching circuits combined with alphanumeric indicator form electroluminescent typewriter  | TF49  | Jan 22 | Hungarian automatic telephone-answering tape recorder shown at Leipzig Fair  | BF47  | May 27 |
| Electronic shield for baffling radar and radar-guided missiles is reported   | EN11  | May 6  | <b>FILTERS</b><br>Ceramic filters improve selectivity of multiband communications-type receiver   | CM84  | Feb 26 | Industrial diamonds with semiconducting properties made in South Africa  | RD76  | Apr 22 |
| Electronics Research & Development Around the World - Australia, England, France, Israel, Italy, Japan, Sweden and Switzerland                                       | SR93  | Feb 12 | Charts normalized for frequency make it easy to determine network component values for frequency-rejection filters  | ERS67 | Jun 17 | Instrument fault in orientation system causes Soviet spaceship backfire  | EN11  | Jun 10 |
| Electroplating, techniques for solving tin-nickel plating problems   | PT86  | Feb 26 | Etched-board transmission line input bandpass filter for uhf fm receiver of camera control system used in rocket sled tests   | TF63  | Apr 1  | Instrument manufacture in India has more than trebled in value in last three years   | BF52  | Jun 24 |
| Electrostatic analyzer for double-focusing mass spectrometer   | RD74  | Jan 29 | Graphical extension of transform techniques clarifies operation of carrier elimination filter   | TF68  | Apr 1  | Instruments, controls, electron microscopes, advanced communications are features of British Exhibition in New York                        | BF46  | Jun 24 |
| Electrostatic focusing of cathode ray tubes  | SR55  | Apr 29 | Multichannel filters for modern microwave applications  | SR67  | Jun 24 | International cooperation in geophysics put on permanent basis   | EN11  | Jan 8  |
| Encapsulant remains serviceable despite continuous exposure to 60 to 250 C temperature   | CM84  | Apr 15 | Procedure for designing Zobel filters made straightforward by use of Caue parameters for specified stopband attenuation   | TF96  | May 20 | International Federation of Automatic Control Conference to open in Moscow next week   | BF34  | Jun 24 |
| Encoder, magnetic noncontact shaft-position disk, offers high rotational speeds and reliability for computer, control and logging data uses                          | RD114 | Apr 29 | Selecting R-C values for filters characterized by no output at infinity frequency or zero frequency   | TF82  | May 13 | International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations                          | BF33  | Feb 19 |
| Encoder, shaft-position disk, design eliminates positional ambiguities   | TF62  | Apr 22 | Standardized low-pass filter-amplifier for sub-audio frequencies used in missile telemetry  | TF88  | Jan 15 | IRE International Show and Convention gives U.S. Firms chance to check activities of foreign competitors                                   | BF36  | Mar 18 |
| England - research and development currently underway in   | SR75  | Feb 12 | Tuning forks used as high-Q resonant elements for audio-frequency narrow-band electro-mechanical filters  | CM108 | May 20 | Israel to make a decision for or against establishing nation-wide tv net in 1960   | BF31  | Jan 22 |
| Environmental control, automated submarine uses electronic data processing and display to give   | BF28  | Jan 29 | Fixturing, portable transistorized depth indicator for fixture, self-compensating tests 24 capacitors at a time in an environmental test chamber  | TF50  | Feb 5  | Japan adopts American NTSC standards to pave way for marketing transistorized color, and black and white tv set in U.S.                    | BF27  | Jan 22 |
| Environmental forecasts could double effectiveness of undersea fleet according to oceanographic research findings  | BF36  | Jan 22 | Flash tube circuit for investigating possibilities of using plasma to propel space vehicles   | TF66  | Jun 10 | Japan boosts tv set output for export  | PC48  | Feb 26 |
| Environmental testing device materials tested at -460F   | PC39  | Jan 29 | Flip-flop circuit uses indicator diode with fluorescent anode whose illumination is controlled by grid potential  | TF52  | Feb 5  | Japan Electronics Parts Show featured new consumer products  | BTW11 | Mar 18 |
| Environmental testing self-compensating fixture tests 24 capacitors at a time in an environmental test chamber   | PT72  | Jan 22 | Flip-flops using tunnel diodes reported at 1960 Solid-State Circuits Conference   | TF39  | Mar 4  | Japan reopens transistor radio exports under official controls   | EN11  | Jun 3  |
| Environmental unit, mobile, uses controller-recorder to program temperature during test of missile components  | PC34  | Jun 17 | Flow rate measurement of a variety of fluids made by detecting nuclear magnetic resonance   | TF77  | Apr 1  | Japanese black-and-white and color tv sets arriving in quantity in U.S. ports  | BF32  | Apr 29 |
| Environments, dynamic, what designers should know about performance of missile components in   | TF102 | Apr 29 | Fluorescent lamps in British railway coaches operate from transistorized inverter power by 24-v battery   | TF58  | Feb 5  | Japanese Company signs contract with U.S. importer for \$1.4 million worth of consumer electronic products                                 | BF30  | Jun 17 |
| Epitaxial technique (vapor-growing high resistivity collector films on low-resistivity substrate) revealed at IRE-AIEE conference may have far reaching implications | EN11  | Jun 24 | Focusing techniques for linear-beam microwave tubes   | SR55  | Apr 29 | Japanese develop new computer logic - high-speed parallel adder-accumulator and shifter  | BF36  | Apr 15 |
| ETL (Etching by Transmitted Light) technique improves fabrication of micro-alloy diffused base transistors (MADT)  | BTW11 | Apr 1  | Fog, how to determine whether to use visual, ir or radar detection in   | TF64  | Jan 29 | Japanese exports to U.S. rose from 22 million in 1958 to 76 million in 1959  | MR26  | Apr 29 |
| Etingshausen effect, definition of   | TF71  | Feb 26 | <b>FOREIGN ELECTRONICS</b><br>(See also Business, Exports & Imports)  |       |        | Japanese Industrial Trade Fair feature consumer items for U.S. market  | EN11  | Apr 29 |
| Evaporating masks, electron beam device accurately drills holes in   | TF71  | Jan 15 | American and Japanese firms agree to share techniques of design and manufacture of diodes   | BF32  | Apr 8  | Japanese-made tropospheric scatter communications system used by U.S. forces in Japan  | EN11  | Jan 29 |
| Evaporation machine used by British to produce microminiature circuits   | TF71  | Jan 1  | Americans study Soviet-built heat-to-electricity converter  | BF48  | Apr 1  | Japanese manufacturers fear their government will set quota for export of transistor radio to U.S.   | BF48  | May 6  |
| <b>EXHIBITIONS</b>   |       |        | Biocurrents in human cells being studied by Soviet Scientist with microelectrode  | EN11  | Mar 4  | Japanese radios bought by appliance chain for sale in U.S.   | EN11  | Jan 1  |
| French and British instrument companies to hold exhibitions in Moscow  | EN11  | Mar 4  | Britain and U.S. government agencies coordinate their time and frequency signal broadcasts  | RD81  | Jun 10 | Japanese to emphasize development of crt tubes for color tv, video tape recorders, aviation and medical electronics and microwave tubes    | EN11  | Feb 12 |
| German Industries Fair of 1960 shows German electronics comes of age   | BF49  | May 13 | British and U.S. computer makers step up sales, promotional and service activities in Europe  | BF34  | Jan 8  | Japanese to market stereo 4-channel tape recorder in U.S.  | EN11  | Jan 22 |
| Hungarian automatic telephone-answering tape recorder shown at Leipzig Fair  | BF47  | May 27 | British approaches to microminiaturization  | TF71  | Jan 1  | Japanese tv set sales increase rapidly   | EN11  | Jan 15 |
| Instruments, controls, electron microscopes, advanced communications are features of British Exhibition in New York  | BF46  | Jun 24 | British electronics boom continues  | BF37  | Mar 18 | Japanese young women electronics production workers: a close-up  | BF36  | Apr 1  |
| Next year's World Trade Fair exhibitors to put more stress on science and technology   | BF46  | May 27 | British multipler system for bilingual broadcasts or convention stereophonic transmissions  | TF87  | Jun 3  | Japan's electronics industry concentrating on production of color tv sets  | EN11  | Jun 24 |
| Transistorized gear stars at National Motor Boat Show  | BF30  | Jan 22 | British tv and radio manufacturers break all sales records  | EN11  | Jan 15 | Leo Esaki joins IBM as resident consultant   | EN11  | Feb 5  |
| <b>EXPORTS (See also Business)</b>   |       |        | Computers and closed-circuit television are bringing office automation to Mideast banks and oil firms   | EN11  | Jul 1  | Low-grade silicon in demand in Europe  | CM68  | Jan 8  |
| American exports of precision instruments in 1959 up \$7 million over 1958   | EN11  | Mar 11 | Counterattacks to petition for import curbs on Japanese transistors are registered in Washington  | BF42  | Jan 15 | Micron-thick permalloy plated onto copper basis of new thin film logic and memory devices developed in Japan                               | EN11  | Apr 1  |
| Electronics industry exports for 1959 are \$415 million, down 3% percent from 1958   | MR26  | May 6  | Czechoslovakian transistor cardio-tachometer in use   | BF28  | Jan 1  | More U.S. gear going into second generation of British missiles  | BF32  | Mar 25 |
| Export Control Act extension in 1960 likely  | BF28  | Jan 1  | Dutch market their first electronic computer which uses transistors and ferrite cores   | BTW11 | Feb 12 | Nassau terminus of 186-mile over-the-horizon troposcatter link to Bahamas completed  | PC39  | Feb 5  |
| Export picture for electronics industry in 1960  | SR49  | Jan 1  | East Germans expect \$175 million sales from western customers, publicize a-c voltmeter and Robtron computer  | BF37  | Mar 18 | NATO's 4, 000-mile tropospheric scatter system Project Ace High to connect all major radar outposts and operational headquarters in Europe | BF38  | Apr 29 |
| Japan boosts tv set output for export  | BF48  | Feb 26 | Electronic distributor circuits for teleprinter developed in Japan and India  | BF31  | Jun 10 | New radar and communications system guard Korea against surprise invasion  | BF40  | May 20 |
| Japan reopens transistor radio exports under official controls   | EN11  | Jun 3  | Electronic Manufacturing Association formed in Israel, includes also government and local scientific institutions   | BF53  | May 6  | One company's approach to beefing up electronics export trade  | EN11  | Apr 29 |
| Japanese manufacturers fear their government will set quota for export of transistor radio to U.S.   | BF48  | May 6  | Electronic oven uses microwave technique for assembly line production of pre-frozen meals in Holland  | BF47  | Jun 10 | Over 1,000 British design engineers crowd one-day special symposium on Electronic Equipment Reliability                                    | BF34  | Jun 10 |
| Japan's export picture   | SR53  | May 27 | Electronics in Japan-background of industry, products and practices, research and engineering, and marketing and export   | SR53  | May 27 | Patent protection in Russia obtainable only by applying for Russian patents  | EN11  | Jan 8  |
| One Company's approach to beefing up electronics export trade  | EN11  | Apr 29 | Electronics research and development around the world   | SR75  | Feb 12 | Pay tv in Canada uses direct wire to give choice of three channels to viewers  | BF52  | Mar 18 |
| Eye, electronic tonometer detects glaucoma by measuring pressure in  | TF115 | Feb 12 | Emphasis at Third International Instrument Electronics and Automation Show in Britain is on industrial controls, digital building blocks  | BF34  | Jun 17 | Plastic type transistor developed by Soviet Scientist  | EN11  | Jan 1  |
| <b>F</b>   |       |        | English radars being ordered by and going on tour to other European countries   | BF53  | Mar 11 | Producing germanium from flue dusts of certain kinds of coal   | CM121 | Jun 24 |
| Fabrication techniques for semiconductor networks used in microcircuits  | TF69  | May 13 | Europe pushes plans for supranational automatic air traffic control system (SATCO)  | BF40  | Apr 22 | Proton synchrotron of European Organization for Nuclear Research in operation  | EN11  | Jan 1  |
| Faceplate improvement of cathode ray tubes   | SR55  | Apr 29 | Export-import picture for electronics industry in 1960  | SR49  | Jan 1  | Radio and TV production rise in Austria  | EN11  | Jun 10 |
| Facsimile now considered as supplement to regular civilian amateur activities  | BF48  | Feb 12 | FAA rules out British Decca Mark X hyperbolic system for navigation   | BTW11 | Jan 22 | Radiophograph weighing 2.8 lb developed by Japanese  | EN11  | Jan 15 |
| Facsimile research spreads, faster transmission and privacy are goals  | BF51  | Apr 8  | Five different electronic firms in five European countries to produce Hawk air defense guided missile   | BF33  | May 6  | RCA to open research laboratory in Japan, will study solid-state phenomena   | EN11  | Jun 24 |
| Facsimile systems, U.S. Weather Bureau completing installation of advanced, high-speed recording equipment for high-altitude weather map network                     | BF49  | May 6  | French and British instrument companies to hold exhibitions in Moscow   | EN11  | Mar 4  | Red China gives 50-Kw shortwave broadcasting station to Cambodian government   | EN11  | Jun 3  |
| FAST (flight advisory service test) portion of Project Trailsmoke to operationally evaluate use of SAGE computer for air traffic control use                         | EN11  | May 6  |   |       |        | Regular stereophonic broadcasting to be initiated in Canada  | BF45  | Jan 15 |
| Fathometer, portable transistorized, for locating fish doesn't need crt  | TF50  | Feb 5  |   |       |        | Report on semiconductor plastics - in U.S.S.R. and in U.S.A.   | CM68  | Jan 22 |
| Feed, auto-track, for circularly-polarized, high-gain antenna for tracking Tiros meteorological satellite  | TF57  | Apr 15 |   |       |        | Russia to host First International Congress on Automatic Control in June   | BF31  | Jun 10 |
| Feedback circuit design for high-frequency, high power transistor oscillator   | TF52  | Jan 8  |   |       |        | Russians develop photoelectric blood pressure meter  | RD75  | Jun 17 |
| Ferrite devices for modern microwave applications  | SR67  | Jun 24 |   |       |        | Russia's Setun computer using magnetic amplifiers operates on ternary rather than binary code  | BF11  | Feb 26 |
| Ferrites, broadband microwave amplifier uses negative resistance of tunnel diode in combination with nonreciprocal ferrite attenuation                               | CM84  | Mar 25 |   |       |        | Solar battery used to power Japanese lighthouse has operated successfully for six months   | BF57  | May 13 |
| Ferrites, devices, Dutch market their first electronic computer which uses transistors and ferrite cores   | BTW11 | Feb 12 |   |       |        | Soviet Academy of Sciences changing some of its research approaches  | BF43  | Apr 1  |
|  |       |        |   |       |        | Soviet automatic control system checks mass-produced parts using crt scanning techniques   | EN11  | Jan 15 |





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| Impedance matching transmitter to antenna using circle diagrams   | ERS73 | Jun 10 | Biomedical space flight instrumentation system used on racing car crews   | RD185 | Mar 11 | Portable current-path verifier for aircraft applications identifier individual wires  | PC51  | Jan 15 |
| <b>IMPORTS</b> (See also Business, Exports & Foreign Electronics)   |       |        | Bridge circuit measures pulse response of armatures to pinpoint faults during production runs   | TF70  | Jun 70 | Portable transistorized depth indicator for locating fish doesn't need crt  | TF50  | Feb 5  |
| Counterattacks to petition for import curbs on Japanese Company signs contract with U.S. importer for \$1.4 million worth of consumer electronic products | BF30  | Jun 17 | Current pulse generator for testing ferrite memory cores  | TF80  | Jan 1  | Portable transistorized sound level meter for measuring noise   | TF64  | Jun 17 |
| Import picture for electronics industry in 1960   | SR49  | Jan 1  | D-c transistor amplifier for measurement of low amplitude long-period surface waves of ocean  | TF85  | Jan 1  | Pulsed x-ray pencil beam gages thickness of hot and cold rolled metals  | PC62  | Jan 22 |
| IRE International Show and Convention gives U.S. Firms chance to check activities of foreign competitors  | BF36  | Mar 18 | Digital oscilloscope for direct read-out of amplitudes and waveforms announced  | EN11  | Feb 5  | Radiation-operated fuel gage for missiles and aircraft  | RD117 | Apr 29 |
| Japan adopts American NTSC standards to pave way for marketing transistorized color, and black and white tv set in U.S.                                   | BF27  | Jan 22 | Digital sampler for measurement of axis-crossing intervals for design of weak signal detectors  | TF88  | Jun 3  | Radiosotope density altimeter is designed for missiles and fast new aircraft  | BF37  | Jan 8  |
| Japanese black-and-white and color tv sets arriving in quantity in U.S. ports   | BF32  | Apr 29 | Double focusing mass spectrometer going into satellite to measure elements in the exosphere   | RD61  | Feb 26 | Radiometer measures noise radiated from plasma at low power levels  | TF159 | Mar-11 |
| Japanese exports to U.S. rose from 22 million in 1958 to 76 million in 1959   | MR26  | Apr 29 | Double-focusing mass spectrometer measures relative amounts and weights of atoms  | RD74  | Jan 29 | Rapid scan spectrometer detects and analyzes infrared energy radiated during power flight portions of missile trajectory  | TF86  | May 20 |
| Japanese radios bought by appliance chain for sale in U.S.  | EN11  | Jan 1  | East Germans publicize a-c voltmeter ranging from 6 mv to 600 mv  | BF37  | Mar 18 | Reversible decade counter for measuring temperature, pressure and the like  | TF86  | Jan 1  |
| Japanese to market stereo 4-channel tape recorder in U.S.   | EN11  | Jan 22 | Electroluminescent devices find expanded market in instrument face applications   | RD81  | Apr 1  | Russians develop photoelectric blood pressure meter   | RD75  | Jun 17 |
| Japanese transistors are registered in Washington   | BF42  | Jan 15 | Electronic ataximeter for measuring involuntary bodily movement   | BTW11 | Jan 29 | Self-powered transistor oscilloscope has response from d-c to over 5 Mc   | TF80  | Mar 18 |
| Incredibly tuning devices for frequency synthesizer gives stable, high-accuracy receiver and transmitters   | RD122 | Feb 12 | Electronic methods for boosting conventional electromechanical counter speed  | RD78  | Jun 10 | Services need inventions in component, transistor, antenna and instrument areas   | BF39  | Jan 22 |
| <b>INDICATORS</b>   |       |        | Electronic tonometer detects glaucoma by measuring pressure within eyeball  | TF112 | Feb 12 | Sharp resonances located using precision R-C oscillator with high degree of stability   | TF76  | Apr 15 |
| (See also Displays, Electroluminescent Devices, Indicator Devices & Registers)  |       |        | Electronic wire gage for nondestructive measurement of wire thickness   | TF109 | Feb 12 | Solid-state radiation detector made of doped silicon gives new speed and accuracy to particle analysis  | BTW11 | Feb 5  |
| Cold-cathode ring-counter drives numerical indicator  | TF80  | Apr 1  | Electronics R & D in instruments in Italy and Sweden  | SR75  | Feb 12 | Soviet exhibit at 1960 Leipzig trade fair focused on new electronic instrument, automation and space  | EN11  | Mar 11 |
| Ferroresonant storage and switching circuits combined with alphanumeric indicator form electroluminescent typewriter                                      | TF49  | Jan 22 | Emphasis at Third International Instrument Electronics and Automation Show in Britain is on industrial controls, digital building blocks                  | BF34  | Jun 17 | Status of industrial instrument business in Japan   | SR53  | May 27 |
| Gas-filler stepping tubes   | TF46  | Feb 19 | Experimental current-measuring technique for determining dielectric absorption in capacitors  | RD90  | Mar 18 | Step-van truck with instruments for measuring air pollution developed   | PC48  | Feb 12 |
| Ground-velocity indicator using c-w Doppler radar developed for helicopters   | EN11  | Jan 8  | Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector                                    | TF58  | Feb 19 | Strain sensing element of whisker size and high strength gives 50 times greater sensitivity than present metallic devices   | BF11  | Feb 26 |
| Indicator triode has fluorescent anode whose illumination is controlled by grid potential for direct data readout   | TF52  | Feb 5  | French and British instrument companies to hold exhibitions in Moscow   | EN11  | Mar 4  | Talks on high-frequency standards and calibrations to highlight technical sessions during 1960 Conference on Standards and Electronic Measurements                                  | BF53  | Jun 3  |
| Monoscope tube generates characters for direct readout on a crt or on paper of digital computer output  | TF117 | Feb 12 | French President DeGaulle impressed with range of test instruments made by manufacturer   | EN11  | May 13 | Technique for checking calibration of f-m and l-v transmitter percentage-of-modulation monitors   | TF67  | Apr 15 |
| Photographically-sensitized metal sheet makes custom labels for instrument and test equipment panels  | PT100 | Jan 1  | French President DeGaulle impressed with range of test instruments made by manufacturer   | PC37  | May 13 | Technique for simply and accurately measuring circuit inductance uses only scope with calibrated sweep velocities   | ERS58 | Mar 4  |
| Portable transistorized depth indicator for locating fish doesn't need crt  | TF50  | Feb 5  | Gas chromatography featured at Instrument Society of America Meeting  | BF47  | Jun 24 | Test instrument sales to both industry and military rise fast   | MR26  | Jan 15 |
| Reversible decade counter used eight-digit transistor-Nixie readout circuit   | TF86  | Jan 1  | High-thrust propulsion systems to shift critical emphasis in satellite development to component and instruments   | BF48  | Apr 29 | Tiny platinum wire is heart of Japanese bolometer mount for measuring microwave power   | CM88  | Apr 1  |
| Small revolving globe for use by astronaut indicates position of orbiting capsule over earth  | RD85  | Apr 1  | Hot and cold constant-impedance loads for measuring noise figure of microwave amplifiers  | RD66  | Feb 5  | Transistorized slicer measures amplitude probability density functions  | TF70  | Jan 29 |
| Transistor reverse-biasing technique raises breakdown point for switching indicator tubes   | TF48  | Jan 8  | Immersion goniometer for measuring ultrasonic velocity in different media   | RD112 | Jun 24 | Transistorized subaudio swept signal generator for testing servos and related equipment and components  | TF67  | Apr 22 |
| Transistorized radio beacon designed to function as aircraft crash position indicator   | TF54  | Jan 22 | Industrial hysteresisgraph uses d-c integrating technique to measure d-c magnetization and hysteresis of magnetic materials                               | TF70  | Mar 25 | Two transistor voltage amplifiers and latchtype relay provide overload protection for voltmeter   | RD92  | Mar 18 |
| Wow-flutter indicator for precise measurement of tape recorder performance  | TF100 | Jun 24 | Instrument fault in orientation system causes Soviet spaceship backfire   | EN11  | Jun 10 | Two-tube generator provides accurate, stable intensity marker for oscilloscope over 8 to 22 Mc frequency range for bandpass measurements  | TF108 | Jun 24 |
| Inductance, circuit, technique for simply and accurately measuring  | ERS58 | Mar 4  | Instrument manufacture in India has more than tripled in value in last three years  | BF52  | Jun 24 | Ultrafast spectrometer for analyzing chemical reactions occurring on 0.1 millisecond developed  | BF42  | Mar 18 |
| Inductance, measurement engineers cite need for better measurement standards of   | BF53  | May 20 | Instruments, controls, electron microscopes, advanced communications are features of British Exhibition in New York                                       | BF46  | Jun 24 | Ultrasonic flowmeter uses two crystal transducers for common-path beam-direction to eliminate temperature errors  | RD78  | Apr 22 |
| Inductance, simple and effective means of measuring in low-Q iron chokes  | TF112 | Apr 29 | Instruments highlighted at 1960 IRE International Show and Convention   | BF47  | Apr 1  | Ultrasonic resonance thickness gage measures missile radomes and nose cones   | PC86  | Feb 26 |
| Induction heating coil opens capsules in predetermined area of dog's gastro-intestinal tract  | PC29  | Jan 1  | Low-temperature research program to provide higher-precision thermometry being expanded   | RD98  | Jun 3  | Undersea oil lines detected by metal locator which generates electromagnetic field  | BF57  | Jan 15 |
| <b>INFORMATION RETRIEVAL</b> (See also Data Processing)   |       |        | Magnetic tape instrumentation recorder has extended bandwidth to accommodate new heads  | TF44  | Jan 8  | Unique instrumentation for investigating possibilities of using plasma to propel space vehicles   | TF66  | Jun 10 |
| Computer applications of future will be in retrieving information and studying biological systems   | TF55  | Jan 29 | Magnetometer computes and measures magnetic field components of lake  | PC33  | May 6  | University of California Lick observatory to construct nebular spectrograph for collecting information on motions of gaseous nebulae  | BF60  | Mar 11 |
| Input geared to unambiguous restricted English main advance of fact-compiler concept Western Joint Computer Conference hears                              | BF35  | May 27 | Mass spectrometer measures quantity of helium escaping in electron tube manufacture   | TF74  | Apr 1  | Use of stroboscope principle for nano and picosecond oscilloscopes described  | EN11  | May 27 |
| Lab model thermoplastic recording system has radar, ir, information retrieval and data processor applications   | EN11  | Jan 22 | Measurement engineers cite need for better measurement standards of inductance and capacitance  | BBF53 | May 20 | What's new in cathode ray tubes for oscillography X-ray analytical instrumentation to find expanding market   | SR55  | Apr 29 |
| Mark I perceptron demonstrates ability to learn the alphabet  | BF43  | Jun 24 | Measurement techniques for evaluating ultrapure refractory materials  | TF71  | Jan 15 |   | BF53  | May 6  |
| <b>INFRARED</b>   |       |        | Measuring circuit for simple and effective determining inductance of low-Q iron chokes  | TF112 | Apr 29 | <b>INSULATORS</b>   |       |        |
| Characteristics of thermal, photoconductive photovoltaic and photoelectromagnet infrared detectors  | TFB72 | Apr 1  | Measuring flow rates of a variety of fluids by detecting nuclear magnetic resonance   | TF77  | Apr 1  | Dielectric diodes and triodes to control large amounts of current using thin insulating crystals of cadmium sulphide being developed  | BTW11 | Jan 22 |
| Controlled environment for infrared studies made possible with 86-ft tunnel   | BF61  | Mar 18 | Measuring switching speed of thin magnetic films using strip transmission line  | TF79  | Jun 3  | Frame of radiation beams provides nondestructive, continuous method of testing cable insulation   | PT135 | May 27 |
| Determination of infrared absorption in evaluating three-element semiconductors   | TF103 | Feb 12 | Milliammeter strips look-alike metals using thermoelastic effect to detect polarity   | PT72  | Jan 8  | Ions detect pinholes in wire and cable insulation   | PT77  | Feb 5  |
| Ground based missile roll control system uses photosensitive or infrared detectors  | RD80  | Mar 25 | Millipore filter tape instrument monitors high-purity water   | PT125 | Jun 24 | Solventless silicone resin for high-temperature insulation now commercially available   | CM118 | Jun 24 |
| Growth foreseen in next two years in infrared maser field   | TF159 | Mar 11 | Miniaturized all-weather radiometric sextant developed for submarine use  | EN11  | Jan 15 | Spray-on insulator dissipates heat and controls temperature on outside of space capsules  | CM105 | Jan 15 |
| How to determine whether to use visual, ir or radar detection in fog or rain  | TF64  | Jan 29 | Modern microwave instruments  | SR67  | Jun 24 | Teflon coated wire eliminates failure under corona stress   | CM80  | Jan 29 |
| Lab model thermoplastic recording system has radar, ir, information retrieval and data processor applications   | EN11  | Jan 22 | New applications of modern microwaves in medical research and spectroscopy  | SR67  | Jun 24 | Temperature-insensitive solid-state dielectric diodes and triodes   | TF59  | Feb 26 |
| Rapid scan spectrometer detects and analyzes infrared energy radiated during power flight portions of missile trajectory                                  | TF86  | May 20 | Noise suppression factor display unit computes and automatically displays ratio of two time-varying quantities  | TF55  | Feb 5  | Integrator for transistorized slicer used to measure amplitude probability density functions  | TF70  | Jan 29 |
| Three infrared and visual detectors under development may change design concepts in advanced military and industrial equipment                            | EN11  | May 27 | Nuclear instrument shipments for 1958 rise 33 percent over those of 1957  | MR22  | Feb 19 | Integrator, logarithmic, for nuclear radiation alarm  | TF43  | Jan 22 |
| Uncooled indium-antimonide photoelectromagnetic detector responds to long infrared wavelengths  | TF62  | Mar 25 | Oscilloscope and oscillograph market will increase 50 percent between 1960 and 1962   | MR24  | Feb 5  | Interference from other stations reduced during ionospheric sounding by circuit which separates desired pulses from unwanted tone signals   | TF118 | May 27 |
| Injected-beam forward-wave amplifiers and backward-wave electronically tunable oscillators, what's new in   | SR55  | Apr 29 | Oscilloscope checks operation of memory drum used in air-traffic control system   | BF39  | Jun 10 | Interference from generators, power lines, spark plugs and other electrical gear to be measured by NBS' Boulder Labs mobile field unit  | BF52  | Jun 24 |
| Inspection automation machine lagging in Britain  | BF52  | May 13 | Oscilloscope with direct digital readout of amplitude and duration of pulse signals reduce operator errors, cut measurement time                          | BF30  | Mar 4  | <b>INVERTERS</b>  |       |        |
| <b>INSTRUMENTS</b> (See also specific instrument)   |       |        | Peak voltmeter uses transistorized flip-flop comparison and adjustment circuit to charge storage capacitor during substantial part of interpulse interval | TF57  | Jun 17 | Inverter for transistorized slicer used to measure amplitude probability density function   | TF70  | Jan 29 |
| Air transportable nuclear reactor now in instrumentation state  | EN11  | Jan 1  | Phase-meter measures two signals in 100 to 520 Mc band with 0.2 degree for c-w and 0.5 degree for pulsed uhf  | TF54  | Mar 4  | Transistorized inverter for Mobile Digital Computer (MOBIDIC)   | TF72  | Mar 25 |
| American exports of precision instruments in 1959 up \$7 million over 1958  | EN11  | Mar 11 | Photographic system records electromagnetic radiation from lightning (sferics) propagated over long distances   | RD64  | Mar 4  | Transistorized inverters working at 1,250 cps power 40-watt fluorescent lamp off 24-v battery in British railway coaches  | TF58  | Feb 5  |
| Automatic spectroscopic system for determining the spectral response of electro-optical materials   | TF66  | Apr 1  | Photographically-sensitized metal sheet makes custom labels for instrument and test equipment panels  | PT100 | Jan 1  | Tunnel diodes used in inverter configuration  | TF55  | Jan 29 |
| Automatic surveying system uses lightbeam projector and profile measuring device to measure airport runway roughness                                      | TF54  | Jun 17 | Photomultiplier and electrometer measure fluorescence of glass dosimetry needle to determine radiation exposure in human body                             | TF74  | Mar 18 | Typical semiconductor inverter for microcircuit ion engine using cesium stream being contracted for by NASA   | TF69  | May 13 |
| Battery-powered transistorized scale-of-64 counter for measuring radioactive tracers improves reliability, reduces cost and weight                        | TF74  | May 6  | Polarity coincidence multiplier detects weak low-frequency signal in high-noise background  | TF67  | Jan 29 | Ionization, transmission of signals through natural layers and through shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosion | TF81  | May 20 |
| Biocurrents in human cells being studied by Soviet Scientist with microelectrode  | EN11  | Mar 4  |   |       |        | Ionospheric sounding, circuit reduces interference from other stations by separating desired pulses from unwanted tone signals  | TF118 | May 27 |
|   |       |        |   |       |        | Isolators for modern microwave applications   | SR67  | Jun 24 |

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| Ions reported to affect health and behavior                                | BF45 | Feb 26 |
| Isolation amplifier, unity-gain, offers high stability and input impedance | TF66 | Feb 26 |
| Israel - research and development currently underway in                    | SR75 | Feb 12 |
| Italy - research and development currently underway in                     | SR75 | Feb 12 |

## J

|  |      |       |
|--|------|-------|
| Jamming chart helps determine effectiveness of radar in presence of  | TF76 | May 6 |
| Japan (See Foreign Electronics)                                      |      |       |
| JETS, Junior Engineering Tech Society, studied two-ton magnetic unit | PC48 | May 6 |

## K

|   |       |        |
|---|-------|--------|
| Keyer, phase-shift, for double-sideband suppressed carrier transmitter                    | TF47  | Feb 5  |
| <b>KLYSTRONS</b>  |       |        |
| Klystron amplifiers for modern microwave applications                                     | SR67  | Jun 24 |
| Klystron, high-power S-band klystron, for long-range radar or troposcatter communications | CM82  | Feb 26 |
| Novel handling techniques for producing super-power klystron over 10 feet tall            | PT192 | Mar 11 |
| Reflex klystron amplifier with hybrid T coupling give improved gain and linearity         | TF64  | Jun 10 |
| Reflex klystrons used as microwave receiver amplifiers for X-band radars                  | TF56  | Jan 8  |
| Reflex klystrons used as millimeter wave amplifiers                                       | TF71  | Mar 18 |
| Ultra-clean electron gun promises greater power rating, longer life for radar klystrons   | EN11  | Mar 25 |
| What's new in megawatt and high-power c-w klystrons                                       | SR55  | Apr 29 |

## L

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| Laminate with properties of Teflon and glass ideal wave applications for high-temperature printed circuits and micro-Lamps, incandescent, now available as pin-sized units | CM79 | Jun 17 |
| Latch circuit using saturable reactor is high-speed, low-cost and simple   | RD66 | Jan 8  |
| Life, operating, extension of in receiving type electron tubes being researched  | SR55 | Apr 29 |
| Light dimmer, solid-state, weighing 1 1/2 pounds promises to cut industrial power bills by 30 percent  | BF39 | May 27 |
| Lightning and earth's magnetic field being studied to develop long-range VLF navigation systems  | RD78 | Apr 8  |
| Lightning discharges to be studied by University of Arizona  | BF60 | Mar 11 |
| Lightning photographed by intermittent recorder  | RD64 | Mar 4  |
| Littrow mirror system for monochromator of rapid scan spectrometer used to detect and analyze infrared energy radiated during power flight portions of missile trajectory  | TF86 | May 20 |

## LOGIC CIRCUITS

|  |       |        |
|--|-------|--------|
| (See Also Digital Techniques)  |       |        |
| Flip-flop uses indicator triode with fluorescent anode whose illumination is controlled by grid potential  | TF52  | Feb 5  |
| High-speed transistor switch for computer logic circuit performs at micro-energy levels  | CM98  | May 13 |
| Japanese develop new computer logic - high speed parallel adder-accumulator and shifter  | BF36  | Apr 15 |
| Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics | RD104 | May 20 |
| Mark I perception demonstrates ability to learn the alphabet   | BF43  | Jun 24 |
| Micron-thick permalloy plated onto copper basis of new thin film logic and memory devices developed in Japan   | EN11  | Apr 1  |
| Parametron logic circuits for digital computers  | TF73  | Jun 3  |
| Tunnel diode logic circuits-modes of operation and effect of circuit component tolerances  | TF103 | Jun 24 |
| Tunnel diodes used in EXCLUSIVE-OR and SUM circuits and flip-flops   | TF55  | Jan 29 |
| Typical semiconductor logic block, and gate and NOR for microcircuits  | TF69  | May 13 |
| Lossev effect, definition of   | TF71  | Feb 26 |
| Low-noise devices used with modern microwave equipment   | SR67  | Jun 24 |

## M

|  |       |        |
|--|-------|--------|
| Machine tool control shows little penetration in Britain   | BF52  | May 13 |
| Machine tools controlled by thyatrons driving step motors in response to signals from a programmed tape              | TF174 | Mar 11 |
| <b>MAGNETICS</b> (See also Thin Films)   |       |        |
| Changemaking machine operates by magnetic sensing  | EN11  | Jun 10 |
| Control systems, solid-state electronics and electromagnetics featured at Seattle's 7th Regional IRE Conference      | BF39  | Jun 10 |
| Current pulse generator for testing ferrite memory cores   | TF80  | Jan 1  |
| Data communications systems linking distant computers use magnetic tape equipment                                    | BF44  | Jun 17 |
| Earth's magnetic field and lightning being studied to develop long-range VLF navigation systems                      | RD78  | Apr 8  |
| Electronics R&D in magnetics in Italy  | SR75  | Feb 12 |
| Experimental solid-state generator for converting pulsed d-c magnetic fields into microwave radiation has been built | EN11  | Feb 19 |
| Flexible Mylar magnetic disk memory unit stores 50,000 to 60,000 bits  | TF55  | Jan 29 |

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|--|-------|--------|
| Industrial hysteresisgraph uses d-c integrating technique to measure d-c magnetization and hysteresis of magnetic materials  | TF70  | Mar 25 |
| Magnetic analyzer for double-focusing mass spectrometer  | RD74  | Jan 29 |
| Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics | RD104 | May 20 |
| Magnetic, noncontact shaft position disk encoder offers high rotational speeds and reliability for computer, control and data logging uses                                       | RD114 | Apr 29 |
| Magnetic recording of color television using time-correction circuits to reproduce hues faithfully   | TF76  | Jan 1  |
| Magnetic resonance, nuclear, discussed at Instrument Society of America Meeting  | BF47  | Jun 24 |
| Magnetic spot-welding electrodes hold small parts to be spliced to sheet or strip material   | PT88  | Apr 15 |
| Magnetometer computes and measures magnetic field components of lake   | PC33  | May 6  |
| Measuring cathode temperature of commercial tubes by using magnetic field parallel to retarding potential  | RD80  | Apr 15 |
| Measuring flow rates of a variety of fluids by detecting nuclear magnetic resonance  | TF77  | Apr 1  |
| Measuring switching speed of thin magnetic films using strip transmission line   | TF79  | Jun 3  |
| Miniature magnetic head for high-density memory drum consists of coil wound over four-layer core   | TF55  | Jan 29 |
| NBS discovers a series of ceramic materials that exhibit simultaneously both ferroelectric and ferrimagnetic properties  | CM128 | Feb 12 |
| Optical-electronic magnetometer control attitude of vehicles in space  | TF55  | Apr 8  |
| Permanent magnet memory unit (Twistor) ready for mass production   | BTW11 | Jan 29 |
| Project Madre to use magnetic-drum receivers to autocorrelate echoes from over-the-horizon radar   | BF28  | Feb 5  |
| Missile warning system   |       |        |
| RCA to open research laboratory in Japan to study electrical, magnetic and optical properties of solid-state phenomena   | EN11  | Jun 24 |
| Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference   | TF39  | Mar 4  |
| Semiconductor wafer Hall probe in magnetic field plotting system speeds cyclotron design   | RD80  | Apr 8  |
| Six ways to use magnetic core shift register elements  | TF80  | Jan 15 |
| Spiral magnetic paths (Twistor) used in digital computer memory  | CM84  | Mar 25 |
| Superconducting electromagnets being explored for use with masers and in solid-state research requiring cryogenic temperatures and a magnetic field                              | EN11  | May 20 |
| Transfluxor (magnetic-electronic) oscillator retains last frequency setting many hours after control signal removal  | TF48  | Mar 4  |
| Two-ton magnetic unit studied by members of JETS (Junior Engineering Tech Society)   | PC48  | May 6  |
| Uncooled indium-antimonide photoelectromagnetic detector responds to long infrared wavelengths   | TF62  | Mar 25 |
| Value of thin magnetic films in computer memory systems being explored by Case Institute of Technology   | BF53  | Feb 12 |
| <b>MAGNETOHYDRODYNAMICS</b> (See also Plasma Physics)  |       |        |
| Experimental magnetohydrodynamic generator produces 2 1/2 kw, runs for four minutes  | EN11  | Mar 25 |
| Magnetohydrodynamics power plant generators offering high-efficiency output being studied  | RD92  | Jan 1  |
| Magnetohydrodynamics symposium of AIEE points up electronics industry's growing interest in plasma research  | EN11  | Mar 4  |
| Magnetohydrodynamics takes on new significance to electronics industry   | BF52  | Mar 11 |
| New developments in direct conversion of heat to electric power without using moving parts   | TF159 | Mar 11 |
| Magnetometer computes and measures magnetic field components of lake   | PC33  | May 6  |
| Magnetometer, optical-electronic, controls attitude of vehicles in space   | TF55  | Apr 8  |
| <b>MAGNETRONS</b>  |       |        |
| Crossed-field amplifier called Circlotron uses magnetron as negative-resistance element  | TF71  | Jan 15 |
| Experimental magnetrons for 32, 12, 8 and 4 mm wavelengths give peak outputs of 1,100, 70, 40, and 40 kw, respectively   | CM96  | Mar 18 |
| Magnetron with 25-kw peak power at 35-kmc developed for surface detect on radar set  | EN11  | Jan 15 |
| What's new in magnetron oscillators  | SR55  | Apr 29 |

## MANAGEMENT

|  |       |        |
|--|-------|--------|
| (See also Government, Manpower, Marketing, and Market Research)  |       |        |
| Automatic teaching machine (Tutor) simulates complex electronic gear, speeds development of technical personnel      | BF39  | Apr 22 |
| Company combats shortage of semiconductor engineers by giving series of in-depth, 13-week courses                    | BF44  | Jun 17 |
| Defense Department urges extensive changes in management of military electronic parts specs.                         | BF31  | Apr 22 |
| Do's and don'ts of hiring engineers and scientists   | BF40  | Mar 11 |
| Electronics to be third largest U.S. industry by 1965  | MR24  | Jun 17 |
| Government may set minimum wage next year for workers making functional components                                   | BTW11 | Apr 15 |
| Guide for measuring new product success record   | MR30  | Feb 26 |
| Labor Department to hold hearing on minimum wage for electronic component parts plants selling to government         | BF44  | Mar 25 |
| Labor Department to rule on minimum wages for tube and semiconductor production workers                              | BF31  | Jan 8  |
| Mass recruitment of electronics engineers by industry firms is on way down according to reports                      | BF40  | Jun 3  |
| Selective paging system uses coded transmission for voice intercommunications with up to 45 stations                 | TF68  | Feb 26 |
| Self-help plan involving team bidding and establishment of trade association speeds industrial growth on Long Island | BF38  | May 6  |
| Survey shows that field engineers resign jobs because not enough management experience is gained                     | BF52  | May 20 |

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|---|-------|--------|
| West Coast manufacturer urges government give Q awards for production   | BF40  | Jan 1  |
| <b>MANPOWER</b> (See also Education and Management)   |       |        |
| Automatic teaching machine (Tutor) simulates complex electronic gear, speeds development of technical personnel   | BF39  | Apr 22 |
| Company combats shortage of semiconductor engineers by giving series of in-depth, 13-week courses   | BF44  | Jun 17 |
| Do's and don't of hiring engineers and scientists   | BF40  | Mar 11 |
| Florida's new industrial lure: plant-and-house package  | BF30  | Jun 10 |
| Government may set minimum wage next year for workers making functional components  | BTW11 | Apr 15 |
| Guggenheim Fellowship winner works in Britain's Atomic Energy Research Establishment  | PC39  | Jun 24 |
| Importance of Japan's manpower in her rising electronics industry   | SR53  | May 27 |
| Japanese young women electronics production workers: a close-up   | BF36  | Apr 1  |
| Labor Department to hold hearing on minimum wage for electronic component parts plants selling to government  | BF44  | Mar 25 |
| Labor Department to rule on minimum wages for tube and semiconductor production workers   | BF31  | Jan 8  |
| Manpower distribution of electronic industry personnel-1959   | SR49  | Jan 1  |
| Mass recruitment of electronics engineers by industry firms is on way down according to reports   | BF40  | Jun 3  |
| Minnesota Governor indicates expanding universities, skilled manpower and favorable financial climate stimulates area's growth                            | BF30  | Jun 17 |
| Survey shows that field engineers resign jobs because not enough management experience is gained  | BF52  | May 20 |
| U.S. firms plan to hire 44 percent more EE graduates in 1960 than in 1959   | BF39  | Jun 24 |
| U.S. Information Agency needs engineers to keep Voice of America's Greenville installation going  | EN11  | Jun 10 |
| What exhibitors are saying about recruiting at forthcoming IRE International Show and Convention  | BF30  | Mar 11 |
| Maps of ground terrain made from air with side-looking all-weather radar  | BF49  | Apr 15 |
| Marker generator provides accurate, stable intensity marks for oscilloscope over 8 to 22 Mc frequency band for bandpass measurements                      | TF108 | Jun 24 |
| <b>MARKETING</b> (See also Market Research and Sales)   |       |        |
| Automatic gas-fume detector alarms, Loran, radio telephones, direction finders, and depth sounder fish finders make up new \$10-million small boat market | BF30  | Jan 22 |
| British and U.S. computermakers step up sales, promotional and service activities in Europe   | BF34  | Jan 8  |
| Commerce department forecasts \$2.2-Billion consumer market in 1960   | BTW11 | Jan 22 |
| Delivery of new single-sideband communications systems for military and commercial market reported  | BTW11 | Mar 18 |
| Digital and analog computermakers seek wide marketing through pricing and design flexibility  | BTW11 | Mar 18 |
| Digital computer for industrial control functions being marketed  | EN11  | Jan 8  |
| Dutch market their first electronic computer which uses transistors and ferrite cores   | BTW11 | Feb 12 |
| Electroluminescent devices output to increase for a wide variety of military and civilian markets   | BTW11 | Jan 29 |
| Electronics market for 1960   | SR49  | Jan 1  |
| Elli Electronics of England expands marketing of computers in U.S.  | BF36  | Mar 18 |
| Increased production, marketing activity forecast for electroluminescent devices  | BTW11 | Apr 1  |
| Japan adopts American NTSC standards to pave way for marketing transistorized color, and black and white tv set in U.S.                                   | BF27  | Jan 22 |
| Japanese Industrial Trade Fair feature consumer items for U.S. market   | EN11  | Apr 29 |
| Japanese to market stereo 4-channel tape recorder in U.S.   | EN11  | Jan 22 |
| Low-grade silicon in demand in Europe   | CM68  | Jan 8  |
| Manufacturers expect continued increase in tv and audio market  | BF39  | Feb 5  |
| Manufacturers give increased attention to developing small computers for small businesses   | BF39  | Apr 8  |
| Marketing techniques of electronics industry in Japan   | SR53  | May 27 |
| Microminiature modules (MICRAM) with component densities of 2 million units per cu ft being marketed  | BTW11 | Mar 25 |
| New business data processing system offers sophistication at moderate price   | BTW11 | Apr 15 |
| One company's approach to beefing up electronics export trade   | EN11  | Apr 29 |
| Self powered portables, more color sets and additional remote control models focal points of 1960 TV market   | BF44  | May 13 |
| Transistorized tv set to be marketed by Japanese firm during 1960   | EN11  | Jan 8  |
| Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications  | BF36  | Feb 26 |
| Tunnel diode factory production announced by U.S. and Japanese firms  | BTW11 | Feb 12 |
| U.S. electron tubes and semiconductors of specialized types and advanced designs in demand abroad   | BF48  | Feb 26 |
| U.S. firms plan to hire 44 percent more EE graduates in 1960 than in 1959   | BF39  | Jun 24 |
| X-ray analytical instrumentation to find expanding market   | BF53  | May 6  |
| <b>MARKET RESEARCH</b> (See also Marketing and Sales)   |       |        |
| Color tv sales to rise \$10 million in 1960   | MR24  | Apr 22 |
| Dollar value of plastics parts produced by electronics companies in 1959 is \$250 million, double 1958's \$125 million                                    | MR24  | Jun 24 |
| Electronics firms urged at EAI Industrial Electronics Conference to sell systems instead of hardware to industrial customers                              | MR22  | Jan 22 |
| Electronics industry exports for 1959 are \$415 million, down 3 percent from 1958   | MR26  | May 6  |
| Electronics to be third largest U.S. industry by 1965   | MR24  | Jun 17 |
| F-m radio set sales to show gain of 50 percent over last year   | MR26  | Feb 12 |



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|---|-------|--------|--|-------|--------|--|---------|--------|
| Guide for measuring new product success record  | MR30  | Feb 26 | National Research Council urges government to give high priority to development of material                                    | CM85  | Apr 8  | Non-newtonian color optics being used in color-reception system using two monochrome tubes shown at regional meeting of Society of Photographic Scientists and Engineers                         | EN11    | Jun 24 |
| Hearing aid sales will increase by 11 percent in 1960   | MR28  | Mar 18 | NBS discovers a series of ceramic materials that exhibit simultaneously both ferroelectric and ferrimagnetic properties        | CM128 | Feb 12 | Sixth annual symposium on Reliability and Quality Control  | BF39    | Jan 29 |
| Hiring in communications equipment industry up 13 percent   | MR26  | Mar 11 | New cathode base metal for tubes greatly improves microphonics and resistance to cathode bowing under severe shock             | CM79  | Jun 17 | Superconductivity symposium disclosed basic work is still concentrating on cryotron, major problem is fabrication  | EN11    | May 27 |
| Industrial products to reach \$8-10 billion sales   | MR26  | Apr 15 | Paper-base phenolic laminate provides flame retardance with excellent cold punching characteristics                            | CM103 | Jun 3  | Tube-transistor comparisons, microelectronics, space electronics, computer applications and engineering education discussed at winter meeting of AIEE  | BF28    | Feb 19 |
| Japanese exports to U.S. rose from 22 million in 1958 to 76 million in 1959   | MR26  | Apr 29 | Predicting possible three-element semiconductor materials  | TF103 | Feb 12 | MEMORIES   |         |        |
| Magnetic tape sales to increase by 30 to 35 percent in 1959 to 1960   | MR22  | Jan 8  | Producing germanium from flue dusts of certain kinds of coal   | CM121 | Jun 24 | (See also Computers, Cores, Data Processing, Techniques, Storage Devices and Thin Films)   | Digital |        |
| Manufacturers look for quadrupled digital computer sales over next five years   | MR24  | Jun 3  | Production of large ceramic pieces to serve as circuit boards reported   | CM87  | May 6  | Current pulse generator for testing ferrite memory cores   | TF80    | Jan 1  |
| Microwaves components study of 1958 production issued by Commerce Department's Business and Defense Services Administration                         | MR24  | Apr 8  | Report on high-temperature ceramics  | CM116 | Jun 24 | Drive-sampling core generators precisely defined strobes to give high s/n ratio in digital computer memories   | TF72    | Mar 25 |
| Military marketing strategy   | MR26  | Mar 25 | Response of electronic system components and materials to irradiation from nuclear-powered aircraft                            | TF69  | Apr 22 | Expandable random-access solid-state memories operate over 15 to 55 C temperature range, require only 3 percent supplies   | TF164   | Mar 11 |
| Nuclear instrument shipments for 1958 rise 33 percent over those of 1957  | MR22  | Feb 19 | Review of uranium compounds suggests some may possess semiconductive properties of interest in high-temperature applications   | CM130 | May 27 | Flexible Mylar magnetic disk memory unit stores 50,000 to 60,000 bits  | TF55    | Jan 29 |
| Oscilloscope and oscillograph market will increase 50 percent between 1960 and 1962   | MR24  | Feb 5  | Scientists grow single crystals of transparent gallium phosphide experimentally  | EN11  | May 13 | Information stored in form of acoustic energy in quartz delay line   | TF159   | Mar 11 |
| Preliminary statistics indicate tube shipments increased 145 percent between 1954 and 1958  | MR22  | Mar 4  | Search for new materials plays key role in maser development   | TF159 | Mar 11 | Magnetic thin films dots for computer memories   | PC184   | Mar 11 |
| Replacement parts, repairs and modifications to cost military \$900 this year   | MR30  | Apr 1  | Solventless silicone resin for high-temperature insulation now commercially available  | CM118 | Jun 24 | Mark I perceptron demonstrates ability to learn the alphabet   | BF43    | Jun 24 |
| Retail sales of tv sets will rise 60 to 70 percent higher in 1970   | MR26  | May 27 | Special machining techniques for forming pure tungsten into intricate shapes   | CM87  | May 6  | Micro-sized ferrite-core memory array for data processing system operates under environmental extremes   | CM98    | May 13 |
| Silicon controlled rectifier dollar sales to double in 1960   | MR22  | Jan 1  | Spray-on insulator dissipates heat and controls temperature on outside of space capsules                                       | CM105 | Jan 15 | Micron-thick permalloy plated onto copper basis of new thin film logic and memory devices developed in Japan   | EN11    | Apr 1  |
| Slip ring assemblies become major electronics components market, sales rise 25 percent yearly   | MR30  | May 13 | Teflon coated wire eliminates failure under corona stress  | CM80  | Jan 29 | Miniature high-density memory drum stores 300,000 bits   | TF55    | Jan 29 |
| Tantalum capacitor manufacturers look for 20 percent sales increase over 1959 level   | MR24  | Jun 10 | Thermoelectric cooling now possible using new semiconductor materials  | CM85  | Feb 26 | Oscilloscope check operation of memory drum used in air-traffic control system   | BF39    | Jun 10 |
| Test instrument sales to both industry and military rise fast   | MR26  | Jan 15 | Two fast-hardening epoxy adhesives introduced for bonding components to circuit boards   | CM116 | Jun 24 | Permanent magnet memory unit (Twistor) ready for mass production   | BTW11   | Jan 29 |
| Ultrasonic cleaning equipment sales to be up 30 percent over next five years  | MR28  | May 20 | Use of gallium phosphide in point-contact devices points to development of gallium phosphide diodes                            | CM108 | May 20 | Precision turning device for finishing outer diameters of memory drums   | PT126   | Apr 29 |
| Year 1960 to see increased semiconductor sales, maintenance of high level 1959 electron tube sales  | MR24  | Jan 29 | What's new in photoconductive materials  | SR55  | Apr 29 | Rice Institute develops 8, 192-word grid tube memory, expect expansion to 32,000 words   | BF59    | May 20 |
| Mars, MIT interplanetary space probe to take photographs of 40 percent of surface of  | BF49  | May 20 | Measurement engineers cite need for better measurement standards of inductance and capacitance                                 | BF53  | May 20 | Spiral magnetic paths (Twistor) used in digital computer memory  | CM84    | Mar 25 |
| <b>MASERS</b>   |       |        | Mechanical environment and assembly of receiving-type electron tubes   | SR55  | Apr 29 | Superconductors to find use as components for high-speed switches and memory systems   | BF32    | Feb 5  |
| Army announces development of 25-lb ruby maser D-c controlled attenuator called Gyraine varies L-band maser pump power in radiometer                | EN11  | Apr 22 | <b>MEDICAL ELECTRONICS</b> (See also Biophysics)   |       |        | Mercury pool tubes, what's new in  | SR55    | Apr 29 |
| Search for new materials plays key role in maser development  | TF71  | Jan 15 | AF studies affect of high intensity sound on human physiological reactions   | PC46  | Jun 24 | Metal locator detects undersea oil lines   | BF57    | Jan 15 |
| Superconducting electromagnets being explored for use with masers and in solid-state research requiring cryogenic temperatures and a magnetic field | TF159 | Mar 11 | Artificial neuron designed as component for studying self-organizing systems reported at 1960 Solid-State Circuits Conference  | TF39  | Mar 4  | Metals that look alike are sorted by millimeter using thermoelectric effect to detect polarity   | PT72    | Jan 8  |
| Mass spectrometer, double focusing, going into satellite to measure elements in the exosphere   | RD81  | Feb 26 | Blooms in human cells being studied by Soviet Scientist with microelectrode  | EN11  | Mar 4  | Meteor showers found to be more frequent than previously suspected by use of radar telescope capable of detecting micrometeorites  | RD106   | May 20 |
| Mass spectrometer tests tightness of seals  | TF74  | Apr 1  | Closed-circuit tv for monitoring dental surgery and for assisting in diagnosis being studied                                   | RD185 | Mar 11 | <b>METEOROLOGY</b> (See also Atmospheric Studies)  |         |        |
| <b>MATERIALS</b>  |       |        | Computer calculates turbidimetric assays in automatic microbiological testing  | RD92  | Jan 1  | Automatic weather station can be air-lifted to normally inaccessible areas by helicopter   | BF43    | May 6  |
| (See also Ceramics, Dielectrics, Insulators, Plastics, Superconductors and Thermoplastics)  |       |        | Cryogenic electron microscope of future may give man his first view of atom  | BF32  | Feb 5  | Circularly-polarized, high-gain antenna for automatic tracking of Tiros meteorological satellites  | TF57    | Apr 15 |
| Auto Company tests energy absorption of materials impact of steel ball of surface   | PC30  | Jun 17 | Czechoslovakian transistor cardio-tachometer in use  | BF28  | Jan 1  | Data gathering and logging system monitors nuclear radiation levels and weather conditions   | RD64    | Jan 22 |
| Automatic spectroscopic system for determining the spectral response of electro-optical materials   | TF66  | Apr 1  | Dental anesthetic device using stereo sound placed in production   | EN11  | May 27 | Electronics R&D in weather aids in Australia   | SR75    | Feb 12 |
| Beryllium oxide heat sink solves problem of heat removal from tube anode in r-f telemetry power amplifier   | CM110 | May 20 | Electronic axiatimeter for measuring involuntary bodily movement   | RD78  | Jun 10 | Instrumented low-cost Arcas and Loki weather rockets slated for daily firing   | BF43    | Apr 29 |
| Defense Department considers establishment of information center on ceramic materials to aid research   | EN11  | May 13 | Electronic equivalent of neuron discussed at winter meeting of AIEE  | BF28  | Feb 19 | Side-looking radar makes all-weather air maps of ground terrain  | BF49    | Apr 15 |
| Device materials tested at 460F   | PC39  | Jan 29 | Electronic tonometer detects glaucoma by measuring pressure within eyeball   | TF115 | Feb 12 | Tiros transmits data with two 33-ounce off-the-shelf f-m telemetry transmitters  | BTW11   | Apr 15 |
| Dielectric diodes and triodes to control large amounts of current using thin insulating crystals of cadmium sulphide being developed                | BTW11 | Jan 22 | Electronics R&D in medicine in Sweden and Israel   | SR75  | Feb 12 | U.S. Weather Bureau completing installation of advanced, high-speed facsimile recording equipment for high-altitude weather map network  | BF49    | May 6  |
| Digital programmer automatically adjusts and controls furnace temperature during preparation of high purity materials                               | RD122 | May 27 | Hearing aid sales rise 11%   | MR28  | Mar 18 | Meter, photoelectric blood pressure, developed by Russians   | RD75    | Jun 17 |
| Emphasis on basic scientific progress and discoveries in Conference on Electronic Conductivity in Organic Solids                                    | RD127 | May 27 | Induction heating coil opens capsules in predetermined area of dog's gastro-intestinal tract                                   | PC29  | Jan 1  | Meter, portable transistorized sound level, for measuring noise  | TF64    | Jun 17 |
| Epoxy resins for encapsulation display novel structure, reactivity and curing characteristics   | CM71  | Feb 19 | Indonesian affect health and behavior in space, submarines and department stores   | BF45  | Feb 26 | Meters, percentage-of-modulation, for f-m and tv transmitters, technique for checking calibration of MICRAM (microminiature individual components reliable assembled modules) are being marketed | TF67    | Apr 15 |
| Four basic research programs underway to develop ductile ceramic and ionic crystals   | CM100 | Jan 15 | Japanese to emphasize development of medical electronics   | EN11  | Feb 12 | Microminiature microscope system converts computer data into visual form   | BTW11   | Mar 25 |
| Gallium phosphide diodes and switching devices withstand 1,500 C  | CM71  | Jan 8  | Low-energy short-lived radioisotope samarium-153 produces high quality diagnostic radiograms                                   | BF42  | Mar 18 | Microfilm, monoscope system converts computer data into visual form  | BF11    | Feb 26 |
| Gas plasma gun sprays materials with high melting points onto materials with relatively low melting points  | PT77  | Feb 5  | Measuring flow rate of blood externally by detecting nuclear magnetic resonance  | TF77  | Apr 1  | <b>MICROMINUTIZATION</b>   |         |        |
| Germanium used in new alloy for brazing stainless steel   | PT127 | Apr 29 | Mutual aid between electronics and medical men seen essential to medical research  | TF159 | Mar 11 | (See also Printed Circuits and Thin Films)   |         |        |
| Germans develop world's purest silicone, and continuous process for making pure crystallized silicon  | BF49  | May 13 | New applications of modern microwaves in medical research and spectroscopy   | SR67  | Jun 24 | Approaches to design and fabrication of microminiaturized digital computer for space applications  | TF95    | Apr 29 |
| Gold-antimony alloy gives more even control of semiconductor doping   | CM71  | Jan 22 | Photomultiplier and electrometer measure fluorescence of glass dosimetry needle to determine radiation exposure in human body  | TF74  | Mar 18 | British approaches to microminiaturization   | TF71    | Jan 1  |
| High degree of piezoelectricity in zinc oxide and cadmium sulfide has been discovered   | BF52  | Jun 24 | Preview of medical electronics sessions for forthcoming IRE International Show and Convention                                  | BF32  | Mar 11 | Ceramic-based microminiature adder for ballistic missile computer  | PC96    | Jan 1  |
| High-purity tungsten now easily plated on metal surface using vapor deposition process  | CM85  | Jun 10 | Russians develop photoelectric blood pressure meter  | RD75  | Jun 17 | Circuits grown form pool of molten semiconductor materials   | BTW11   | Jan 29 |
| How built-in damping controls violent motion imposed by vibration   | CM186 | Mar 11 | Semiconducting industrial diamonds may find application as highly sensitive thermometers                                       | RD76  | Apr 22 | Eastern Joint Computer Conference indicates computers are heading for 1,000-Mc operation and microminiaturized circuits  | TF55    | Jan 29 |
| Immersion goniometer for measuring ultrasonic velocity in different media   | RD112 | Jun 24 | Solid-state radiation detector made of doped silicon used in surgical probe for cancer treatment control                       | BTW11 | Feb 5  | Electron beam device accurately drills small holes in evaporating masks used in microminiaturization   | TF71    | Jan 15 |
| Knitted metal mesh protects electronic equipment from shock and vibration   | CM94  | Mar 18 | Status of medical electronics in Japan   | SR53  | May 27 | Germanium diffused base transistor with open circuit base connection serves as inductive negative resistance diode in microcircuits  | TF60    | Apr 22 |
| Laminate with properties of Teflon and glass ideal for high-temperature printed circuits and microwave applications                                 | CM79  | Jun 17 | Television tracking system records eye focus points and movements  | TF57  | Apr 22 | Half inch cube modules holding 12 to 18 components used in reconnaissance drone guidance system, commercial and military computers   | CM123   | Apr 29 |
| Low-grade silicon in demand in Europe   | CM68  | Jan 8  | University of California probes new ways to use radiation in brain study   | BF53  | Feb 12 | Microminiaturization discussed at winter meeting of AIEE   | BF28    | Feb 19 |
| Material and backing-plate selection for sonar transducer design  | TF62  | Feb 26 | Wireless eyeglass hearing aid developed  | PC43  | May 27 | Microminiaturization to get special attention at 1960 Solid-State Circuit Conference   | EN11    | Jan 29 |
| Materials for potting base of electron tubes  | CM84  | May 6  | <b>MEETINGS</b> (See also Conferences and Conventions)   |       |        | Microminiature modules (MICRAM) with component densities of 2 million units per cu ft being marketed   | BTW11   | Mar 25 |
| Materials hold key to development of electron tubes capable of reliable performance at high ambient temperatures                                    | CM118 | Apr 29 | Advanced research projects discussed at North-east Electronics Research and Engineering Meeting                                | TF71  | Jan 15 | Microminiature tube circuits featuring nuclear radiation resistance offered at IRE International Show and Convention   | BTW11   | Apr 1  |
| Materials progress in transistor potting, high-tensile strength polyethylene and plastic laminates reported   | CM84  | Apr 15 | Gas chromatography featured at Instrument Society of America Meeting   | BF47  | Jun 24 | Microminiaturization discussions dominate Electronic Components Conference   | BF46    | May 27 |
| Materials research activity in Japan  | SR53  | May 27 | Magnethydrodynamics symposium of AIEE points up electronics industry's growing interest in plasma research                     | EN11  | Mar 4  | Microminiaturization highlighted at 1960 IRE International Show and Convention   | BF47    | Apr 1  |
| Measurement techniques for evaluating ultrapure refractory materials  | TF71  | Jan 15 | Marine experts at AIEE winter meeting indicate sophisticated electronic gear on ships may mean more solid-state power supplies | EN11  | Feb 12 | Micro-sized vacuum tubes encapsulated in a solid block reported at 1960 Western Joint Computer Conference  | CM100   | Jun 3  |
| Methods of metallizing ceramics for brazing into ceramic-metal assemblies   | CM86  | May 6  | More use of tantalum and columbium for capacitors seen at Electrochemical Society meeting                                      | EN11  | May 20 |  |         |        |
| More use of tantalum and columbium for capacitors seen at Electrochemical Society meeting   | EN11  | May 20 |  |       |        |  |         |        |

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|---|-------|--------|--|-------|--------|--|-------|--------|
| New developments in microminiaturization  | TF159 | Mar 11 | What's new in linear-beam and crossed field type microwave tubes   | SR55  | Apr 29 | Rapid scan spectrometer detects and analyzes infrared energy radiated during power flight portions of missile trajectory                               | TF86  | May 20 |
| New triple-diffused n-p-n silicon mesa devices designed for low-power high-speed switches shrunk to pico size   | CM82  | Apr 8  | Midwest Program on Airborne Television Instruction, sixteen colleges in six midwestern states designed as communications network for   | BF59  | May 20 | Rearward communications for BMEWS provided by submarine cable from Greenland to north of Arctic Circle   | BF42  | Feb 5  |
| Practicality of using small ceramic receiving tubes in thermionic integrated micromodular circuits (TIMMS)  | CM82  | Jun 10 | Military Affiliate Radio System (MARS) considers facsimile and slow-scan tv as supplement to regular amateur activities  | BF48  | Feb 12 | Remote Underwater Manipulator (RUM), a converted Ontos tank, uses TV guide for exploring, installing and removing fixed sonar gear                     | BF31  | Jun 17 |
| Recent advances in preparing thin film ceramic dielectrics for microminiature capacitors  | CM96  | Jan 1  | <b>MILITARY ELECTRONICS</b> (See also specific headings)   |       |        | Replacement parts, repairs and modifications to cost military \$900 this year  | MR30  | Apr 1  |
| Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference  | TF39  | Mar 4  | Acknowledgement by U.S. of recon operation drops cloak from a big and growing area of electronics industry   | BF34  | May 27 | R-f cables and connectors for military applications (See p42, Dec 25, 1959 issue for 1st part of this article)   | TF90  | Jan 1  |
| Selective diffusion and shaping of semiconductors to form complete circuits cut size and weight, improves reliability   | TF69  | May 13 | AF develops translator for converting Russian into English at 35 words a second  | EN11  | May 20 | Role of electronics in Japan's defense set up  | SR53  | May 27 |
| Series of papers on thin films presented in IBM Journal   | CM78  | Jun 17 | AF is investigating X-rays as possible means of space communication  | BF45  | Feb 12 | Search radar facility built by Air Force to provide defense against airborne vehicles  | PC45  | Jan 1  |
| Solid-State Circuits Conference indicates micro-electronics is moving rapidly out of research phase   | BF36  | Feb 12 | AF studies affect of high intensity sound on human physiological reactions   | PC46  | Jun 24 | Servics need inventions in component, transistor, antenna and instrument areas   | BF39  | Jan 22 |
| U.S. headstart over Russia in microminiaturization seen as future space asset   | BTW11 | Apr 8  | Airborne early warning blimps to carry largest radar and electronic equipment complex  | EN11  | Jan 15 | Simulator for selecting best possible target among all in-range attackers  | RD76  | Jan 29 |
| Microphone, miniature capacitor, with 15Kc bandwidth for measurement use, and tv and moving picture studios   | RD80  | May 6  | Army announces development of 25-lb ruby master ARPA contracts awarded to study ways of nullifying attack by nuclear-armed vehicles entering earth's atmosphere from outer space         | BF36  | May 13 | Sonobuoys and repair kits bought by Navy for antisubmarine warfare   | EN11  | Jan 15 |
| Microphone, sound-canceling, makes ordinary voice communication possible in 150-db areas  | PC41  | Apr 22 | Automated submarine uses electronic data processing and display to give ship, engineering, communications, weapons and environmental control   | BF28  | Jan 29 | Telemetry transmitter for ICBM operates through ionized plasma around re-entry missile   | BTW11 | Feb 12 |
| Microphonics in tubes reduced by new cathode base metal   | CM79  | Jun 17 | BMEWS detection and communication system prime contractors get contract awards   | EN11  | Feb 26 | Three infrared and visual detectors under development may change design concepts in advanced military and industrial equipment                         | EN11  | May 27 |
| Microscope, cryogenic electron, of future may give man his first view of atom   | BF32  | Feb 5  | Central organization may be set up to administer program for control over design and procurement of military components  | EN11  | May 27 | Titan flight test program will use pulse-code-modulation telemetry system  | BTW11 | Mar 4  |
| Microscopes, electron, are one of features at British Exhibition in New York  | BF46  | Jun 24 | Defense Department urges extensive changes in management of military electronic parts specs.   | BF31  | Apr 22 | Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches preset level in nuclear-powered Navy vessels                       | TF43  | Jan 22 |
| <b>MICROWAVE SYSTEMS &amp; DEVICES</b> (See also specific headings)   |       |        | Delivery of new single-sideband communications systems for military and commercial market reported   | BTW11 | Mar 18 | Transistorized receiver in model ship helps Navy trainees to study ship-handling problems  | PC43  | Apr 29 |
| Alloyed-emitter, pnp mesa transistor operates in low microwave region and is mounted in coaxial shell   | RD82  | Apr 15 | Department of Defense pushing program to find out more about radar signatures for ICBM's   | EN11  | Jun 17 | Where Polaris stands today - ELECTRONICS visits Navy's first ballistic missile assembly installation   | BF32  | Apr 15 |
| Biasing techniques permit small-area junction germanium diodes to switch microwave in waveguides or transmission lines  | TF85  | Jan 15 | Electron sealing process using optically-ground and mated glass stem and envelopes to extend military tube life  | EN11  | May 6  | Will debate over military policy mean orders or cutbacks?  | BF26  | Mar 4  |
| Broadband microwave amplifier uses negative resistance of tunnel diode in combination with nonreciprocal ferrite attenuation  | CM84  | Mar 25 | Electronics industry will probably get 17 percent of defense budget in ten years   | BF53  | Apr 1  | Wire-guided missiles developed in Europe being appraised by Army   | BF38  | Jan 15 |
| Characteristics and relative cost of coaxial cable and waveguide terminations   | TF50  | Jan 8  | Equations and charts for determining range parameters of active and passive sonar systems  | SR75  | Feb 12 | Millimeter sorts look-alike metals using thermo-electric effect to detect polarity   | PT72  | Jan 8  |
| Compact hybrid microwave mixer for airborne radar receiver is now available   | CM70  | Feb 5  | FAA has raft of big and little plans for 1960  | BF40  | Feb 12 | Millimeter wave amplifiers made from reflex klystrons  | CM68  | Feb 19 |
| Corner reflector antenna offers high-gain, broad-frequency response, narrow beam width and low back radiation   | RD82  | May 6  | Federal spending for coming fiscal year to hold close to last year's figures   | TF41  | Feb 19 | Millimeter wavelength pulsed magnetrons develop high power   | TF71  | Mar 18 |
| Crossed-field amplifier called Circlotron uses magnetron as negative-resistance element   | TF71  | Jan 15 | Fifty-pound Doppler radar detects and accurately locates moving vehicles and men to trace battlefield deployment   | BF32  | Jan 29 | Millimeter waves research promises communications applications   | CM96  | Mar 18 |
| Eastern Joint Computer Conference indicates computers are heading for 1,000-Mc operation and microminiaturized circuits   | TF55  | Jan 29 | Fuel cell power supply for Marine and Army portable field radar to be delivered  | TF67  | Mar 18 | Milling, electron beam metalworking equipment for MILS (missile-impact locating system) developed for Navy uses oceanographic sound-ranging techniques | TF159 | Mar 11 |
| Electronic oven uses microwave technique for assembly line production of pre-frozen meals in Holland  | BF47  | Jun 10 | Generation, detection and transmission of millimicrosec transients being studied at University of Kansas under Navy grant for Project Jayhawk  | EN11  | Apr 29 | Miniature gas-filled stepping tubes for counters operating up to 1Mc   | PT86  | Feb 26 |
| Elliptically polarized X-band horn antenna has d-db and 6-db beamwidths of 140 degrees  | TF50  | Mar 4  | Japanese-made tropospheric scatter communications system used by U.S. forces in Japan  | BF60  | Mar 11 | Minuteman's guidance and control systems need reliable components for underground storage lasting years  | EN11  | Jun 17 |
| End-fire arrays of high-dielectric ceramic rods give low silhouette and high vertical resolution in uhf region  | TF60  | Feb 5  | Large-scale digital computer permits Navy high degree of realism in simulating mock submarine battles  | EN11  | Jan 29 | Accurate pulse-code modulation system for missile telemetry being built  | EN11  | Jan 1  |
| Experimental magnetrons for 32, 12, 8 and 4 mm wavelengths give peak outputs of 1, 100, 70, 80 and 40 kw, respectively  | CM96  | Mar 18 | Long-range 3-D target finding radar installed  | BF35  | Jun 24 | Automatic fault-finding system for testing battery control center of Hawk Weapons System   | TF60  | Jun 17 |
| Experimental solid-state generator for converting pulsed d-c magnetic fields into microwave radiation has been built  | EN11  | Feb 19 | Major use of tunnel diodes seen in industrial and military electronics   | PC42  | Jun 10 | BMEWS detection and communication system prime contractors get contract awards   | EN11  | Feb 26 |
| Hot and cold constant-impedance loads for measuring noise figure of microwave amplifiers  | RD66  | Feb 5  | Mid-continent link in Army's worldwide communications network now operational  | TF159 | Mar 11 | Ceramic-based microminiature adder for ballistic missile computer  | CM96  | Jan 1  |
| Japanese to emphasize development of microwave tubes  | EN11  | Feb 12 | Military electronics market for 1960   | BF35  | Mar 4  | Department of Defense pushing program to find out more about radar signatures for ICBM's   | EN11  | Jun 17 |
| Laminated with properties of Teflon and glass ideal for high-temperature printed circuits and microwave applications  | CM79  | Jun 17 | Military marketing strategy  | SR49  | Jan 1  | Eliminating communication blackout resulting from plasma sheath formation during vehicle reentry using sufficiently high frequency                     | EN11  | Jun 17 |
| Microwave components and measuring instruments receive much attention at 1960 IRE International Show and Convention   | BF47  | Apr 1  | Military weapon system development stresses too much breakthrough research, too many unit cost compromises   | MR26  | Mar 25 | Federal spending on missiles for coming fiscal year to level off   | TF105 | May 27 |
| Microwave components study of 1958 production issued by Commerce Department's Business and Defense Services Administration  | MR24  | Apr 8  | Million-watt transmitter to be completed by year's end for Navy  | BF39  | Jan 29 | Five different electronic firms in five European countries to produce Hawk air defense guided missile  | BF32  | Jan 29 |
| Microwave data link transmits output of side-looking, all-weather terrain mapping radar to ground film recorder   | BF49  | Apr 15 | Missile-impact locating system (MILS) developed for Navy uses oceanographic sound-ranging techniques   | BF41  | Jan 29 | Galactic noise measured by 4-stage sounding rocket   | BF33  | May 6  |
| Microwave links for Japanese television distribution  | SR53  | May 27 | More U.S. gear going into second generation of British missiles  | EN11  | Jun 17 | Ground based missile roll control system uses photosensitive or infrared detectors   | EN11  | Jan 8  |
| Microwave tube called X-Band ampliflon has large anode-dissipation densities  | TF71  | Jan 15 | Navy begins test on UDQFT (Universal Digital Operation Flight Trainer) used to simulate complicated jet flight conditions  | BF32  | Mar 25 | Invisible electronic shield for baffling radar and radar-guided missiles is reported   | RD80  | Mar 25 |
| Modern microwaves-applications, antennas, generators, amplifiers, components and test equipment   | SR67  | Jun 24 | Navy experimental moon-relay communications system demonstrated  | BF44  | Apr 15 | Maneuverable dish radar to scan and track ballistic missiles for BMEWS   | EN11  | May 6  |
| Monopulse tracking radars compared with sequential lobing and conical scan techniques   | TF51  | Apr 22 | Navy survey predicts end equipment sales up \$1.3 billion in 1960  | EN11  | Feb 5  | Match-head size tunnel diode holds great promise for missile satellite and ultra-high-speed data processing applications                               | BF47  | Mar 18 |
| New developments in line-of-sight and over-the-horizon systems  | TF159 | Mar 11 | Navy's Corvus carrier aircraft missile, with passive radar guidance, gets contract push  | EN11  | May 13 | Million-watt transmitter being developed will detect missile-launchings by detecting echoes from ionized trails  | PC69  | Mar 4  |
| Phasemeter measures two signals in 100 to 520 Mc band with 0.2 degree for c-w and 0.5 degree for pulsed uhf   | TF54  | Mar 4  | Navy's surface warships to get new dual-purpose guided missile system called Typhon  | BTW11 | Mar 11 | Miniature tv camera system transmitted high-resolution pictures from Redstone missile  | BF41  | Jan 29 |
| Plasma circuit used as an oscillator to generate microwave energy at 2,000 Mc   | BTW11 | Mar 4  | New AF-operated facility uses computers and complex communications system to coordinate space surveillance, catalog everything in orbit  | BF34  | Mar 4  | Minuteman's guidance and control systems need reliable components for underground storage lasting years  | EN11  | Jan 8  |
| Reflex klystrons used as microwave receiver amplifiers for X-band radars  | TF56  | Jan 8  | Nuclear bomb alarm system design to positively identify atomic explosions installed by AF  | BTW11 | Apr 8  | Missile-impact locating system (MILS) developed for Navy uses oceanographic sound-ranging techniques   | BF39  | Jun 17 |
| Reflex klystrons used as millimeter wave amplifiers   | TF71  | Mar 18 | Oceanographic research indicates undersea fleet effectiveness could be doubled by environmental forecasts  | BF36  | Jan 22 | Missile telemeter-radio interference: Cause and cure   | EN11  | Jun 17 |
| Remove pulse-coded fault alarm for millihop microwave systems   | TF82  | Jan 1  | Portable power-pack using 30 ion-membrane fuel cells under development for Marine and Army Project Defender, a study program to find tomorrow's space defense, to use pincushion radar   | PC53  | May 6  | Missile tracking ship to get more radar measuring equipment  | BF24  | Jan 8  |
| Rutgers University probes various microwave areas   | BF53  | Feb 12 | Project Madre to use magnetic-drum receivers to autocorrelate echoes from over-the-horizon radar missile warning system  | BF42  | Feb 26 | Missiles and space continue to account for much government money spent in guidance and componentry research area                                       | EN11  | Jan 1  |
| Specifications for components in millimeter band Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv | CM68  | Feb 19 | Project Midas heat-seeking missile defense satellite to work with BMEWS radar  | BF28  | Feb 5  | Mobile controller-recorder programs temperatures to test missile components  | EN11  | Jun 3  |
| Thailand, Laos and Vietnam to have telecommunication network for radio and tv   | TF70  | Apr 8  | Project Tepepe detects both missile launchings and nuclear explosions using over-the-horizon radar propagation of electromagnetic waves through subsurface of earth being studied for AF | BF42  | Apr 1  | More U.S. gear going into second generation of British missiles  | PC34  | Jun 17 |
| Tiny platinum wire is heart of Japanese bolometer mount for measuring microwave power   | BF29  | Jan 1  | Prototype of SAC's Automatic Combat Control System (SACCS) being set up  | BF28  | Feb 5  | Navy's Corvus carrier aircraft missile, with passive radar guidance, gets contract push  | EN11  | Jun 3  |
| Triangular waveguide antenna is more rigid and easier to construct than large slotted waveguide cross sections  | CM88  | Apr 1  | R&D costs for Army's Nike-Zeus anti-missile pass \$1/2 billion   | BTW11 | Mar 4  | Navy's surface warships to get new dual-purpose guided missile system called Typhon  | BTW11 | Mar 11 |
| Varactor diodes available in experimental quantities, used for high-efficiency subharmonic oscillators in microwave computers   | RD64  | Feb 19 | Radar warning system that gives 3-dimensional information can be airlifted to site   | BF36  | Mar 25 | New Mexico's electronics industry now in multimillion dollar bracket through missile development, R&D  | BF49  | Apr 29 |
| What's new in electron tubes for low noise, small-signal and power amplifiers   | CM131 | May 27 |  | PC45  | Jan 15 | Nonablative nose cone to be used to determine effects of plasma sheath on radio signals  | BF41  | Apr 15 |
|   | SR55  | Apr 29 |  | EN11  | Jan 1  |  | RD66  | Feb 5  |



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| Participants in Sixth National Flight Test Instrumentation Symposium hear that U.S. is far ahead of Soviets in ballistic missile and satellite fields                     | BF53  | Jun 3  | Selective calling system for aircraft data links removes necessity of continuously monitoring a communication channel                                    | TF108 | Apr 29 | Nixies switched by means of Trixies which use transistor reverse-biasing technique to raise breakdown point  | TF48   | Jan 8  |
| Precision Atlas guidance system recently used to measure rotation of earth  | EN11  | Jun 17 | Step-van truck with instruments for measuring air pollution developed  | BF48  | Feb 12 | Noise, digital sampler for measurement of axis-crossing intervals for theoretical studies of   | TF88   | Jun 3  |
| Probes make patterns of airflow around missile nose cone inside hypersonic wind tunnel in color   | BF52  | Feb 26 | Technique for checking calibration of f-m and tv transmitter percentage-of-modulation monitors   | TF67  | Apr 15 | Noise, effect of on range parameters of active and passive sonar   | TF41   | Feb 19 |
| Project Defender, a study program to find tomorrow's space defense, to use pinushion radar  | BF42  | Feb 26 | Transistorized monitor developed to test electrical contacts under shock and vibration conditions  | RD78  | Apr 8  | Noise figure measurement of microwave amplifiers uses hot and cold constant-impedance loads  | RD66   | Feb 5  |
| Project Madre to use magnetic-drum receivers to autocorrelate echoes from over-the-horizon radar missile warning system   | BF28  | Feb 5  | Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches preset level in nuclear-powered Navy vessels                         | TF43  | Jan 22 | Noise measurement, portable transistorized sound level meter for   | TF64   | Jun 17 |
| Project Tepee detects both missile launchings and nuclear explosions using over-the-horizon radar   | BF28  | Feb 5  | Monochromator, rapid scan, for spectrometer used to detect and analyze infrared energy radiated during power flight portions of missile trajectory       | TF86  | May 20 | Noise problems in digital computer memories solved using drive-sampling core to generate precisely defined strobes   | TF72   | Mar 25 |
| Propagation of electromagnetic waves through subsurface of earth being studied for possible use as missile communication network by AF                                    | BTW11 | Mar 4  | Monochromator system automatic for determining the spectral response of electro-optical materials  | TF66  | Apr 1  | Noise problems of photomultipliers solved by sensitive flaw detector for finding defects in paper  | TF64   | Apr 15 |
| R&D costs for Army's Nike-Zeus anti-missile pass \$1/2 billion  | PC45  | Jan 15 | Monoscope-camera system converts computer data into visual form on microfilm   | BF11  | Feb 26 | Noise suppression factor display unit computes and automatically displays ratio of two time-varying quantities   | TF55   | Feb 5  |
| Radar transmitter for anti-missile Zeus being tested  | BF34  | May 27 | Monoscope tube generates characters for direct readout on a cro or on paper of digital computer output   | TF117 | Feb 12 | Nomograph gain and beamwidth of helical antenna obtained with one setting of straightedge on   | ERS180 | Mar 11 |
| Radar view of atlas ICBM  | BF45  | Feb 26 | Moon relay communications system kicks off Armed Forces Communications and Electronics Association's 14th Convention                                     | BF42  | Jun 10 | Nomographs for estimating radiation capability low-frequency electrically-short antennas   | ERS86  | Mar 18 |
| Radiation-operated fuel gage for missiles and aircraft  | RD117 | Apr 29 | Morphology of 27 possible electro-optical power amplifiers   | TF71  | Feb 26 | <b>NUCLEONICS</b> (See also Radiation)   |        |        |
| Radioisotope density altimeter is designed for missiles and fast new aircraft   | BF37  | Jan 8  | Motors, printed-circuit, answers to questions about Motors, printed, interest in mounts as electric auto talk is revived                                 | CM80  | Apr 22 | Accurate and stable pulse height discriminator for nuclear physics work  | TF89   | May 20 |
| Rapid scan spectrometer detects and analyzes infrared energy radiated during power flight portions of missile trajectory  | TF86  | May 20 | Motors, step, drive milling machine via thyatron-controlled signals from a programmed tape   | BTW11 | Apr 22 | Air transportable nuclear reactor now in instrumentation stage   | EN11   | Jan 1  |
| Rearward communications for BMEWS provided by submarine cable from Greenland to north of Arctic Circle  | BF42  | Feb 5  | Mount, floating, for uhf triodes   | TF174 | Mar 11 | Applications of ignitrons in nuclear fields  | SR55   | Apr 29 |
| Signal transmission through natural ionized layers and ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions  | TF81  | May 20 | Multiplex circuits control robot which performs jobs in dangerously radioactive areas  | CM68  | Jan 8  | Astracon, a small light amplifier tube, increases light-gathering ability of telescopes, permits viewing of high-energy particle tracks                                  | PC82   | Jun 10 |
| Sixty-ft reflector for 3-axis antenna provides hemispheric coverage of missile and satellite telemetered data   | PC40  | Jan 1  | Multiplex system, British, for bilingual broadcasts or conventional stereophonic transmissions   | TF46  | Jan 22 | Battery-powered transistorized scale-of-64 counter for measuring radioactive tracers, improves reliability, reduces cost and weight                                      | TF74   | May 6  |
| Steel marble used as moving short circuit to analyze sensitivity of fuzes used in guidance and detonation missiles  | PC48  | Apr 29 | <b>MULTIPLIERS</b>   | TF87  | Jun 3  | Cadmium sulfide field-effect transistor used experimentally as radiation detector  | BF42   | Mar 18 |
| Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv  | TF70  | Apr 8  | Photomultiplier and electrometer measure fluorescence of glass dosimetry needle to determine radiation exposure in human body                            | TF74  | Mar 18 | Cesium cell converter working at high temperatures produces significant amounts of a-c electricity   | CM78   | Jan 29 |
| Telemetry transmitter for ICBM operates through ionized plasma around re-entry missile  | BTW11 | Feb 12 | Polarity coincidence multiplier detects weak low-frequency signal in high-noise background   | TF67  | Jan 29 | Data gathering and logging system monitors nuclear radiation levels and weather conditions   | RD64   | Jan 22 |
| Titan flight test program will use pulse-code-modulation telemetry system   | BTW11 | Mar 4  | Q multiplier used as oscillator in electronic wire gage for nondestructive measurement of wire thickness   | TF109 | Feb 12 | Double-focusing mass spectrometer measures relative amounts and weights of atoms   | RD74   | Jan 29 |
| Transistorized circuits for guiding Able series space exploration probes  | TF60  | Jan 29 | Specifications of frequency multiplier used in millimeter band   | CM68  | Feb 19 | Electronics R & D in nuclear energy in France and Israel   | SR75   | Feb 12 |
| Ultrasonic resonance thickness gage measures missile radomes and nose cones   | PC86  | Feb 26 | What's new in multiplier phototubes  | SR55  | Apr 29 | Generation, detection and transmission of millimicrosec transients being studied at University of Kansas under Navy grant for Project Jayhawk                            | BF60   | Mar 11 |
| Waveguide, 2,200 ft long delivered to AF missile center   | EN11  | Jan 1  | <b>MULTIVIBRATORS</b>  | BF42  | Mar 18 | Light sensor in automatic bomb alarm system now being installed in strategic U. S. cities  | PC45   | Apr 8  |
| What designers should know about performance of missile components in dynamic environments  | TF102 | Apr 29 | Cadmium sulfide field-effect transistor used   | ERS58 | Jan 22 | Measuring flow rates of a variety of fluids by detecting nuclear magnetic resonance  | TF77   | Apr 1  |
| Where Polaris stands today - ELECTRONICS visits Navy's first ballistic missile assembly installation  | BF32  | Apr 15 | Choosing transistors for monostable multivibrators used as variable delay generators   | TF55  | Feb 19 | Microminiature tube circuits featuring nuclear radiation resistance offered at IRE International Show and Convention   | BTW11  | Apr 1  |
| Will debate over military policy mean orders or cutbacks?   | BF26  | Mar 4  | Cadmium sulphide field-effect phototransistors used successfully in oscillator, multivibrator, amplifier and radiation detector circuits                 | TF73  | Apr 8  | Multiplex circuits control robot which performs jobs in dangerously radioactive areas  | TF46   | Jan 22 |
| Wire-guided missiles developed in Europe being appraised by Army  | BF38  | Jan 15 | Graphical method of solving sweep oscillator multivibrator instability problems encountered in tv receivers  | BTW11 | Jan 29 | Nuclear bomb alarm system design to positively identify atomic explosions installed by AF  | BTW11  | Apr 8  |
| Mixer circuit for comparator used in automatic fault-finding system for testing battery control center of Hawk Weapons System   | TF60  | Jun 17 | Insuring stability in precision time delay multivibrators used in radar and industrial electronics   | TF57  | Apr 22 | Nuclear-fueled power plant using magnetohydrodynamic generators being studied  | RD92   | Jan 1  |
| Mixer, compact hybrid microwave, for airborne radar receiver is now available   | CM70  | Feb 5  | Multivibrators grown from pool of molten semiconductor materials   | TF67  | Mar 18 | Nuclear instrument shipments for 1958 rise 33 percent over those of 1957   | MR22   | Feb 19 |
| Mixer, tv tuner, specially developed diffused-base mesa transistor used in  | TF64  | Apr 8  | Saturating-core multivibrator used as power converter in portable battlefield radar  | TF67  | Mar 18 | Project Tepee detects both missile launchings and nuclear explosions using over-the-horizon radar  | BF28   | Feb 5  |
| MOBIDIC used drive-sampling core to generate precisely defined strobes to solve noise problems  | TF72  | Mar 25 | Starter multivibrator for coding circuit used to record output of tv system tracking eye focus points and movements                                      | TF57  | Apr 22 | Proton synchrotron of European Organization for Nuclear Research in Operation  | EN11   | Jan 1  |
| Modulation and remodulation problems solvable using graphical extension of transfer techniques  | TF68  | Apr 1  | Trigger multivibrator for self-powered transistor oscilloscope   | TF80  | Mar 18 | Quartz crystals and atomic clocks are subjects of major interest at 14th annual Frequency Control Symposium  | BF38   | Jun 24 |
| <b>MODULATORS</b>   |       |        | Music synthesizer potential for forming new music being investigated by Joint Columbia University-RCA project  | BF60  | Mar 11 | Radar field causes continuous discharge in bulb with gas of reduced pressure   | PC83   | Apr 15 |
| Completely passive, balanced modulator circuits using thin permalloy film described at 1960 Winter Convention on Military Electronics                                     | RD78  | Feb 26 | Mutators, or power amplifiers, for handling various combination of electric, radioactive and thermal power   | TF71  | Feb 26 | Radiation-operated fuel gage for missiles and aircraft   | RD117  | Apr 29 |
| Frequency modulating a resonant circuit using reactance switching technique   | TF74  | Feb 26 | Mylar magnetic disk memory unit stores 50,000 to 60,000 bits   | TF55  | Jan 29 | Response of electronic system components and materials to irradiation from nuclear-powered aircraft  | TF69   | Apr 22 |
| Phase-shift modulator for double-sideband suppressed carrier transmitter  | TF47  | Feb 5  | <b>NAVIGATION SYSTEMS</b>  |       |        | Semiconducting industrial diamonds may find application as counters of radio-activity  | RD76   | Apr 22 |
| Power tubes for pulse modulators  | SR55  | Apr 29 | (See also Air Traffic Control, Aviation and Guidance Systems)  |       |        | Semiconductor wafer Hall probe in magnetic field plotting system speeds cyclotron design   | RD80   | Apr 8  |
| Pulse-position modulator used in vhf telemetry system for eliminating communication blackout from plasma sheath formation during vehicle reentry                          | TF105 | May 27 | Automatic gas-fume detector alarms, Loran, radiotelephones, direction finders, and depth sounder fish finders make up new \$10-million small boat market | BF30  | Jan 22 | Signal transmission through natural ionized layers and ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions | TF81   | May 20 |
| Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit  | TF68  | May 6  | Electronics R & D in navigation systems in France  | SR75  | Feb 12 | Silicon-carbide rectifier that withstand 500 C and is useable in nuclear environments  | CM94   | Mar 18 |
| Transistorized f-m modulator for tape target classifier used to train land-based sonar student operators  | TF65  | Mar 25 | FAA 1960 program to concentrate heavily on air navigation facilities   | BF40  | Feb 12 | Silicon pn junctions used as particle detectors  | RD74   | Apr 22 |
| Modules, half-inch cube holding 12 to 18 components used in reconnaissance drone guidance system, commercial and military computers                                       | CM123 | Apr 29 | FAA orders test monitoring control equipment to check out VORTAC air navigation system   | EN11  | Feb 26 | Solid-state radiation detector made of doped silicon gives new speed and accuracy to particle analysis   | BTW11  | Feb 5  |
| Modules in battery control center of Hawk Weapons System tested by automatic fault-finding system   | TF60  | Jun 17 | FAA rules out British Decca Mark X hyperbolic system for navigation  | BTW11 | Jan 22 | Transistorized pulse generator for synchronizing events in zero-gradient synchrotron   | TF63   | Jun 10 |
| Modules, peg board type pallet permits connections to be dip soldered   | PT192 | Mar 11 | Optical-electronic active system for communications, navigation, and tracking and acquisition applications   | TF71  | Jan 15 | Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches present level in nuclear-powered Navy vessels  | TF43   | Jan 22 |
| Modules, thermoelectric cooling of, for electronics components in R&D stage   | RD68  | Feb 5  | Precipitation static eliminated from airborne radio and navigation equipment by sharp tungsten pins  | RD96  | Jun 3  | Vibrating platform uses beads to simulate atomic motion  | PC74   | Jan 29 |
| <b>MONITORS</b>   |       |        | Study of atmospheric noise needed to develop long-range vlf navigation systems   | RD78  | Apr 8  | West Berlin's Institute for Nuclear Research gets new transistorized computer  | BF31   | Jun 10 |
| (See also Displays, Indicators and Readout Devices)   |       |        | Navigation for hypersonic or space craft aided by computer-directed map projection system under development  | EN11  | Jun 3  | Nuvistor goes into production  | BF35   | Feb 19 |
| Closed-circuit tv for monitoring dental surgery and for assisting in diagnosis being studied  | TD92  | Jan 1  | Negative resistance elements, use of in active circuit synthesis   | BF44  | May 20 |  |        |        |
| Closed-circuit tv monitors quality during production of mesa transistors  | PT86  | Apr 8  | Neon lamp on rotating arm of constant speed motor replace crt in portable transistorized depth indicator   | TF50  | Feb 5  | <b>OCEANOGRAPHY</b> (See also Sonar)   |        |        |
| Data gathering and logging system monitors nuclear radiation levels and weather conditions ground station monitoring circuit for slow-scan tv chain used with Stroscope I | RD64  | Jan 22 | Nemst effect, definition of  | TF71  | Feb 26 | D-c transistor amplifier for measurement of low-amplitude long-period surface waves of ocean   | TF85   | Jan 1  |
| Millipore filter tape instrument monitors high-purity water   | PT125 | Jun 24 | Network, Twin-T, charts normalized for frequency provide rapid solution to parameters for  | ERS67 | Jun 17 | Equations and charts for determining range parameters of active and passive sonar systems  | TF41   | Feb 19 |
| Monitoring production flow items gets good start in Britain   | BF52  | May 13 | Networks, semiconductor for microelectronics   |       |        | Missile-impact locating system (MILS) developed for Navy uses oceanographic sound-ranging techniques   | EN11   | Jun 17 |
| Plane and vehicle movements monitored by tv system  | BF44  | Mar 25 | Networks synthesis rather than analysis stressed at Conference on Active Network and Feedback Systems  | BF44  | May 20 | Oceanographers position underwater photographic cameras, take samples of sea water and bottom sediments with help of sonar   | TF93   | Jun 24 |
| Pulsed x-ray pencil beam gages thickness of hot and cold rolled metals  | PC62  | Jan 22 | Neuron model and electronic equivalent discussed at winter meeting of AIEE   | BF28  | Feb 19 | Oceanographic research indicates undersea fleet effectiveness could be doubled by environmental forecasts  | BF36   | Jan 22 |
|   |       |        |  |       |        | Remote Underwater Manipulator (RUM), a converted Ontos tank, uses TV guide for exploring, installing and removing fixed sonar gear                                       | BF31   | Jun 17 |

|  |       |        |   |       |        |  |       |        |
|--|-------|--------|---|-------|--------|--|-------|--------|
| Underwater camera flash and film-rewind circuits control picture taking at depths of 6 miles....   | TF62  | Apr 8  | What's new in cathode ray tubes for oscillography   | SR55  | Apr 29 | Plasma circuit used as an oscillator to generate microwave energy at 2,000 Mc .....  | BTW11 | Mar 4  |
| Oil lines buried undersea detected by metal locator which generates electromagnetic field .....  | BF57  | Jan 15 | Oven, electronic, uses microwave technique for assembly line production of pre-frozen meals .....   | BF47  | Jun 10 | Properties of representative liquid polymers for cold-molding cable systems .....  | TF67  | May 1  |
| Operation Skyhook balloons will study cosmic rays at 18 to 22 mi altitudes .....   | EN11  | Jan 1  | Overload circuit, transistorized, for production and maintenance testing of transistors with low d-c voltages .....   | RD125 | Feb 12 | Telemetry transmitter for ICBM operates through ionized plasma around re-entry missile .....   | BTW11 | Feb 12 |
| <b>OPTICS</b> (See also Infrared and Photography)  |       |        |   |       |        |  |       |        |
| Astracon, a small light amplifier tube, increases light-gathering ability of telescopes, permits viewing of high-energy particle tracks .....                                  | PC82  | Jun 10 |   |       |        | Unique instrumentation for investigating possibilities of using plasma to propel space vehicles .....  | TF66  | Jun 10 |
| Automatic spectroscopic system for determining the spectral response of electro-optical materials .....  | TF66  | Apr 1  |   |       |        |  |       |        |
| Fiber optics used in closed-circuit tv dental monitor .....  | RD92  | Jan 1  |   |       |        |  |       |        |
| Non-newtonian color optics being used in color-reception system using two monochrome tubes shown at regional meeting of Society of Photographic Scientists and Engineers ..... | EN11  | Jun 24 |   |       |        |  |       |        |
| Optical-electronic active system for communications, navigation, and tracking and acquisition application .....  | TF71  | Jan 15 |   |       |        |  |       |        |
| Optical-electronic magnetometer control attitude of vehicles in space .....  | TF55  | Apr 8  |   |       |        |  |       |        |
| Optical maser growth expected to grow in next two years .....  | TF159 | Mar 11 |   |       |        |  |       |        |
| Optical measurement for evaluating three-element semiconductor materials .....   | TF103 | Feb 12 |   |       |        |  |       |        |
| Orientation of vehicles in space using optical-electronic magnetometer as control .....  | TF55  | Apr 8  |   |       |        |  |       |        |
| Polyopic sealing technique improves the reliability and life of glass envelope electron tubes  | PT114 | May 20 |   |       |        |  |       |        |
| Power amplifiers using electro-optical effects handle various combinations of electric, radioactive and thermal power .....  | TF11  | Feb 26 |   |       |        |  |       |        |
| RCA to open research laboratory in Japan to study electrical, magnetic and optical properties of solid-state phenomena .....   | EN11  | Jun 24 |   |       |        |  |       |        |
| Recording optical tracking instrument (ROTI) used with rapid scan spectrometer to detect infrared energy radiated during power flight portions of missile trajectory .....     | TF86  | May 20 |   |       |        |  |       |        |
| Unconventional slow-scan TV chain assists astronomers in finding sunspots with balloon-borne optical telescope .....   | TF49  | Jun 17 |   |       |        |  |       |        |
| <b>OSCILLATORS</b>   |       |        |   |       |        |  |       |        |
| Balanced-bridge and semiconductor diode circuits for one-tube oscillator-mixers in tv and fm tuners .....  | TF76  | Jan 15 |   |       |        |  |       |        |
| Cadmium sulfide field-effect transistor used experimentally as oscillator .....  | BF42  | Mar 18 |   |       |        |  |       |        |
| Cadmium sulphide field-effect phototransistors used successfully in oscillator, multivibrator, amplifier and radiation detector circuits .....                                 | EN11  | Feb 26 |   |       |        |  |       |        |
| Continuously running crystal-controlled transistor oscillator gate for pulse-height-to-digital signal converter .....  | TF58  | Jan 8  |   |       |        |  |       |        |
| Designing high-frequency, high-power transistor oscillator circuits .....  | TF52  | Jan 8  |   |       |        |  |       |        |
| Designing simultaneous dual-frequency oscillators .....  | RD182 | Mar 11 |   |       |        |  |       |        |
| Determining proper bias and correct circuit impedances for operating tunnel diodes as switches, amplifiers or oscillators .....  | TF82  | Jun 3  |   |       |        |  |       |        |
| Dynamic tester evaluates transistors by their performance as component in oscillator circuit .....   | RD66  | Feb 19 |   |       |        |  |       |        |
| Eight-pulse transistor train oscillator for pulse-height-to-digital signal converter .....   | TF58  | Jan 8  |   |       |        |  |       |        |
| Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector .....   | TF58  | Feb 19 |   |       |        |  |       |        |
| Graphical method of solving sweep oscillator multivibrator instability problems encountered in tv receivers .....  | TF55  | Feb 19 |   |       |        |  |       |        |
| High-voltage oscillator supply for self-powered transistor oscilloscope .....  | TF80  | Mar 18 |   |       |        |  |       |        |
| Plasma circuit used as an oscillator to generate microwave energy at 2,000 Mc .....  | BTW11 | Mar 4  |   |       |        |  |       |        |
| Precision R-C oscillator uses controlled phase-shift network in feedback loop get high degree of frequency stability .....   | TF76  | Apr 15 |   |       |        |  |       |        |
| Q multiplier used as oscillator in electronic wire gage for nondestructive measurement of wire thickness .....   | TF109 | Feb 12 |   |       |        |  |       |        |
| Specially developed diffused-base mesa transistor used in oscillator for tv tuner .....  | TF64  | Apr 8  |   |       |        |  |       |        |
| Subharmonic phase-locked oscillator give promise of microwave computer operation .....   | TF55  | Jan 29 |   |       |        |  |       |        |
| Transfluxor (magnetic-electronic) oscillator retains last frequency setting many hours after control signal removal .....  | TF48  | Mar 4  |   |       |        |  |       |        |
| Tunnel diode microwave oscillator and amplifier circuits reported at 1960 Solid-State Circuits Conference .....  | TF39  | Mar 4  |   |       |        |  |       |        |
| Typical semiconductor phase-shift oscillator for microcircuits .....   | TF69  | May 13 |   |       |        |  |       |        |
| Varactor diodes available in experimental quantities, used for high-efficiency subharmonic oscillators in microwave computers .....  | CM131 | May 27 |   |       |        |  |       |        |
| Variable 90-Mc oscillator for precision phase-meter used for c-w and pulsed uhf .....  | TF54  | Mar 4  |   |       |        |  |       |        |
| What's new in backward-wave and magnetron oscillator tubes .....   | SR55  | Apr 29 |   |       |        |  |       |        |
| <b>OSCILLOSCOPES &amp; OSCILLOGRAPHY</b>   |       |        |   |       |        |  |       |        |
| Digital oscilloscope for direct readout of amplitudes and waveforms announced .....  | EN11  | Feb 5  |   |       |        |  |       |        |
| Digital readout oscilloscope shown at IRE Show .....   | BF47  | Apr 1  |   |       |        |  |       |        |
| Oscilloscope and oscillograph market will increase 50 percent between 1962 and 1969 .....  | MR24  | Feb 5  |   |       |        |  |       |        |
| Oscilloscope with direct digital readout of amplitude and duration of pulse signals reduce operator errors, cut measurement time .....   | BF30  | Mar 4  |   |       |        |  |       |        |
| Sampling attachment for conventional oscilloscopes can resolve rise times of 1/3 nanosec with repetition rates up to 50 Kc .....   | TF96  | Jun 24 |   |       |        |  |       |        |
| Sampling oscilloscope permits measurement of computer diode recovery times down to 500 picosec .....   | TF59  | Apr 8  |   |       |        |  |       |        |
| Self-powered transistor oscilloscope has response from d-c to over 5 Mc .....  | TF80  | Mar 18 |   |       |        |  |       |        |
| Two-tube generator provides accurate, stable intensity marker for oscilloscope over 8 to 22 Mc frequency range for bandpass measurements .....                                 | TF108 | Jun 24 |   |       |        |  |       |        |
| Use of stroboscope principle for nano and picosecond oscilloscopes described .....   | EN11  | May 27 |   |       |        |  |       |        |
|  |       |        | Paging system, selective, uses coded transmission for voice intercommunications with up to 45 Stations .....  | TF68  | Feb 68 |  |       |        |
|  |       |        | Paper and plastic film capacitors, characteristics of .....   | TF78  | Mar 25 |  |       |        |
|  |       |        | Paper defects found by sensitive flaw detector system .....   | TF64  | Apr 15 |  |       |        |
|  |       |        | Parabolic reflectors used in modern microwaves .....  | SR67  | Jun 24 |  |       |        |
|  |       |        | Parametric amplifier, electron-beam, operated in synchronous pumping mode improves receiver sensitivity, increases range of coho MTI radar by 50 percent .....  | RD92  | May 13 |  |       |        |
|  |       |        | Parametric amplifier increases range of 5-band radar used to track reentry vehicles .....   | RD116 | Apr 29 |  |       |        |
|  |       |        | Parametric amplifier, linear-beam, microwave tube for .....   | SR55  | Apr 29 |  |       |        |
|  |       |        | Parametric amplifiers with variable-capacitance diodes expected to start appearing in systems soon .....  | TF159 | Mar 11 |  |       |        |
|  |       |        | Parametric resonance, electronic, discussed at Instrument Society of America Meeting .....  | BF47  | Jun 24 |  |       |        |
|  |       |        | Parametron logic, register, adder, counter, translator and converter circuits for digital computers .....   | TF73  | Jun 3  |  |       |        |
|  |       |        | Patent protection in Russia obtainable only by applying for Russian patents .....   | EN11  | Jan 8  |  |       |        |
|  |       |        | Patent searching using computer techniques being tested by U. S. Patent Office .....  | RD124 | Feb 12 |  |       |        |
|  |       |        | Peltier effect, definition of .....   | TF71  | Feb 26 |  |       |        |
|  |       |        | Peltier effect gives wide-range temperature control .....   | TF71  | Jan 15 |  |       |        |
|  |       |        | Perceptron, Mark I, demonstrates ability to learn the alphabet .....  | BF43  | Jun 24 |  |       |        |
|  |       |        | Perceptron, new development in learning systems .....   | TF159 | Mar 11 |  |       |        |
|  |       |        | Periodic focused traveling wave tubes, what's new in .....  | SR55  | Apr 29 |  |       |        |
|  |       |        | Phasemeter measures two signals in 100 to 520 Mc band with 0.2 degree for c-w and 0.5 degree for pulsed uhf .....   | TF54  | Mar 4  |  |       |        |
|  |       |        | Phasemeter, polarity coincidence multiplier used as Phenolic laminate, paper-base, provides flame retardance with excellent cold punching characteristics ..... | TF67  | Jan 29 |  |       |        |
|  |       |        | Phosphors for cathode ray tubes, what's new in .....  | CM103 | Jun 3  |  |       |        |
|  |       |        | Photocells, silicon, used as detectors in projector optical sound track pickup .....  | SR55  | Apr 29 |  |       |        |
|  |       |        | Photoconductive infrared detectors, characteristics of .....  | PC68  | Jan 8  |  |       |        |
|  |       |        | Photoconductive power amplifiers using electro-optical effects handle various combinations of .....   | TF72  | Apr 1  |  |       |        |
|  |       |        | Photoelectric blood pressure meter developed by Russians .....  | RD75  | Jun 17 |  |       |        |
|  |       |        | Photoelectric, radioactive and thermal power .....  | TF71  | Feb 26 |  |       |        |
|  |       |        | Photoelectricity, researchers demonstrate experimental photogenerator for converting solar energy by photoelectric emission .....                               | EN11  | May 27 |  |       |        |
|  |       |        | Photoelectromagnetic detector, uncooled, made of indium-antimonide responds to long infrared wavelengths .....  | TF62  | Mar 25 |  |       |        |
|  |       |        | Photoelectromagnetic infrared detectors, characteristics of .....   | TF72  | Apr 1  |  |       |        |
|  |       |        | <b>PHOTOGRAPHY</b> (See also Infrared and Optics)   |       |        |  |       |        |
|  |       |        | MIT interplanetary space probe to take photographs of 40 percent of Mars' surface .....   | BF49  | May 20 |  |       |        |
|  |       |        | Monoscope-camera system converts computer data into visual form on microfilm .....  | BF11  | Feb 26 |  |       |        |
|  |       |        | Oceanographers position underwater photographic cameras, take samples of sea water and bottom sediments with help of sonar .....                                | TF93  | Jun 24 |  |       |        |
|  |       |        | Photographic system records electromagnetic radiation from lightning (sferics) propagated over long distances .....   | RD64  | Mar 4  |  |       |        |
|  |       |        | Photographically-sensitized metal sheet makes custom labels for instrument and test equipment panels .....  | PT100 | Jan 1  |  |       |        |
|  |       |        | Single-transistor circuit forms efficient photo-flash power converter .....   | TF57  | Jan 22 |  |       |        |
|  |       |        | Transistorized f-m uhf receiver for camera control system used in rocket sled tests .....   | TF63  | Apr 1  |  |       |        |
|  |       |        | Underwater camera flash and film-rewind circuits control picture taking at depths of 6 miles .....  | TF62  | Apr 8  |  |       |        |
|  |       |        | Watchdog satellites to carry TV cameras and electrostatic tape recorders to check performance of other satellites .....   | BF35  | Jun 10 |  |       |        |
|  |       |        | Photorectifier based on combination of photoconductor and electret reported at 1960 Solid-State Circuits Conference .....                                       | TF39  | Mar 4  |  |       |        |
|  |       |        | Phototubes, what's new in .....   | SR55  | Apr 29 |  |       |        |
|  |       |        | Photovoltaic effect, definition of .....  | TF71  | Feb 26 |  |       |        |
|  |       |        | Photovoltaic infrared detectors, characteristics of .....   | TF72  | Apr 1  |  |       |        |
|  |       |        | Pico transistors made of triple-diffused npn silicon mesa designed as low-power high-speed switches (See also Magneto-hydrodynamics) .....                      | CM82  | Apr 8  |  |       |        |
|  |       |        | Piezoelectricity, high degree of, discovered in zinc oxide and cadmium sulfide .....  | BF52  | Jun 24 |  |       |        |
|  |       |        | Pinger, sonar, helps oceanographers position underwater photographic cameras, take samples of sea water and bottom sediments .....                              | TF93  | Jun 24 |  |       |        |
|  |       |        | <b>PLASMA PHYSICS</b> (See also Magneto-hydrodynamics)  |       |        |  |       |        |
|  |       |        | Eliminating communication blackout resulting from plasma sheath formation during vehicle reentry using sufficiently high frequency .....                        | TF105 | May 27 |  |       |        |
|  |       |        | Gas plasma gun sprays materials with high melting points onto materials with relatively low melting points .....  | PT77  | Feb 5  |  |       |        |
|  |       |        | Magneto-hydrodynamics symposium of AIEE points up electronics industry's growing interest in plasma research .....  | EN11  | Mar 4  |  |       |        |
|  |       |        | Magneto-hydrodynamics takes on new significance to electronics industry .....   | BF52  | Mar 11 |  |       |        |
|  |       |        | NASA contracts for design of experimental cesium-stream ion engine .....  | EN11  | Jun 17 |  |       |        |
|  |       |        | New development in plasma physics .....   | TF159 | Mar 11 |  |       |        |
|  |       |        | Nonablative noise cone to be used to determine effects of plasma sheath on radio signals .....  | RD66  | Feb 5  |  |       |        |
|  |       |        |   |       |        | PLASTICS   |       |        |
|  |       |        |   |       |        | Dollar value of plastics parts produced by electronics companies in 1959 is \$250 million, double 1958's \$125 million .....                     | MR24  | Jun 24 |
|  |       |        |   |       |        | Flexible Mylar magnetic disk memory unit stores 50,000 to 60,000 bits .....  | TF55  | Jan 29 |
|  |       |        |   |       |        | Plastic and paper film capacitors, characteristics of .....  | TF78  | Mar 25 |
|  |       |        |   |       |        | Plastic holders for rack-mount printed circuit cards developed .....   | PT85  | Jan 29 |
|  |       |        |   |       |        | Plastic laminates for missile use give substantially superior ablation resistance .....  | CM84  | Apr 15 |
|  |       |        |   |       |        | Plastic skin packaging for electronic components, wire and circuit board assemblies and electro-mechanical parts .....                           | PT82  | Jan 29 |
|  |       |        |   |       |        | Plastic type transistor developed by Soviet scientist .....  | EN11  | Jan 1  |
|  |       |        |   |       |        | Plotter, high-speed digital, cuts time for reducing teletyped data .....   | TF41  | Jan 8  |
|  |       |        |   |       |        | Report on semiconductor plastics - in U. S. S. R. and in U. S. A. .....  | CM68  | Jan 22 |
|  |       |        |   |       |        | Spincasting of plastic parabolic radio mirrors may provide antenna surface accuracies presently not practical .....                              | RD96  | Jan 15 |
|  |       |        |   |       |        | USSR claims to have made transistors from plastic fiber using bombardment techniques .....   | BF26  | Jan 22 |
|  |       |        |   |       |        | Vacuum-formed plastic skin protects unheated relays mounted on plug-in printed circuit boards .....  | PT195 | Mar 11 |
|  |       |        |   |       |        | Plating, brush, air-operated masking jig speeds precision soldering of transistor tabs .....   | PT70  | Mar 4  |
|  |       |        |   |       |        | Plating, techniques for correcting rhodium plating defects .....   | PT124 | Apr 29 |
|  |       |        |   |       |        | Polarity coincidence multiplier detects weak low-frequency signal in high-noise background .....   | TF67  | Jan 29 |
|  |       |        |   |       |        | Pollution, air, step-van truck with instruments for measuring developed .....  | PC48  | Feb 12 |
|  |       |        |   |       |        | Polyethylene with high tensile strength at high temperatures used for films, tapes, molded industrial parts, and wire and cable insulation ..... | CM84  | Apr 15 |
|  |       |        |   |       |        | Pyrooptic sealing to extend military tube life .....   | EN11  | May 6  |
|  |       |        |   |       |        | Post office, self-service, installed in twin cities .....  | PC48  | Jun 3  |
|  |       |        |   |       |        | Potentiometer dials and knobs drilled-tapped and assembled by six-spindle turret .....   | PT90  | Mar 25 |
|  |       |        |   |       |        | Potentiometers, variable, grown from pool of molten semiconductor materials .....  | BTW11 | Jan 29 |
|  |       |        |   |       |        | Potting cable systems, properties of representative liquid polymers for .....  | TF67  | May 6  |
|  |       |        |   |       |        | Potting base of electron tubes, material for .....   | CM84  | May 6  |
|  |       |        |   |       |        | Power dissipation, reduction of in receiving-type electron tubes being researched .....  | SR55  | Apr 29 |
|  |       |        |   |       |        | <b>POWER SOURCES &amp; SUPPLIES</b> (See also Batteries)   |       |        |
|  |       |        |   |       |        | Basic design considerations of silicon solar cells for use as power supplies on satellites .....   | TF167 | Mar 11 |
|  |       |        |   |       |        | Cesium cell converter working at high temperatures produces significant amounts of a-c electricity .....   | CM78  | Jan 29 |
|  |       |        |   |       |        | Fuel cell power supply for Marine and Army portable field radar to be delivered .....  | EN11  | Apr 29 |
|  |       |        |   |       |        | Linear circuits used to obtain precise voltage regulation of output of transistorized d-c to a-c inverter .....                                  | TF61  | Apr 15 |
|  |       |        |   |       |        | Magneto-hydrodynamics power plant generators offering high-efficiency output being studied .....   | RD92  | Jan 1  |
|  |       |        |   |       |        | Portable power pack using 30 ion-membrane fuel cells under development for Marine and Army .....   | PC53  | May 6  |
|  |       |        |   |       |        | Silicon solar cells power automobile .....   | PC52  | Jun 24 |
|  |       |        |   |       |        | Single-transistor circuit forms efficient photoflash power converter .....   | TF57  | Jan 22 |
|  |       |        |   |       |        | Solar-powered call system gives drivers choice of emergency highway service .....  | PC53  | Jun 3  |
|  |       |        |   |       |        | Sophisticated electronic gear on ships may mean use of more solid-state power supplies .....   | EN11  | Feb 12 |
|  |       |        |   |       |        | Thermoelectric generator built which delivers 5 Kw by direct conversion of heat into electricity without major moving parts .....                | RD96  | Jun 3  |
|  |       |        |   |       |        | Power tubes, high-vacuum, what's new in .....  | SR55  | Apr 29 |
|  |       |        |   |       |        | <b>PRINTED CIRCUITS</b> (See also Microminiaturization and Thin Films)   |       |        |
|  |       |        |   |       |        | Answers to printed circuit motor questions .....   | CM80  | Apr 22 |
|  |       |        |   |       |        | Bins feed small parts in assembly sequence during manufacture of printed circuit boards .....  | PT88  | Apr 8  |
|  |       |        |   |       |        | Interest in printed motor mounts as electric auto talk is revived .....  | BTW11 | Apr 22 |
|  |       |        |   |       |        | Laminate with properties of Teflon and glass ideal for high-temperature printed circuits and microwave applications .....                        | CM79  | Jun 17 |
|  |       |        |   |       |        | Low-pressure air most efficient method to cool components during manual soldering of printed circuits .....                                      | PT104 | May 13 |
|  |       |        |   |       |        | Plastic-backed paper negatives transfer etched circuit wiring patterns onto copper-clad epoxy glass laminates .....                              | PT70  | Mar 4  |
|  |       |        |   |       |        | Plastic holders for rack-mount printed circuit cards developed .....   | PT85  | Jan 29 |
|  |       |        |   |       |        | Plug-in type single ended tantalum foil capacitors give more capacitance in less space .....   | CM98  | Jan 1  |
|  |       |        |   |       |        | Printed circuit masters drafted on film with ultraviolet light .....   | PT80  | Jun 17 |
|  |       |        |   |       |        | Production of large ceramic pieces to serve as circuit boards reported .....   | CM87  | May 6  |
|  |       |        |   |       |        | Silk screening machine for semiautomatic production of printed circuits has traveling head .....   | PT98  | Mar 18 |
|  |       |        |   |       |        | Transistors developed which are almost flush with print circuit boards .....   | EN11  | May 20 |
|  |       |        |   |       |        | Vacuum-formed plastic skin protects unheated relays mounted on plug-in printed circuit boards .....  | PT195 | Mar 11 |
|  |       |        |   |       |        |  |       |        |



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|--|-------|--------|--|-------|--------|--|-------|--------|
| Process control, computer and automatic control uses in chemical, petroleum, railroad and broadcast industries discussed at winter meeting of AIEE | BF28  | Feb 19 | Novel handling techniques for producing super-power klystron over 10 feet tall   | PT192 | Mar 11 | Project Mercury man-in-space capsule delivered   | BF31  | Apr 22 |
| Process control transistorized digital computer for open-loop control in processing operations   | BW11  | Feb 19 | Odd-shaped cans made of easily-formed metal by filling simple die with Neoprene plug   | PT91  | Apr 15 | Project Mercury, NASA gives \$30-million contract for worldwide tracking and communications net for  | BW11  | Feb 5  |
| <b>PRODUCTION TECHNIQUES</b>   |       |        | Oscilloscope with direct digital readout of amplitude and duration of pulse signals reduce operator errors, cut measurement time                     | BF30  | Mar 4  | Project Mercury, NASA seeks supplemental 1960 funds of \$19 million to spur development of   | BW11  | Mar 11 |
| Adjustable punch and die kits for multiple-hole punching of short-run sheet metal parts announced  | PT133 | Feb 12 | Peg board type pallet permits connections of modules to be dip soldered  | PT192 | Mar 11 | Project Mercury satellite to be tracked by 50 antenna systems  | BF33  | Mar 4  |
| Air suspension helps regulate amplitude of vibrator finishing equipment  | PT106 | May 13 | Photographically-sensitized metal sheet makes custom labels for instrument and test equipment panels   | PT100 | Jan 1  | Project Midas heat-seeking missile defense satellite to work with BMEWS radar  | BF42  | Apr 1  |
| Apothecary weights used to measure brush contact force   | PT74  | Feb 19 | Plastic-backed paper negatives transfer etched circuit wiring patterns onto copper-clad epoxy glass laminates  | PT100 | Jan 1  | Project Polevault provides troposcatter link for BMEWS rearward communications   | BF42  | Feb 5  |
| Automated transistor assembly systems turns out npn alloy junction transistors for computers at rate of 1,800 per hour                             | BW11  | Feb 19 | Plastic holders for rack-mount printed circuit cards developed   | PT70  | Mar 4  | Project Scout research vehicle with nonablative nose cone to be used to determine effects of plasma sheath on radio signals                                    | RD66  | Feb 5  |
| Automatic alloy boat loaders boost transistor production   | PT122 | Jun 24 | Plastic holders for rack-mount printed circuit cards developed   | PT85  | Jan 29 | Project Skyhook balloons will record cosmic rays in upper atmosphere with 800-lb block of film   | RD94  | Jan 15 |
| Automatic assembly systems show little movement in Britain   | BF52  | May 13 | Polyethylene glycol improves acid solder flux performance  | PT82  | Jan 29 | Project Spin for developing superconductive gyro; use seen in subs and space vehicles  | BW11  | Jan 29 |
| Automatic control holds voltage across weld constant   | PT102 | Jan 1  | Polyoptic sealing technique improves the reliability and life of glass envelope electron tubes   | PT114 | May 20 | Project Tepepe detects both missile launchings and nuclear explosions using over-the-horizon radar   | BF28  | Feb 5  |
| Automatic control unit for operating dielectric strength testers   | PT88  | May 6  | Portable welding handgun carries own filler  | PT77  | Jan 8  | Project Tiros meteorological satellite, circularly-polarized, high-gain antenna for automatic tracking of  | TF57  | Apr 15 |
| Bins feed small parts in assembly sequence during manufacture of printed circuit boards  | PT88  | Apr 8  | Precision turning device for finishing outer-diameters of memory drums   | PT126 | Apr 29 | Project Traismoke, FAST (flight advisory service test) portion of will operationally evaluate use of SAGE computer for air traffic control use                 | EN11  | May 6  |
| Bridge circuit measures pulse response of armatures to pinpoint faults during production runs  | TF70  | Jun 10 | Precision winding machine for submarine cable and capacitor manufacturing  | PT86  | Jun 10 | Project White Alce provides troposcatter link for BMEWS rearward communications  | BF42  | Feb 5  |
| British approaches to producing microcircuit circuits  | TF71  | Jan 1  | Pre-punched tape directs numerical machine tool control equipment automatically  | PC37  | Mar 18 | Propagation losses in water, effect of on range parameters of active and passive sonar   | TF41  | Feb 19 |
| Brush plating and air-operated masking jig speed precision soldering of transistors tabs   | PT70  | Mar 4  | Printed circuit masters drafted on film with ultraviolet light   | PT80  | Jun 17 | Propagation, space, R&D in Sweden  | SR75  | Feb 12 |
| Characteristics and uses of electronic-production staples  | TF68  | Apr 15 | Producing germanium from flue dusts of certain kinds of coal   | CM121 | Jun 24 | Propulsion, wave vehicle, unique instrumentation for investigating possibilities of using plasma for protection circuit for super-power uhf ceramic-metal tube | TF66  | Jun 10 |
| Contour extruded aluminum tubing is being considered for waveguide components with integral flange   | PT104 | Jun 3  | Production and automatic test equipment high-lighted at 1960 IRE International Show and Convention   | BF47  | Apr 1  | Pull-in drop-out gap of low-voltage relays reduced when operated from high-voltage supply  | RD62  | Jan 22 |
| Control using voltage constraint and NOR logic improves consistency and reliability of spot welds  | TF48  | Feb 19 | Production line tester for checking for contact chatter of electromagnetic relays uses thyatron timing circuit                                       | TF94  | May 20 | <b>PULSE TECHNIQUES</b>  |       |        |
| Current pulse generator for testing ferrite memory cores   | TF80  | Jan 1  | Self-compensating fixture tests 24 capacitors at a time in an environmental test chamber   | PT72  | Jan 22 | Electrical stroboscope displays pulses with rise times of 10-10 sec  | RD81  | Apr 1  |
| Die makers get individual air conditioned, sound-proof booth   | PC72  | Feb 19 | Semiautomatic silicon crystal-growing furnace triples production capacity  | EN11  | Jan 29 | Novel approach to pulse amplifier design reduces standby current, improves gain  | TF64  | May 6  |
| Digital programmer automatically adjusts and controls furnace temperature during preparation of high-purity materials                              | RD122 | May 27 | Servocontrolled photo cell monitors diameter of wire as it is drawn  | PT90  | Feb 26 | Pulse-height-to-digital signal converter   | TF58  | Jan 8  |
| Drop-feeding and unloading of workpieces on centerless grinder speeds up production of synchro shafts  | PT74  | Jan 22 | Shell-type transformer used to nondestructively test magnetic sheet material   | PT90  | Feb 26 | Pulsed magnetrons achieve high power   | CM96  | Mar 18 |
| Electron beam metalworking equipment for use in surface treating, welding, milling or drilling   | PT86  | Feb 26 | Shrunken polyethylene tubing used as harness wrapping  | PT86  | Apr 8  | Pulsed x-ray pencil beam gages thickness of hot and cold rolled metals   | PC62  | Jan 22 |
| Electron sealing process using optically-ground and mated glass stem and envelopes to extend military tube life                                    | EN11  | May 6  | Silk screening machine for semiautomatic production of printed circuits has travelling head  | PT98  | Mar 18 | Remove pulse-coded fault alarm for multithop microwave systems   | TF82  | Jan 1  |
| Electron tube testing automatically prepares test data in digital form for computer analysis   | PT74  | Feb 5  | Simple steps for speeding inspection of small lots of components   | PT72  | Feb 19 | Sampling attachment for conventional oscilloscopes can resolve rise times of 1/3 nanosec with repetition rates up to 50 Kc                                     | TF96  | Jun 24 |
| Electronic oven uses microwave technique for assembly line production of pre-frozen meals in Holland   | BF47  | Jun 10 | Single crystal rods of high-temperature compound semiconductors can be grown and purified in electron beam vertical zone refiners                    | PT104 | Jun 3  | Transistorized pulse generator for synchronizing events in zero-gradient synchrotron   | TF63  | Jun 10 |
| End-welded studs mount d-c power supply chassis to racking mounting panels   | PT88  | Apr 15 | Six-spindle turret drill drills, taps and assembles potentiometer dials and knobs  | PT90  | Mar 25 | What's new in pulse helix traveling wave tubes   | SR55  | Apr 29 |
| Erasers clean component leads  | PT89  | Apr 8  | Soviet automatic control system checks mass-produced parts using crt scanning technique  | EN11  | Jan 15 | Punch press, hand portable, made from toggle clamp   | PT73  | Mar 4  |
| Fabricating semiconductor networks for micro-circuits  | TF69  | May 13 | Soviets report method of drawing wires of 1 or 2 microns in diameter   | PT100 | Mar 18 | Punch set, adjustable, for multiple-hole punching of shortrun sheet metal parts announced  | PT133 | Feb 12 |
| Fit of mating glass parts can be accurately determined by methods known as the water drop and fringe pattern                                       | PT106 | Jun 3  | Special ink for coding Teflon wire announced   | PT72  | Mar 4  |  |       |        |
| Frame of radiation beams provides nondestructive, continuous method of testing cable insulation  | PT135 | May 27 | Special machining techniques for forming pure tungsten into intricate shapes   | CM87  | May 6  | Q-meter, uhf, that computes and reads out circuit Q shown at IRE Show  | BF47  | Apr 1  |
| Fully automatic electromechanical machine assembles alloy-junction transistors of high uniformity and quality                                      | TF57  | Mar 25 | Specialty-designed part trays and tote boxes speed assembly, reduce production costs   | PT88  | Mar 25 | Quartz-to-metal seals for high-frequency vacuum tubes  | CM102 | Jun 3  |
| Gas plasma sprays materials with high melting points onto materials with relatively low melting points   | PT77  | Feb 5  | Spike power control unit overcomes misfiring of high-speed power resistance welder   | EN11  | Mar 11 |  |       |        |
| Germanium used in new alloy for brazing stainless steel  | PT127 | Apr 29 | Squeezer rapidly straightens bent or kinked transistor leads   | PT72  | Jan 8  |  |       |        |
| Germans cut prices of radio and TV sets through improved production techniques   | BF49  | May 13 | Stackable small parts bins being made of molded plastic  | PT89  | Jun 10 |  |       |        |
| High-purity silicon dielectric for potting transistors is nonmelting and greaseless  | CM84  | Apr 15 | Standardized tooling cuts cost and design time   | PT88  | Jun 10 |  |       |        |
| How built-in damping controls violent motion imposed by vibration  | CM186 | Mar 11 | Stepping relay controls operation of lazy susan used to pace electronic assemblers   | PT76  | Feb 5  |  |       |        |
| Improved lapping, polishing and base-plating of vhf quartz crystals developed  | PT84  | Apr 22 | Streamlined drafting procedures to expedite R & D production   | PT98  | Mar 18 |  |       |        |
| Ions detect pinholes in wire and cable insulation  | PT77  | Feb 5  | Strippable printed circuit negatives improve accuracy and design flexibility   | PT82  | Jan 29 |  |       |        |
| Low-pressure air most efficient method to cool components during manual soldering of printed circuits  | PT104 | May 13 | Techniques for correcting rhodium plating defects  | PT124 | Apr 29 |  |       |        |
| Machine for assembling sealed contact reed relays housed in glass walled area  | PT86  | Apr 22 | Techniques for solving tin-nickel plating problems   | PT86  | Feb 26 |  |       |        |
| Magnetic spot-welding electrodes hold small parts to be welded to sheet or strip material  | PT88  | Apr 15 | Three-dimensional x-rays diagnose component failures more readily  | PT74  | Jan 22 |  |       |        |
| Making and using water virtually free of particulate matter, dissolved solids and gases  | PT132 | May 27 | Toggle clamp makes portable hand punch press   | PT73  | Mar 4  |  |       |        |
| Mass spectrometer measures quantity of helium escaping in electron tube manufacture  | TF74  | Apr 1  | Umbilical tubing provides convenient method of closing a hermetically sealed container   | PT91  | Mar 25 |  |       |        |
| Materials progress in transistor potting, high-tensile strength polyethylene and plastic laminates reported  | CM84  | Apr 15 | Use of completed chassis as dipping fixtures cuts time required to fungus-proof plug-in circuit cards  | PT93  | Apr 1  |  |       |        |
| Method of protectively coating beryllium metal described   | PT91  | May 6  | Vacuum air jet and mechanical transfer methods combined in machine to weld leads to diode headers  | PT88  | Apr 15 |  |       |        |
| Methods of metallizing ceramics for brazing into ceramic-metal assemblies  | CM86  | May 6  | Vacuum-formed plastic skin protects unshoused relays mounted on plug-in printed circuit boards   | PT195 | Mar 11 |  |       |        |
| Micro-alloy diffused base transistor (MADT) fabrication improved using Etching by Transmitted Light (ETL) technique                                | BW11  | Apr 1  | Vibratory finishing equipment, our suspension helps regulate amplitude of  | PT106 | May 13 |  |       |        |
| Microelectronics may cut semiconductor circuit production costs  | BF36  | Feb 12 | West Coast manufacturer urges government give Q awards for production  | BE40  | Jan 1  |  |       |        |
| Milliammeter sorts look-alike metals using thermoelectric effect to detect polarity  | PT72  | Jan 8  | Wheel-shaped component carrier in oven makes 150 c tests of silicon diodes   | PT130 | Feb 12 |  |       |        |
| Milipore filter tape instrument monitors high-purity water   | PT125 | Jun 24 | Profile measuring device and lightbeam projector make up automatic surveying system for measuring airport runway roughness                           | TF54  | Jun 17 |  |       |        |
| Miniature slip ring assembly starts with encapsulation, finishes with machining and metal deposition   | PT106 | Jan 15 | Project Ace High, NATO's 4,000-mile tropospheric scatter system, to connect all major radar outposts and operational headquarters in Europe          | BF38  | Apr 29 |  |       |        |
| Molding cable junctions, connectors and terminations with cast-in-place solid elastomers   | PT90  | Apr 1  | Project Defender, a study program to find tomorrow's space defense, to be operated in conjunction with NATO's 4,000-mile tropospheric scatter system | BF42  | Feb 26 |  |       |        |
| Multi-aperture configuration simplifies core winding   | CM70  | Jan 8  | Project Double Jump to be incorporated into NATO's 4,000-mile tropospheric scatter system  | BF38  | Apr 29 |  |       |        |
| Multipurpose fixture for fabricating bulky electronic equipment shelters and consoles  | PT102 | May 13 | Project Hot Line to be incorporated into NATO's 4,000-mile tropospheric scatter system   | BF38  | Apr 29 |  |       |        |
|  |       |        | Project ICFE (International Cooperative Emulsion Flight) study effect of cosmic on emulsions   | RD94  | Jan 15 |  |       |        |
|  |       |        | Project Janhawk grant given by Navy to University of Kansas to study generation, detection and transmission of millimicrosec transients              | BF60  | Mar 11 |  |       |        |
|  |       |        | Project Madre to use magnetic-drum receivers to autocorelate echoes from over-the-horizon radar missile warning system                               | BF28  | Feb 5  |  |       |        |

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|---|-------|--------|--|--------|--------|--|-------|--------|
| Generation, detection and transmission of millimicrosecond transients being studied at University of Kansas under Navy grant for Project Jayhawk Georgia Institute of Technology creates division to study radar and communications | BF60  | Mar 11 | Cadmium sulfide field-effect transistor used experimentally as radiation detector  | BF42   | Mar 18 | Reader, optical-electronic, for translation machine recognizes 1,000 Russian characters per second   | EN11  | Jun 10 |
| Ground-velocity indicator using c-w Doppler radar developed for helicopters   | BF53  | Feb 12 | Data gathering and logging system monitors nuclear radiation levels and weather conditions   | RD64   | Jan 22 | <b>READOUT DEVICES</b> (See also Displays, Electroluminescent Devices, Indicators and Registers)   |       |        |
| High-power pulsed S-band klystron for long-range radar or troposcatter communications   | EN11  | Jan 8  | Design criteria for electrically short antennas with high radiation efficiency   | TF84   | Jun 3  | Indicator triode has fluorescent anode whose illumination is controlled by grid potential for direct data readout                                      | TF52  | Feb 5  |
| How to determine whether to use visual, ir or radar detection in fog or rain  | CM82  | Feb 26 | Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector   | TF58   | Feb 19 | Monoscope tube generates characters for direct readout on a ciro or on paper of digital computer output  | TF117 | Feb 12 |
| Insuring stability in precision time delay multi-vibrators used in radar and industrial electronics   | T64   | Jan 29 | Frame of radiation beams provides nondestructive, continuous method of testing cable insulation  | PT135  | May 27 | Readout circuits for magnetic noncontact shaft-position disk encoders  | RD114 | Apr 29 |
| International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations   | TF73  | Apr 8  | How radiation affects tunnel diode operation   | BF32   | May 6  | Reversible decade counter used eight-digit transistor-Nixie readout circuit  | TF86  | Jan 1  |
| Invisible electronic shield for baffling radar and radar-guided missiles is reported  | BF33  | Feb 19 | Low-energy short-lived radioisotope samarium-153 produce high quality diagnostic radiograms  | BF42   | Mar 18 | Small BEAM-X switch tube may claim extended market   | CM126 | Feb 12 |
| Lab model thermoplastic recording system has radar, ir, information retrieval and data processor applications   | EN11  | May 6  | Microminiature tube circuits featuring nuclear radiation resistance offered at IRE International Show and Convention   | BTW11  | Apr 1  | Solid-state character generator for VIDAC (Visual Information Display and Control) System  | TF55  | Jun 10 |
| Long-range 3-D target finding radar installed   | PC42  | Jun 10 | Model test range will permit all-weather, interference-free testing of antenna radiation patterns  | RD64   | Jun 8  | Solid-state high-speed printer-plotter prints and plots from computer-prepared magnetic tape   | EN11  | Jan 22 |
| Long-range radar, computer with high reliability key units in ground-controlled satellite guidance system   | BF43  | May 27 | Photomultiplier and electrometer measure fluorescence of glass dosimetry needle to determine radiation damage to human body  | TF46   | Jan 22 | <b>RECEIVERS</b> (See Broadcasting, Communications, Consumer Products, Radar, Radio and Television)  |       |        |
| Magnetron with 25-kw peak power at 35-kmc developed for surface detection radar set   | EN11  | Jan 15 | Radiation damage to semiconductors seen as major research task   | TF74   | Mar 18 | Advanced crystal-controlled carrier-operated antinoise circuits for receivers feature simple design, low power drain, high dependability               | TF113 | May 27 |
| Maneuverable dish radar to scan and track ballistic missiles for BMEWS  | BF47  | Mar 18 | Radiation-operated fuel gage for missiles and aircraft   | EN11   | May 20 | Ceramic filters improve selectivity of multiband communications-type receiver  | CM84  | Feb 26 |
| Military to get mobile, high-power folding radar assembly   | PC34  | Jun 10 | Response of electronic system components and materials to radiation from nuclear-powered aircraft  | RO117  | Apr 29 | Circuit reduces interference from other stations during ionospheric sounding by separating desired pulses from unwanted tone signals                   | TF118 | May 27 |
| Missile tracking ship to get more radar measuring equipment   | EN11  | Jan 1  | Semiconducting industrial diamonds may find application as counters of radioactivity   | TF69   | Apr 22 | Compact hybrid microwave mixer for airborne radar receiver is now available  | CM70  | Feb 5  |
| Monopulse tracking radars compared with sequential lobing and conical scan techniques   | TF51  | Apr 22 | Signal transmission through natural ionized ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions        | RD76   | Apr 22 | Electron-beam parametric amplifier operated in synchronous pumping mode improves receiver sensitivity, increases range of coho MTI radar by 50 percent | RD92  | May 13 |
| NATO's 4,000-mile tropospheric scatter system Project Ace High to connect all major radar outposts and operational headquarters in Europe   | BF38  | Apr 29 | Silicon pn junctions used as particle detectors  | TF81   | May 20 | French compatible color tv system features sequential transmission of chrominance, uses one-line memory in receiver                                    | TF57  | May 6  |
| Navy's Corvus carrier aircraft missile, with passive radar guidance, gets contract push   | BTW11 | Mar 11 | Solid-state radiation detector made of doped silicon gives new speed and accuracy to particle analysis   | RD74   | Apr 22 | Frequency synthesizer uses solid-state tuner to provide stable, high-accuracy receivers and transmitters   | RD122 | Feb 12 |
| New Radar and communications system guard Korea against surprise invasion   | BF40  | May 20 | Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit   | TF68   | May 6  | India has decided to mass-produce cheap radio receivers (under \$25)   | BF52  | Jun 24 |
| Parametric amplifier increases range of S-band radar used to track reentry vehicles   | RD116 | Apr 29 | Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches preset level in nuclear-powered Navy vessels                                     | TF43   | Jan 22 | Microlloy diffused-base transistors used in tuner design for portable tv sets  | TF76  | Mar 18 |
| Plasma circuit used as an oscillator to generate microwave energy at 2,000 Mc   | BTW11 | Mar 4  | Ultraviolet radiometry standard developed by NBS University of California probes new ways to use radiation in brain study  | RD64   | Feb 19 | Production of 100 receivers for use in \$2 million uhf tv rejuvenation planned   | BF32  | Jun 3  |
| Project Defender, a study program to find tomorrow's space defense, to use pincushion radar   | BF42  | Feb 26 | What's new in radiation detecting tubes  | BF53   | Feb 12 | Project Madre to use magnetic-drum receivers to autocorrelate echoes from over-the-horizon radar missile warning system                                | BF28  | Feb 5  |
| Project Madre to use magnetic-drum receivers to autocorrelate echoes from over-the-horizon radar missile warning system   | BF28  | Feb 5  | <b>RADIO</b> (See also Broadcasting, Communications, Receivers and Transmitters)   | SR55   | Apr 29 | Receiver used in vhf telemetry system for eliminating communication blackout from plasma sheath formation during vehicle reentry                       | TF105 | May 27 |
| Project Midas heat-seeking missile defense satellite to work with BMEWS radar   | BF42  | Apr 1  | American-made all-transistor a-m/f-m portable radio being test-marketed  | EN11   | Jun 10 | Reflex klystrons used as microwave receiver amplifiers for X-band radars   | TF56  | Jan 8  |
| Project Tepee detects both missile launchings and nuclear explosions using over-the-horizon radar   | BF28  | Feb 5  | Atmospheric duct which traps and propagates radio waves at low loss discovered for diode circuits for one-tube oscillator-mixers in tv and fm tuners                 | BTW11  | Feb 5  | Search radar facility built by Air Force to provide defense against airborne vehicles  | TF79  | May 13 |
| Radar field causes continuous discharge in bulb with gas of reduced pressure  | PC83  | Apr 15 | Balanced-bridge and semiconductor diode circuits for one-tube oscillator-mixers in tv and fm tuners  | TF76   | Jan 15 | Side-looking radar makes all-weather air maps of ground terrain  | TF68  | Feb 26 |
| Radar signal bounced off sun's outer corona found to take 17 minutes to echo  | BTW11 | Feb 12 | British tv and radio manufacturers break all sales records   | EN11   | Jan 15 | Subsection of antenna for 3-D Air Height Surveillance Radar portion of air traffic control system to be delivered                                      | BF44  | May 13 |
| Radar target simulator to train operators for DEW line  | PC64  | Jan 8  | Crackdown on Class D Citizens Radio looms if users don't toe the line  | BF28   | Jan 8  | Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv                                   | TF64  | Apr 8  |
| Radar telescope detects micrometeorites, determines meteor showers are more frequent than previously suspected  | RD106 | May 20 | Doublesideband suppressed carrier modulation technique save power, permits exalted-carrier detection   | TF47   | Feb 5  | System for typing flight simulator into remote standard ground-controlled intercept radar  | TF63  | Apr 1  |
| Radar test tower determines effect of radomes on antenna radiation  | BF49  | Mar 25 | FCC yearend report shows more than 1 1/2 million transmitters now on air in more than 50 services  | BF33   | Jan 22 | Transistorized receiver in model ship helps navy trainees to study ship-handling problems  | PC43  | Apr 29 |
| Radar transmitter for antimissile Zeus being tested   | BF34  | May 27 | F-m radio set sales to show gain of 50 percent over last year  | MR26   | Feb 12 | Transistorized tv receiver with 19-in. screen and rechargeable battery announced   | EN11  | Jun 3  |
| Radar view of atlas ICBM  | BF45  | Feb 26 | Future of stereophonic radio broadcasting to be determined by Washington this week   | BF37   | Jan 1  | Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications   | BF36  | Feb 26 |
| Radar warning system that gives 3-dimensional information can be airlifted to site  | EN11  | Jan 1  | India has decided to mass-produce cheap radio receivers (under \$25)   | BF52   | Jun 24 | Vhf receiver may be grown from pool of molten semiconductor materials  | BTW11 | Jan 29 |
| Reflex klystrons used as microwave receiver amplifiers for X-band radars  | TF56  | Jan 8  | Missile telemetry-radio interference: Cause and cure   | BF24   | Jan 8  | Receiving-type electron tubes, what's new in   | SR55  | Apr 29 |
| Search radar facility built by Air Force to provide defense against airborne vehicles   | PC45  | Jan 1  | Multi-junction drift-field transistor simplifiers design of portable and auto radios   | CM82   | Apr 22 | Reciprocal circuit gives output which is inversely proportional to input for use with analog computers and systems                                     | TF92  | May 20 |
| Side-looking radar makes all-weather air maps of ground terrain   | BF49  | Apr 15 | NBS studies automatic computation methods for determining best possible frequencies for radio transmitters used as road markers on air lanes                         | RD72   | Jun 17 | Reconnaissance systems, acknowledgement by U.S. of recon operation drops cloak from a big and growing area of electronics industry                     | BF34  | May 27 |
| Subsection of antenna for 3-D Air Height Surveillance Radar portion of air traffic control system to be delivered   | BF29  | Apr 8  | Nonablative noise cone to be used to determine effects of plasma sheath on radio signals   | RD66   | Feb 5  | <b>RECORDERS</b> (See also Audio, Consumer Products, Magnetics and Photography)  |       |        |
| Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv  | TF70  | Apr 8  | Precipitation static eliminated from airborne radio and navigation equipment by sharp tungsten pins  | RD96   | Jun 3  | Cosmic rays in upper atmosphere to be recorded by 800-lb block of film carried in Project Skyhook balloons   | RD94  | Jan 15 |
| System for typing flight simulator into remote standard ground-controlled intercept radar   | TF86  | May 13 | Radio and tv production rise in Austria  | EN11   | Jun 10 | Four-track stereo tape recorder and miniature 7-transistor 45-rpm radio-phonograph shown at Japanese Industrial Trade Fair                             | EN11  | Apr 29 |
| Transistorized precision multiple-range sweep generator for airborne radar system   | TF92  | Jan 15 | Self-policing by industries of class D Citizens Radio being studied  | BF29   | Feb 5  | High-speed digital plotter cuts time for reducing telemetered data   | TF41  | Jan 8  |
| Uhf transponder beacon in Tirois I improves radar data quality, provides horizon-to-horizon coverage  | RD96  | May 13 | Thailand, Laos and Vietnam to have telecommunication network for radio and tv  | BF29   | Jan 1  | Hungarian automatic telephone-answering tape recorder shown at Leipzig Fair  | BF47  | May 27 |
| Ultra-clean electron gun promises greater power rating, longer life for radar klystrons   | EN11  | Mar 25 | Transistorized radio beacon designed to function as air craft crash position indicator   | TF54   | Jan 22 | Japanese to emphasize development of video tape recorders  | EN11  | Feb 12 |
| Using graphical extension of transform techniques to find spectrum of radar return in presence of antenna scan modulation   | TF68  | Apr 1  | Transistorized receiver in model ship helps Navy trainees to study ship-handling problems  | PC43   | Apr 29 | Japanese to market stereo 4-channel tape recorder in U.S.  | EN11  | Jan 22 |
| <b>RADAR AND RADIO ASTRONOMY</b><br>(See also Space Electronics)  |       |        | Use of sun as huge reflector to relay radio signals between distant points described   | RD115  | Jun 24 | Lab model thermoplastic recording system gives kinescope-quality b-w picture, green and red predominating color picture                                | EN11  | Jan 22 |
| Army announces development of 25-lb ruby maser  | EN11  | Apr 22 | What's new in radio frequency power tubes  | SR55   | Apr 29 | Magnetic recording of color television using time-correction circuits to reproduce hues faithfully   | TF76  | Jan 1  |
| Broadband log-periodic antennas for monitoring and signal interception, direction finding, satellite tracking, radio astronomy and h-f communications uses  | TF58  | Jun 17 | <b>RADIO ASTRONOMY</b> (See Radar & Radio Astronomy)   |        |        | Magnetic tape instrumentation recorder has extended bandwidth to accommodate new heads   | TF44  | Jan 8  |
| Cost of world's largest radio telescopes has soared to over \$100 million   | BF33  | May 6  | Radioisotope density altimeter is designed for missiles and fast new aircraft  | 37     | Jan 8  | Mobile tv recorder can be modified for American, UK or European standards  | PC94  | Jan 15 |
| Electronic R&D in radio astronomy in Australia  | SR75  | Feb 12 | Radiometer, d-c controlled attenuator called Gyralyne varies L-Band maser pump power in  | TF71   | Jan 15 | New magnetic tape system TRACTOR capable of storing 60 million characters is announced   | EN11  | May 6  |
| International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations   | BF33  | Feb 19 | Radiometer measures noise radiated from plasma at low power levels   | TF159  | Mar 11 | New tube produces velocity modulation gratings on thermoplastic recording tape   | EN11  | Jan 15 |
| Large fixed hemisphere and small movable barrel-shaped reflector cut antenna sag for radio telescope use  | RD81  | Apr 1  | Radiometric sextant, miniaturized all-weather, developed for submarine use   | EN11   | Jan 15 | Photographic system records electromagnetic radiation from lightning (sferics) propagated over long distances  | RO64  | Mar 4  |
| NASA reports satellite tracking performance is tied to size of antenna new  | BF33  | 29     | Radiotelephone weighing 2.8 lb developed by Japanese   | EN11   | Jan 15 | Portable recorder designed to operate unattended in remote areas announced at Western Joint Computer Conference  | BF35  | May 27 |
| Radar telescope detects micrometeorites, determines meteor showers are more frequent than previously suspected  | RD106 | May 20 | Radiotelephones together with automatic gas-fume detector alarms Loran, direction finders, and depth sounder fish finders make up new \$10-million small boat market | BF30   | Jan 22 | Recording and measuring system for automatic survey system used to measure airport runway roughness  | TF54  | Jun 17 |
| Spider-web 142-ft radio telescope built in Scotland to study aurora   | PC52  | May 13 | Radomes, radar test tower determines effect of on antenna radiation  | BF49   | Mar 25 | Tape target classifier trains land-based sonar student operators   | TF65  | Mar 25 |
| <b>RADIATION</b> (See also Antennas, Communications, Microwaves, Nucleonics and Radar)  |       |        | Radomes, transmission analogy for propagation in sandwiches of dielectric sheets and conducting films or grids used for  | ERS100 | May 20 |  |       |        |
| Battery-powered transistorized scale-of-64-counter for measuring radioactive tracers improves reliability, reduces cost and weight  | TF74  | May 6  | Rain, how to determine whether to use visual, ir or radar detection in   | TF64   | Jun 29 |  |       |        |
|   |       |        | RCC (Remote Communications Complex) for SAC's Automatic Combat Control System (SACCS)  | BF36   | Mar 25 |  |       |        |
|   |       |        | Reactor R&D, electronic, in France   | SR75   | Feb 12 |  |       |        |



|   |       |        |  |       |        |  |       |        |
|---|-------|--------|--|-------|--------|--|-------|--------|
| Television tracking system records eye focus points and movements.....  | TF57  | Apr 22 | Reliability of receiving-type electron tubes .....   | SR55  | Apr 29 | Probes make patterns of airflow around missile nose cone inside hypersonic wind tunnel in color Project Defender, a study program to find tomorrow's space defense, to use pin-cushion radar ..... | BF52  | Feb 26 |
| Thermoplastic recording of television signals provoking interest .....  | BF46  | Jan 15 | Test equipment for reliability checkout of Subroc antisubmarine telemetering system .....  | PC78  | Jan 29 | Propagation of electromagnetic waves through subsurface of earth being studied for AF .....  | BTW11 | Mar 4  |
| Transistor audio volume compressor for interview tape recorders .....   | TF62  | Jan 8  | Remote pulse-coded fault alarm for multihop microwave systems .....  | TF82  | Jan 1  | Proton synchrotron of European Organization for Nuclear Research in Operation .....  | EN11  | Jan 1  |
| Video band recorder-reproducer for analog and pulse signals to be produced .....  | EN11  | Mar 25 | Remote transmitter generates control pulses during vertical blanking interval to control TV receiver .....   | TF79  | May 13 | Public facsimile research spreads, faster transmission and privacy are goals .....   | BF51  | Apr 8  |
| Watchdog satellites to carry TV cameras and electrostatic tape recorders to check performance of other satellites .....   | BF35  | Jun 10 | Replacement parts market for 1960 .....  | SR49  | Jan 1  | Radar field causes continuous discharge in bulb with gas of reduced pressure .....   | PC83  | Apr 15 |
| Wow-flutter indicator for precise measurement of tape recorder performance .....  | TF100 | Jun 24 | Representatives, manufacturers, place in 1960 electronics sales picture .....  | SR49  | Jan 1  | Radar signal bounced off sun's outer corona found to take 17 minutes to echo .....   | BTW11 | Feb 12 |
| Rectification characteristic, determination of in evaluating three-element semiconductor materials .....  | TF103 | Feb 12 | Rescue beacons become part of airliner liferaft equipment .....  | PC52  | May 20 | Radar telescope detects micrometeorites, determines meteor showers are more frequent than previously suspected .....   | RD106 | May 20 |
| <b>RECTIFIERS</b> (See also Diode Circuits, Diodes, and Power Sources and Supplies)   |       |        | <b>RESEARCH</b> (See also specific headings)   |       |        | Radiation damage to semiconductors seen as major research task .....   | EN11  | May 20 |
| Color code standards for designating semi-conducting diode and rectifier types adopted .....  | CM83  | Apr 22 | Academic research laboratories map new project to open new research areas, expand others .....   | BF60  | Mar 11 | RCA to open research laboratory in Japan, will study solid-state phenomena .....   | EN11  | Jun 24 |
| Controlled-rectifier switch called Transwitch for computers turned off by small negative pulse .....  | TF71  | Jan 15 | Academic research probes new ways to expand man's knowledge .....  | BF53  | Feb 12 | Research activities in electron tubes .....  | SR55  | Apr 29 |
| Silicon-carbide rectifier that withstand 500 C and is useable in nuclear environments .....   | CM94  | Mar 18 | Advanced research project discussed at Northeast Electronics Research and Engineering Meeting .....  | TF71  | Jan 15 | Research activities in Japan .....   | SR53  | May 27 |
| Silicon controlled rectifier dollar sales to double in 1960 .....   | MR22  | Jan 1  | Alloyed-emitter, pnp mesa transistor operates in low microwave region and is mounted in coaxial shell .....  | RD82  | Apr 15 | Researchers demonstrate experimental photogenerator for converting solar energy by photoelectric emission .....  | EN11  | May 27 |
| Solid-state static power relays and circuit breakers using silicon-controlled rectifiers have contact rating from milliwatts to kilowatts .....   | TF114 | May 27 | Atmospheric duct which traps and propagates radio waves at low loss discovered .....   | BTW11 | Feb 5  | Scientists grow single crystals of transparent gallium phosphide experimentally .....  | EN11  | May 13 |
| Refiners, electron beam zone, can be used for growing and purifying single crystal rods of high-temperature compound semiconductors .....   | PT104 | Jun 3  | Battelle Memorial Institute to research cooling techniques .....   | CM78  | Jun 17 | Series of papers on thin films presented in IBM Journal .....  | CM78  | Jun 17 |
| Reflector, sixty-ft, for 3 axis antenna provides hemispheric coverage of missile and satellite telemetered data .....   | PC40  | Jan 1  | Britain reports 10 percent of annual sales are absorbed in research .....  | BF37  | Mar 18 | Silicon pn junctions used as particle detectors .....  | RD74  | Apr 22 |
| Reflectors, spincasting of plastic parabolic radio mirrors may provide antenna surface accuracies presently not practical .....   | RD96  | Jan 15 | Cadmium sulfide field-effect transistor announced by GM Research .....   | BF42  | Mar 18 | Simulator for selecting best possible target among all in-range attackers .....  | RD76  | Jan 29 |
| Reflex klystrons, what's new in .....   | SR55  | Apr 29 | Cesium cell converter working at high temperatures produces significant amounts of a-c electricity .....   | CM78  | Jan 29 | Soviet Academy of Sciences changing some of its research approaches .....  | BF43  | Apr 1  |
| <b>REGISTERS</b>  |       |        | Closed-circuit tv for monitoring dental surgery and for assisting in diagnosis being studied .....   | TD92  | Jan 1  | Spincasting of plastic parabolic radio mirrors may provide antenna surface accuracies presently not practical .....  | RD96  | Jan 15 |
| Film cryotron shift register reported at 1960 Solid-State Circuits Conference .....   | TF39  | Mar 4  | College and universities deeply involved in research and scientific projects at half-year mark .....   | BF59  | May 20 | Stanford Research Institute reports \$22 million research contracts were handled in 1959 .....   | BF59  | May 20 |
| Indicator triode-transistor flip-flops are coupled to form shift register .....   | TF52  | Feb 5  | Completely passive, balance modulator circuits using thin permalloy film described at 1960 Winter Convention on Military Electronics .....   | RD78  | Feb 26 | Streamlined drafting procedures to expedite R&D production .....   | PT98  | Mar 18 |
| Parameter register circuits for digital computers. Shift register made from crossed film cryotrons deposited on insulating superconductors .....  | TF73  | Jun 3  | Controlled environment for infrared studies made possible with 86-ft tunnel .....  | BF61  | Mar 18 | Study of atmospheric noise needed to develop long-range vlf navigation systems .....   | RD78  | Apr 8  |
| Six ways to use magnetic core shift register elements .....   | TF55  | Jan 29 | Cosmic rays in upper atmosphere to be recorded by 800-lb block of film carried in Project Skyhook balloons .....   | RD94  | Jan 15 | Subsurface propagation of electromagnetic waves being studied .....  | PC30  | Apr 22 |
| Tunnel diodes used in shift registers .....   | TF80  | Jan 15 | Cryogenic gyro under development; broad capabilities inherent in low-temperature devices spur further studies .....  | BF32  | Feb 5  | Sun-position sensor for establishing coordinate reference system on space vehicle reported at 1960 Winter Convention on Military Electronics .....   | RD62  | Mar 4  |
| <b>REGIONAL DEVELOPMENTS</b>  |       |        | Defense Department considers establishment of information center on ceramic materials to aid research .....  | EN11  | May 13 | Superconducting electromagnets being explored for use with masers and in solid-state research requiring cryogenic temperatures and a magnetic field .....  | EN11  | May 20 |
| Control systems, solid-state electronics and electromagnetics featured at Seattle's 7th Regional IRE Conference .....   | BF39  | Jun 10 | Double-focusing mass spectrometer measures relative amounts and weights of atoms .....   | RD78  | Jun 10 | Superconductivity symposium disclosed basic work is still concentrating on cryotron, major problem is fabrication .....  | EN11  | May 27 |
| Detroit area fast becoming important to electronics industry, particularly in R&D .....   | BF42  | Mar 18 | Emphasis on basic scientific progress and discoveries in Conference on Electronic Conductivity in Organic Solids .....   | RD127 | May 27 | Survey of future developments now emerging from electronics' laboratories .....  | TF159 | Mar 11 |
| Florida's new industrial lure: plant-and-house package .....  | BF30  | Jun 10 | Experimental magnetohydrodynamic generator produces 2½ kw, runs for four minutes .....   | EN11  | Mar 25 | Thermoelectric cooling modules for electronic components in R&D stage .....  | RD68  | Feb 5  |
| Hawaii's Department of Economic Development reports rapid expansion of electronics work .....   | EN11  | Jun 17 | FAA has raft of big and little plans for 1960 .....  | BF40  | Feb 12 | Transistormen give financial aid to support Stanford solid-state research .....  | BF45  | Jan 1  |
| Latest survey indicates New England 1970 sales will be \$2 billion .....  | BF45  | Apr 22 | Federal spending on R&D to surpass \$15 billion in 1960 .....  | BF40  | Jan 29 | Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications .....   | BF36  | Feb 26 |
| Minnesota Governor indicates expanding universities, skilled manpower and favorable financial climate stimulates area's growth .....  | BF30  | Jun 17 | Fluid amplifier uses gas and liquid pressures instead of voltages .....  | BF41  | Mar 25 | Tunnel diodes being pushed to higher oscillation frequencies .....   | EN11  | Jan 8  |
| New Mexico's electronics industry now in multi-million dollar bracket through missile development, R&D .....  | BF41  | Apr 15 | Forthcoming Solid-State Circuits Conference indicates R & D labs are in tunnel diode race .....  | BF32  | Jan 1  | Tunnel diode being investigated as potentially useful computer element .....   | EN11  | Mar 4  |
| Regional distribution of electronics industry personnel .....   | SR49  | Jan 1  | Four basic research programs underway to develop ductile ceramic and ionic crystals .....  | CM100 | Jan 15 | Two American electronic men who toured Russia impressed with Soviet scientific education and research .....  | BTW11 | Apr 8  |
| Self-help plan involving team bidding and establishment of trade association speeds industrial growth on Long Island .....  | BF38  | May 6  | Galactic noise measured by 4-stage sounding rocket .....   | EN11  | Jan 8  | Two Operation Skyhook balloons will study cosmic rays at 18 to 22 mi altitudes .....   | EN11  | Jan 1  |
| Six-month shakedown of instantaneous audio-meter used to rate viewing habits in New York City completed .....   | BF44  | Apr 8  | How radiation affects tunnel diode operation .....   | BF32  | May 6  | Ultrafast spectrometer for analyzing chemical reactions occurring on 0.1 millisecond developed .....   | BF42  | Mar 18 |
| Sixteen colleges in six midwestern states designated as communications network for Midwest Program on Airborne Television Instruction Transistormen give financial aid to support Stanford solid-state research ..... | BF45  | Jan 1  | Industrial diamonds with semiconducting properties made in South Africa .....  | RD76  | Apr 22 | Use of carbon monoxide for frequency standards being studied .....   | BTW11 | Apr 8  |
| Twin cities get self-service post office .....  | PC48  | Jun 3  | Low-temperature research program to provide higher-precision thermometry being expanded .....  | RD98  | Jun 3  | Vibrating platform uses beads to simulate a seismic motion .....   | PC74  | Jan 29 |
| Washington, D. C., is where firms go to seek an inside track for R & D .....  | BF34  | Apr 22 | Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics ..... | RD104 | May 20 | Washington, D. C., is where firms go to seek an inside track for R & D .....   | BF34  | Apr 22 |
| West Coast manufacturer urges government give Q awards for production .....   | BF40  | Jan 1  | Magnetohydrodynamics power plant generators offering high-efficiency output being studied .....  | RD92  | Jan 1  | Resin, solventless silicone, for high-temperature insulation now commercially available .....  | CM118 | Jun 24 |
| <b>REGULATORS</b> (See also Power Sources and Supplies)   |       |        | Magnetohydrodynamics symposium of AIEE points electronics industry's growing interest in plasma research .....   | EN11  | Mar 4  | Resistors, British approaches to producing film resistors for microminiaturization .....   | TF71  | Jan 1  |
| Five-transistor line voltage regulator uses Zener diodes .....  | TF64  | Feb 5  | Magnetohydrodynamics takes on new significance electronics industry .....  | BF52  | Mar 11 | Resources—their role in future of Japanese electronics industry .....  | SR53  | May 27 |
| Generator-regulator for autos uses only semiconductors and resistors .....  | TF52  | Feb 19 | Mark I perceptron demonstrates ability to learn the alphabet .....   | BF43  | Jun 24 | R-f precision fixed capacitors, characteristics of .....   | TFB26 | Feb 26 |
| Linear circuits used to obtain precise voltage regulation of output of transistorized d-c to a-c inverter .....   | TF61  | Apr 15 | Materials hold key to development of electron tubes capable of reliable performance at high ambient temperatures .....   | CM118 | Apr 29 | Right-Leduc effect, definition of .....  | TF71  | Feb 26 |
| Regulator circuit for self-powered transistor oscilloscope .....  | TF80  | Mar 18 | Military weapon system development stresses too much breakthrough research, too many unit cost compromises .....   | BF39  | Jan 29 | Robot performs jobs in dangerously radioactive areas by multiplexed commands .....   | TF46  | Jan 22 |
| <b>RELAYS</b>   |       |        | Missiles and space continue to account for much government money spent in guidance and componentry research area .....   | EN11  | Jun 3  | <b>ROCKETS</b> (See also Missiles)   |       |        |
| Close differential operation of stock relays using low-voltage relays operated from a high-voltage supply .....   | RD62  | Jan 22 | MIT interplanetary space probe to take photographs of 40 percent of Mar's surface .....  | BF49  | May 20 | Eliminating communication blackout resulting from plasma sheath formation during vehicle reentry using sufficiently high frequency .....   | TF105 | May 27 |
| Machine for assembling sealed contact reed relays housed in glass waisted area .....  | PT86  | Apr 22 | Model test range will permit all-weather, interference-free testing of antenna radiation patterns .....  | RD64  | Jan 8  | Instrumented low-cost Arcas and Loki weather rockets slated for daily firing .....   | BF43  | Apr 29 |
| Production line tester for checking for contact chatter of electromagnetic relays uses thyatron timing circuit .....  | TF94  | May 20 | National Research Council urges government to give high priority to development of material .....  | CM85  | Apr 8  | NASA plans to launch 25 to 30 major vehicles and 100 sounding rockets each year for three years .....  | EN11  | May 20 |
| Solid-state static power relays and circuit breakers using silicon-controlled rectifiers have contact rating from milliwatts to kilowatts .....   | TF114 | May 27 | NBS studies automatic computation methods for determining best possible frequencies for radio transmitters used as road markers on air lanes .....                                     | RD72  | Jun 17 | Rocket sleds use transistorized camera control to photograph ejection seat performance .....   | TF63  | Apr 1  |
| Stepping relay controls operation of lazy susan used to pace electronic assemblers .....  | PT76  | Feb 5  | New applications of modern microwaves in medical research and spectroscopy .....   | SR67  | Jun 24 | Signal transmission through natural ionized layers and ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions .....                     | TF81  | May 20 |
| Two transistor voltage amplifiers and latchtype relay provide overload protection for voltmeter .....   | RD92  | Mar 18 | New Mexico's electronics industry now in multi-million dollar bracket through missile development, R & D .....   | BF41  | Apr 15 | ROTI (recording optical tracking instrument) used with rapid scan spectrometer to detect infrared energy radiated during power flight portions of missile trajectory .....                         | TF86  | May 20 |
| Vacuum-formed plastic skin protects unmounted relays mounted on plug-in printed circuit boards .....  | PT195 | Mar 11 | New mode of transistor operation (combination tunneling and avalanche effect) being explored by several companies .....  | BTW11 | Apr 22 | RUM (Remote Underwater Manipulator), a converted Ontos tank, uses TV guide for exploring, installing and removing fixed sonar gear .....   | BF31  | Jun 17 |
| <b>RELIABILITY</b>  |       |        | Nonablative noise cone to be used to determine effects of plasma sheath on radio signals .....   | RD66  | Feb 5  | Runway, airport, roughness of measured by automatic surveying system using lightbeam projector and profile measuring device .....  | TF54  | Jun 17 |
| Electronic equivalent of neuron discussed at winter meeting of AIEE .....   | BF28  | Feb 19 | Oceanographic research indicates overseas fleet effectiveness could be doubled by environmental forecasts .....  | BD36  | Jan 22 |  |       |        |
| Military weapon system development stresses too much breakthrough research, too many unit cost compromises .....  | BF39  | Jan 29 | Plasma circuit used as an oscillator to generate microwave energy at 2,000 Mc .....  | BTW11 | Mar 4  |  |       |        |
| Minuteman's guidance and control systems need reliable components for underground storage lasting years .....   | BF39  | Jun 17 | Plastic type transistor developed by Soviet Scientist .....  | EN11  | Jan 1  |  |       |        |
| Over 1,000 British design engineers crowd one-day special symposium on Electronic Equipment Reliability .....   | BF34  | Jun 10 | Predicting possible three-element semiconductor materials .....  | TF103 | Feb 12 |  |       |        |

**SALES** (See also Business, Government, Marketing, Market Research and Military Electronics)

British and U.S. computer makers step up sales, promotional and service activities in Europe ..... BF34 Jan 8

British tv and radio manufacturers break all sales records ..... EN11 Jan 15

Color tv sales to rise \$10 million in 1960 ..... MR24 Apr 22

Components manufacturers say total sales were up 23 percent for the year ..... BF35 Jun 24

East Germans expect \$175 million sales from western customers, publicize a-c voltmeter and Robron computer ..... BF37 Mar 18

Electronics firms urged at EAI Industrial Electronics Conference to sell systems instead of hardware to industrial customers ..... MR22 Jan 22

Federal spending for coming fiscal year to hold close to last year's figures ..... BF32 Jan 29

Federal spending on R&D to surpass \$15 billion in 1960 ..... BF40 Jan 29

Fivefold increase in data processing sales for 1965 ..... BTW11 Feb 19

F-m radio set sales to show gain of 50 percent over last year ..... MR26 Feb 12

Hearing aid sales rise 11% ..... MR28 Mar 18

Industrial products to reach \$8-10 billion sales ..... MR26 Apr 15

Japanese tv set sales increase rapidly ..... EN11 Jan 15

Latest survey indicates New England 1970 sales will be \$2 billion ..... BF45 Apr 22

Magnetic tape sales to increase by 30 to 35 percent on 1959 in 1960 ..... MR22 Jan 8

Manufacturers expect continued increase in tv and audio market ..... BF39 Feb 5

Manufacturers look for quadrupled digital computer sales over next five years ..... MR24 Jun 3

Navy survey predicts and equipment sales up \$1.3 billion in 1960 ..... EN11 May 13

Nuclear instrument shipments for 1958 rise 33 percent over those of 1957 ..... MR22 Feb 19

Prediction of industry-wide increase in semiconductor sales boosted by announcements of production expansion ..... EN11 Feb 12

Retail sales of tv sets will rise 60 to 70 percent higher in 1970 ..... MR26 May 27

Sales in electronic industry for 1960 ..... SR49 Jan 1

Silicon controlled rectifier dollar sales to double in 1960 ..... MR22 Jan 1

Tantalum capacitor manufacturers look for 20 percent sales increase over 1959 level ..... MR24 Jun 10

Test instrument sales to both industry and military rise fast ..... MR26 Jan 15

What exhibitors are saying about sales at forthcoming IRE International Show and Convention, Year 1960 to see increased semiconductor sales, maintenance of high level 1959 electron tube sales ..... MR24 Jan 29

Sampler, axis-crossing interval, for design of weak signal detectors ..... TF88 Jun 3

Sampler circuit for noise suppression factor display unit ..... TF55 Feb 5

Sampling problems solved using graphical extension of transfer technique ..... TF68 Apr 1

Sandwich propagation, transmission line analogy for SATCO (supranational automatic air traffic control system) being pushed in Europe ..... ER5100 May 20

BF40 Apr 22

**SATELLITES**

(See also Military Electronics, Missiles & Space Electronics)

Advent active communications satellite should have space relay station in operation by 1962, be totally operational by 1964 ..... EN11 Jun 24

Basic design considerations of silicon solar cells for use as power supplies on satellites ..... TF167 Mar 11

Broadband log-periodic antenna for monitoring and signal interception, direction finding, satellite tracking, radio astronomy and h-f communications uses ..... TF58 Jun 17

Circularly-polarized, high-gain antenna for automatic tracking of Tiros meteorological satellites ..... TF57 Apr 15

Command guidance system developed for Titan ICBM guides Tiros into preselected circular orbit ..... PC40 Jun 3

Electronics R&D in satellites in England and Australia ..... SR75 Feb 12

Experimental progress towards transoceanic communication by means of passive earth satellites reported ..... BTW11 Apr 8

First Project Mercury man-in-space capsule delivered ..... BF31 Apr 22

High-thrust propulsion systems to shift critical emphasis in satellite development to component and instruments ..... BF48 Apr 29

Long-range radar, computer with high reliability in ground-controlled satellite guidance system ..... BF43 May 27

Match-head size tunnel diode holds great promise for missile satellite and ultra-high-speed data processing applications ..... PC69 Mar 4

NASA gives \$30-million contract for worldwide tracking and communications net for Project Mercury ..... BTW11 Feb 5

NASA plans to launch 25 to 30 major vehicles and 100 sounding rockets each year for three years ..... EN11 May 20

NASA reports satellite tracking performance is tied to size of antenna ..... BF33 Apr 29

New AF-operated facility uses computers and complex communications system to coordinate space surveillance, catalog everything in orbit ..... BF34 Mar 4

Participants in Sixth National Flight Test Instrumentation Symposium hear that U.S. is far ahead of Soviets in ballistic missile and satellite fields ..... BF53 Jun 3

Pioneer V will be transmitting information over distance of 50 million miles in August, 1960 ..... BF49 Mar 25

Project Mercury satellite to be tracked by 50 antenna systems ..... BF33 Mar 4

Project Midas heat-seeking missile defense satellite to work with BMEWS radar ..... BF42 Apr 1

Satellite astronomical observatory with 50-inch telescope and data communicating systems planned by NSF and NASA ..... BTW11 Mar 18

Sixty-ft reflector for 3-axis antenna provides hemispheric coverage of missile and satellite telemetered data ..... PC40 Jan 1

Soviets plan whole new series of artificial satellites ..... BF57 May 13

Spray-on insulator dissipates heat and controls temperature on outside of space capsules ..... CM105 Jan 15

Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit ..... TF68 May 6

Tiros transmits data with two 33-ounce off-the-shelf f-m telemetry transmitters ..... BTW11 Apr 15

Transistorized pulse height-to-time converter for earth satellite telemetry system ..... TF82 Jan 15

Uhf transponder beacon in Tiros I improves radar data quality, provides horizon-to horizon coverage ..... RD96 May 13

U.S. to help Canada launch first satellite for studying ionosphere and galactic noise ..... BF61 Mar 18

Watchdog satellites to carry TV cameras and electrostatic tape recorders to check performance of other satellites ..... BF35 Jun 10

Saturable reactor used in adjustable counting and timing circuits operating primarily as frequency dividers ..... TF61 May 6

Saturable reactor used in high-speed, low cost simple latch circuit ..... RD66 Jan 8

Scaler, battery-powered transistorized, for measuring radioactive tracers improves reliability, reduces cost and weight ..... TF74 May 6

Schmitt trigger for transistorized slicer used to measure amplitude probability density functions ..... TF70 Jan 29

Screens for cathode ray tubes, what's new in ..... SR55 Apr 29

Sea life, noise spectrum for ..... TF41 Feb 19

Seal tightness in manufacture of electron tubes measured with mass spectrometer ..... TF74 Apr 1

Seals, quartz-to-metal, for high-frequency vacuum tubes ..... CM102 Jun 3

Secam (sequential a memoire) French compatible color tv system, features sequential transmission of chrominance, uses one-line memory in receiver ..... TF57 May 6

Seebeck effect, definition of ..... TF71 Feb 16

**SEMICONDUCTORS**  
(See also Diodes, Microminiaturization, Solid-State Physics and Transistors)

American and Japanese firms agree to share techniques of design and manufacture of diodes ..... BF32 Apr 8

Circuits grown from pool of molten semiconductor materials ..... BTW11 Jan 29

Color code standards for designating semiconductor diode and rectifier types adopted ..... CM83 Apr 22

Company combats shortage of semiconductor engineers by giving series of in-depth, 13-week courses ..... BF44 Jun 17

Controlled-rectifier switch called Transwitch for computers turned off by small negative pulse ..... TF71 Jan 15

Electronics R&D in semiconductors and transistors in England, Sweden, Israel and Japan ..... SR75 Feb 12

Germanium diffused base transistor with open circuit base connection serves as inductive negative resistance diode in microcircuits ..... TF60 Apr 22

Germans concentrate on semiconductor and vacuum tube development ..... BF49 May 13

Gold-antimony alloy gives more even control of semiconductor doping ..... CM71 Jan 22

Industrial diamonds with semiconducting properties made in South Africa ..... RD76 Apr 22

Multi-junction drift-field transistor simplifies design of portable and auto radios ..... CM82 Apr 22

New developments in semiconductor research ..... TF159 Mar 11

Predicting possible three-element semiconductor materials ..... TF103 Feb 12

Prediction of industry-wide increase in semiconductor sales boosted by announcements of production expansion ..... EN11 Feb 12

Radiation damage to semiconductors seen as major research task ..... EN11 May 20

Report on semiconductor plastics - in U.S.S.R. and in U.S.A. ..... CM68 Jan 22

Review of uranium compounds suggests some may possess semiconductor properties of interest in high-temperature applications ..... CM130 May 27

Scientists grow single crystals of transparent gallium phosphide experimentally ..... EN11 May 13

Selective diffusion and shaping of semiconductors to form complete circuits cuts size and weight, improves reliability ..... TF69 May 13

Semiautomatic silicon crystal-growing furnace triples production capacity ..... EN11 Jan 29

Semiconductor resistors and capacitors for microcircuits ..... TF69 May 13

Semiconductor r-f switches for modern microwave applications ..... SR67 Jun 24

Semiconductor wafer Hall probe in magnetic field plotting system speeds cyclotron design ..... RD80 Apr 8

Silicon carbide rectifier that withstand 500 c in useable in nuclear environments ..... CM94 Mar 18

Silicon pn junctions used as particle detectors ..... RD74 Apr 22

Single crystal rods of high-temperature compound semiconductors can be grown and purified in electron beam vertical zone refiners ..... PT104 Jun 3

Solid-State Circuits Conference indicates microelectronics is moving rapidly out of research phase ..... BF36 Feb 12

Soviet semiconductor and computer production rates increase ..... EN11 Jan 29

Strain sensing element of whisker size and high strength give 50 times greater sensitivity than present metallic devices ..... BF11 Feb 26

Technique of vapor-grown high resistivity collector films on a low-resistivity substrate (revealed at IRE-AIEE conference) may have far reaching implications ..... EN11 Jun 24

Thermoelectric cooling now possible using new semiconductor materials ..... CM85 Feb 26

Transistorized automobile ignition system uses surfacegap spark plugs ..... RD82 Mar 25

Tunnel diode circuit designs open new markets for computer, communications and receiver amplifier applications ..... BF36 Feb 26

Uncooled indium-antimonide photoelectromagnetic detector responds to long infrared wavelengths ..... TF62 Mar 25

U.S. electron tubes and semiconductors of specialized types and advanced designs in demand abroad ..... BF48 Feb 26

Year 1960 to see increased semiconductor sales, maintenance of high level 1959 electron tube sales ..... MR24 Jan 29

Sensor, light, in automatic bomb alarm system now being installed in strategic U.S. cities ..... PC45 Apr 8

Sensor, sun-position, for establishing coordinate reference system on space vehicle reported at 1960 Winter Convention on Military Electronics ..... RD62 Mar 4

**SERVO-MECHANISMS**  
(See also Control Circuits and Coasters)

Control transformer tester aligns coarse-line servo systems without precision synchros ..... TF84 Mar 18

Electronics R&D in servomechanisms in Italy ..... SR75 Feb 12

Multiplex circuits control robot which performs jobs in dangerously radioactive areas ..... TF46 Jan 22

Servo detector for automatic survey system used to measure roughness of airport runways ..... TF54 Jun 17

Steering transistor circuits control reversible decade counter generating error signals ..... TF86 Jan 1

Setun computer developed by Russia uses magnetic amplifiers and operates on ternary rather than binary code ..... BF11 Feb 26

Sextant, miniaturized all-weather radiometric, developed for submarine use ..... EN11 Jan 15

Sferic data may improve navigation ..... RD78 Apr 8

Sferics (lightning photographed by intermittent recorder) ..... RD64 Mar 4

Shaper, ramp and step, for noise suppression factor display unit ..... TF55 Feb 5

Shaping network for attitude-control system in Able series space exploration probes ..... TF60 Jan 29

Shields, r-f, transmission line analogy for propagation in sandwiches of dielectric sheets and conducting films or grids used for ..... ER5100 May 20

Shipping automation shows good start in Britain Shock, knitted metal mesh protects electronic equipment from ..... CM94 Mar 18

Silver antimony telluride, evaluation of as semiconductor material ..... TF103 Feb 12

Simulated transformer tests magnetic sheet ..... PT90 Feb 26

Simulator for selecting best possible target among all in-range attackers ..... RD76 Jan 29

Simulator, radar target, to train operators for DEW line ..... PC64 Jan 8

Simulators, system for typing flights simulator into remote standard ground-controlled intercept radar ..... TF86 May 13

Similarity theory and relation to microelectronics discussed at 1960 Solid-State Circuits Conference ..... TF39 Mar 4

Slicer, transistorized, measures amplitude probability density functions ..... TF70 Jan 29

Slip ring assemblies become major electronics components market, sales rise 25 percent yearly ..... MR30 May 13

Slip rings, miniature, assembly starts with encapsulation, finishes with machine and metal disposition ..... PT106 Jan 15

Test circuit shows how to accurately measure gain and phase angle characteristics of closed-loop synchro, resolver and computer amplifiers ..... ER588 May 13

Transistorized subaudio swept signal generator for testing servos and related equipment and components ..... TF67 Apr 22

Sockets, floating tube, for uhf triodes ..... CM68 Jan 8

Solar cells, silicon, power automobile ..... PC52 Jun 24

**SOLDERING TECHNIQUES** (See also Production Techniques)

Brush plating and air-operated masking jig speed precision soldering of transistor tabs ..... PT70 Mar 4

Low-pressure air most efficient method to cool components during manual soldering of printed circuits ..... PT104 May 13

Peg board type pallet permits connections of modules to be dip soldered ..... PT192 Mar 11

Polyethylene glycol improves acid solder flux performance ..... PT132 Feb 12

Solenoids, rotary, designing for space and weight saving with ..... CM66 Mar 4

**SOLID-STATE PHYSICS**  
(See also Diodes, Microminiaturization and Transistors)

Cadmium sulfide field-effect transistor announced by GM Research ..... BF42 Mar 18

Control systems, solid-state electronics and electromagnetics featured at Seattle's 7th Regional IRE Conference ..... BF39 Jun 10

Dielectric diodes and triodes to control large amounts of current using thin insulating crystals of cadmium sulphide being developed ..... BTW11 Jan 22

Electronics R&D in solid state physics in France ..... SR75 Feb 12

Experimental solid-state generator for converting pulsed dc magnetic fields into microwave radiation has been built ..... EN11 Feb 19

Frequency synthesizer uses solid-state tuner to provide stable, high-accuracy receivers and transmitters ..... RD122 Feb 12

Microelectronics to get special attention at 1960 Solid-State Circuits Conference ..... EN11 Jan 29

Predicting possible three-element semiconductor materials ..... TF103 Feb 12

RCA to open research laboratory in Japan, will study solid-state phenomena ..... EN11 Jun 24

Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference ..... TF39 Mar 4

Solid state high-speed printer-plotter prints and plots from computer-prepared magnetic tape ..... EN11 Jan 22

Superconducting electromagnets being explored for use with masers and in solid-state research requiring cryogenic temperatures and a magnetic field ..... EN11 May 20

Temperature-insensitive solid-state dielectric diodes and triodes ..... TF59 Feb 26

Transistormen give financial aid to support Stanford solid-state research ..... BF45 Jan 1

**SONAR** (See also Military Electronics, Oceanography & Transducers)

C-w Doppler radar ground velocity system for helicopter permits sonar dunking operations ..... PC35 May 27

Equations and charts for determining range parameters of active and passive sonar systems ..... TF41 Feb 19

Material and backin p-plate selection for sonar transducer design ..... TF62 Feb 26

Oceanographers position underwater photographic cameras, take samples of sea water and bottom sediments with help of sonar ..... TF93 Jun 24

Remote Underwater Manipulator (RUM), a converted Ontos tank, uses TV guide for exploring, installing and removing fixed sonar gear ..... BF31 Jun 17

Sonobuys and repair kits bought by Navy for antisubmarine warfare ..... EN11 Jan 15

Tape target classifier trains land-based sonar student operators ..... TF65 Mar 25

Space-charge focused klystrons, what's new in ..... SR55 Apr 29



Space-charge-limited dielectric diodes and triodes... TF59 Feb 29

SPACE ELECTRONICS

(See also Military Electronics, Missiles, & Radar & Radio Telescopes)

Advent active communications satellite should space relay station in operation by 1962, be totally operational by 1964... EN11 Jun 24
AF is investigating X-rays as possible means of space communication... BF45 Feb 12
Approaches to design and fabrication of micro-miniaturized digital computer for space applications... TF95 Apr 29
ARPA contracts awarded to study ways of nullifying attack by nuclear-armed vehicles entering earth's atmosphere from outer space... BF36 May 13
Basic design considerations of silicon solar cells for use as power supplies on satellites... TF67 Mar 11
Biomedical space flight instrumentation system tested on racing car crews... RD185 Mar 11
Ceramic gas bearings in new gyro reduces drift for space guidance applications... CM76 Jun 17
Computers, instruments and electrostatic propulsion for space discussed at winter meeting of AIEE... BF28 Feb 19
Cost of world's largest radio telescopes has soared to over \$100 million... BF33 May 6
Double focusing mass spectrometer going into satellite to measure elements in the exosphere... RD81 Feb 26
Electronics probes the universe is theme of 12th Annual National Aeronautical Electronics Conference... BF45 May 20
Electronics R&D in satellites in England and Australia... SR75 Feb 12
Federal spending on space research for coming fiscal year to increase over last year... BF32 Jan 29
Hawaii's Department of Economic Development reports rapid expansion of electronics work... EN11 Jun 17
High-thrust propulsion systems to shift critical emphasis in satellite development to components and instruments... BF48 Apr 29
Instrument fault in orientation system causes Soviet spaceship backfire... EN11 Jun 10
Instrumented low-cost Arcas and Loki weather rockets slated for daily firing... BF43 Apr 29
International Ordinary Administrative Radio Conference reallocates frequency spectrum and reports new regulations... BF33 Feb 19
Ions affect health and behavior in space, submarines and department stores... BF45 Feb 26
Missiles and space continue to account for much government money spent in guidance and componentry research area... EN11 Jun 3
MIT interplanetary space probe to take photographs of 40 percent of Mar's surface... BF49 May 20
NASA contracts for design of experimental cesium-stream ion engine... EN11 Jun 17
NASA gives \$30-million contract for worldwide tracking and communications net for Project Mercury... BTW11 Feb 5
NASA plans to spend 12-15 billion dollars on space exploration over next 10 years... EN11 Feb 26
NASA reports satellite tracking performance is tied to size of antenna... BF33 Apr 29
NASA seeks supplemental 1960 funds of \$19 million to spur man-in-space program... BTW11 Mar 11
Navigation for hypersonic or space craft aided by computer-directed map projection system under development... EN11 Jun 3
Navy experimental moon-relay communications system demonstrated... EN11 Feb 5
Negotiation for instrumented package for moon shot started... EN11 May 6
New AF-operated facility uses computers and complex communications system to coordinate space surveillance, catalog everything in orbit... BF34 Mar 4
Optical-electronic magnetometer control attitude of vehicles in space... TF55 Apr 8
Parametric amplifier increases range of 5-band radar used to track reentry vehicles... RD116 Apr 29
Participants in Sixth National Flight Test Instrumentation Symposium hear that U.S. is far ahead of Soviets in ballistic missile and satellite fields... BF53 Jun 3
Pioneer V will be transmitting information over distance of 50 million miles in August, 1960... BF49 Mar 25
Preview of space electronics sessions for forthcoming IRE International Show and Convention... BF32 Mar 11
Project Defender, a study program to find tomorrow's space defense, to use pinfusion radar... BF42 Feb 26
Project Mercury satellite to be tracked by 50 antennas... BF33 Mar 4
Radar signal bounced off sun's outer corona found to take 17 minutes to echo... BTW11 Feb 12
Radar telescope detects micrometeorites, determines meteor showers are more frequent than previously suspected... RD106 May 20
Satellite astronomical observatory with 50-inch telescope and data communicating system planned by NSF and NASA... EN11 Mar 18
Signal transmission through natural ionized layers and ion shields formed by nuclear vehicles, hypersonic reentry vehicles, rocket motor exhausts and nuclear explosions... TF81 May 20
Small revolving globe for use by astronaut indicates position of orbiting capsule over earth... RD85 Apr 1
Solid-state radiation detector made of doped silicon gives precise measurement of cosmic rays and Van Allen radiation belt... BTW11 Feb 5
Soviet exhibit at 1960 Leipzig trade fair focused on new electronic instruments, automation and space... EN11 Mar 11
Space communications plans outlined at Armed Forces Communications and Electronics Association's 14th Convention... BF42 Jun 10
Spider-web 142-ft telescope built in Scotland to study aurora... PC52 May 13
Sun-position sensor for establishing coordinate reference system on space vehicles reported at 1960 Winter Convention on Military Electronics... RD62 Mar 4
Technical details of Soviet spaceship launched May 16 beginning to leak out... EN11 Jun 3
Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit... TF68 May 6

Timepiece calibrated to two references will be needed by astronauts reports University of Michigan... BF59 May 20

Transistorized circuits for guiding Able series space exploration probes... TF60 29
Transportable probe taking 7-ft antenna and data collector) being tested for ARPA... BF33 Apr 29
Unconventional slow-scan TV chain assists astronomers in finding sunspots with balloon-borne optical telescope... TF49 Jun 17
Unique instrumentation for investigating possibilities of using plasma to propel space vehicles... TF66 Jun 10
University of California Lick observatory to construct nebular spectrograph for collecting information on motions of gaseous nebulae... BF60 Mar 11
University of Michigan reports astronauts will need to keep track of two kinds of time... BF59 May 20
U. S. headstart over Russia in microminiaturization seen as future space asset... BTW11 Apr 8
U. S. to help Canada launch first satellite for studying ionosphere and galactic noise... BF61 Mar 18
Use of sun as huge reflector to relay radio signals between distant points described... RD115 Jun 24
Walchdog satellites to carry TV cameras and electrostatic tape recorders to check performance of other satellites... BF35 Jun 10
Spectrometer, double-focusing mass, measures relative amounts and weights of atoms... RD74 Jan 29
Spectrometer, mass, measures quantity of helium escaping in electron tube manufacture... TF74 Apr 1
Spectroscopic system, automatic, for determining the spectral response of electro-optical materials... TF66 Apr 1
Spectroscopy, new applications of modern microwaves in... SR67 Jun 24
Spectrum analysis aided using graphical extension of transform technique... TF68 Apr 1
Speech research in Swede... SR75 Feb 12
Spincasting of plastic parabolic radio mirrors may provide antenna surface accuracies presently not practical... RD96 Jan 15
Squeezer rapidly straightens bent or kinked transistor leads... PT72 Jan 8
Stabilotron, what's new in... SR55 Apr 29
Standard, frequency, use of carbon monoxide for being studied... BTW11 Apr 8
Standard of ultraviolet radiation developed by NBS... RD64 Feb 19
Standard time code added experimentally to WWV's regular broadcasts for simultaneous observations at widely separated locations... RD114 Jun 24
Stapes, characteristics and use of types used in electronic production... TF68 Apr 15
Static power relays and circuit breakers using silicon-controlled rectifiers have contact rating from milliwatts to kilowatts... TF114 May 27
Static, precipitation, eliminates airborne radio and navigation equipment by sharp tungsten pins... RD96 Jun 3
Steering, automatic, using wire loops, guidance cable and transistorized detector demonstrated... BF40 Jun 17

STEREOPHONICS

(See also Audio, Broadcasting and Radio)
A-m/a-m method of stereo broadcasting announced British multiplex system for bilingual broadcasts or conventional stereophonic transmissions... EN11 Feb 5
Confusion hinders stereo transmission - fierce competition centers on remote speaker business... BF39 Feb 5
Dental anesthetic device using stereo sound placed in production... EN11 May 27
FCC to evaluate industry groups stereophonic f-m broadcast tests... BF48 Jun 3
Four-track stereo tape recorder and miniature 7-transistor 45-rpm radio-phonograph shown at Japanese Industrial Trade Fair... EN11 Apr 29
Future of stereophonic radio broadcasting to be determined by Washington this week... BF37 Jan 1
German's market binocular tape for stereo equipment... BF49 May 13
Japanese to market stereo 4-channel tape recorder in U.S... EN11 Jan 22
NAB convention to discuss stereophonic and station automation equipment... BF48 Apr 1
National Stereophonic Radio Committee suspends activities... BF63 Mar 11
Regular stereophonic broadcasting to be initiated in Canada... BF45 Jan 15
Stereo stimulates f-m broadcasters; FCC says standards may be established by fall 1960... BF30 Apr 22
Stereophonic broadcasting will no make big breakthrough for some time... TF159 Mar 11
Stereoscopic x-rays diagnose component failures more readily... PT74 Jan 22

STORAGE DEVICES

(See also Memories and Thin Films)
Electronics R&D in thin film storage in England... SR75 Feb 12
Ferromagnetic storage and switching circuits combined with alphanumeric indicator form electroluminescent typewriter... TF49 Jan 22
Information stored in form of acoustic energy in quartz delay line... TF159 Mar 11
Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics... RD104 May 20
Switching and storage circuits are made from crossed film cryotrons deposited on insulating superconductors... TF55 Jan 29
What's new in storage tubes... SR55 Apr 29
Store automation in Britain behind U. S. but big move expected... BF52 May 13
Stratoscope 1, unconventional slow-scan TV chain for assists astronomers in finding sunspots with balloon-borne optical telescope... TF49 Jun 17
Stretcher circuit pulse, for transistorized pulse height-to-time analyzer... TF82 Jan 15
Strip techniques used in modern microwave equipment... SR67 Jun 24
Strobe circuit using pnpn 4-layer diode for portable battlefield radar... TF67 Mar 18
Strobescope, electrical, displays pulses with rise time of 10-10 sec... RD81 Apr 1
Strobescope principle used of for nano and picosecond oscilloscopes described... EN11 May 27
SUBIC (Submarine Integrated Control) program for automatic submarine... BF28 Jan 29
Subroc antisubmarine telemetering system is given Reliability Check-out... PC78 Jan 29

Subtractor, electronic, for reducing system disturbances when measuring switching speed of thin magnetic film using strip transmission line... TF79 Jun 3
Suhl effect, definition of... TF71 Feb 26
Sun-position sensor for establishing coordinate reference system on space vehicle reported at 1960 Winter Convention on Military Electronics... RD62 Mar 4

SUPERCONDUCTORS

(See also Cryogenics)
Cryogenic gyro under development; broad capabilities inherent in low-temperature devices spur further studies... BF32 Feb 5
Superconductive gyro called feasible; use seen in subs and space vehicles... BTW11 Jan 29
Switching and storage circuits are made from crossed film cryotrons deposited on insulating superconductors... TF55 Jan 29
Transistorized test set for measuring critical current in superconducting contacts of cryogenic circuits... TF52 Jan 22
Super-power electron tubes, what's new in... SR55 Apr 29
Surface-gap spark plug used in transistorized ignition system for automobiles... RD82 Mar 25
Surface treating, electron beam metalworking equipment for... RT86 Feb 26
Surveillance systems frequency scanning antennas for groundmapping or scanning radar systems... TF70 May 6
Survey system, automatic, uses lightbeam projector and profile measuring device to measure airport runway roughness... TF54 Jun 17
Sweden - research and development currently underway in... SR75 Feb 12

SWITCHES

(See also Relays)
Biasing techniques permit small-area junction germanium diodes to switch microwave in waveguides or transmission lines... TF85
Bilateral word switch for expandable random-access solid-state memory... TF164 Mar 11
Controlled-rectifier switch called Transwitch for computers turned off by small negative pulse... TF71 Jan 15
Determining proper bias and correct circuit impedances for operating tunnel diodes as switches, amplifiers or oscillators... TF82 Jun 3
Gallium phosphide diodes and switching devices withstand 1,500 C... CM71 Jan 8
Half-amp silicon diodes with 0.3 usec recovery time in volume production for computers... CM105 Jan 15
High-speed transistor switch for computer logic circuit perfoms at micro-energy levels... CM98 May 13
Magnetic element of ferrite composition for storage, switching and logic applications in digital computers has advantage of open flux path, excellent squareness characteristics... RD104 May 20
Measuring switching speed of thin magnetic films using strip transmission line... TF79 Jun 3
Small BEAM-X switch tube may claim extended market... CM126 Feb 12
Solid-state static power relays and circuit breakers using silicon-controlled rectifiers have contact rating from milliwatts to kilowatts... TF114 May 27
Switching speeds of 100 to 10 nanoseconds or less possible with cryotron Superconductivity Symposium here... EN11 May 27
Temperature-insensitive solid-state dielectric circuit devices for switching applications... TF59 Feb 26

SWITCHING CIRCUITS

Electronics R&D in semiconductor switching in Japan... SR57 Feb 12
Equalizer switching network for wideband magnetic tape instrumentation recorder... TF44 Jan 8
Ferromagnetic storage and switching circuits combined with alphanumeric indicator form electroluminescent typewriter... TF49 Jan 22
Five nanosec switching of high currents required to electrically explode wires... CM97 Mar 18
Flip-flop uses indicator triode with fluorescent-anode whose illumination is controlled by grid potential... TF52 Feb 5
Frequency modulating a resonant circuit using reactance switching technique... TF74 Feb 26
Remote switching circuits for controlling robot which performs jobs in dangerously radioactive areas... TF46 Jan 22
Sampling oscilloscope permits measurement of computer diode recovery times down to 500 picosec... TF59 Apr 8
Selecting power transistors to give required switching speed, gain and current-carrying capacity in computer switching applications... TF44 Mar 4
Superconductors to find use as components for high-speed switches and memory systems... BF32 Feb 5
Switching and storage circuits are made from crossed film cryotrons deposited on insulating superconductors... TF55 Jan 29
Transistor reverse-biasing technique raises breakdown point for switching indicator tubes... TF48 Jan 8
Unique switching device (not specified) makes side-looking radar used for all-weather air mapping of ground terrain... BF49 Apr 15
Switzerland - research and development currently underway in... SR75 Feb 12
Synchro shafts, drop-feeding and unloading of workpieces on centerless grinder steps up production of... PT74 Jan 22
Synchronized sweep devices, graphical method of solving multivibrator instability problems encountered in... TF55 Feb 19
Synthesizer, frequency, uses solid-state tuner to provide stable, high-accuracy receivers and transmitters... RD122 Feb 12
Systems, electronics firms urged at EAI Industrial Electronics Conference to sell systems instead of hardware to industrial customers... MR22 Jan 22

T

Tachometer, cardio, using transistors is in use in Czechoslovakia... BF28 Jan 1
Tape, magnetic, sales to increase by 30 to 35 percent on 1959 in 1960... MR22 Jan 8
Tape target classifier trains land-based sonar student operators... TF65 Mar 25
TCC (Traffic Control Center) for SAC's Automatic Combat Control System (SACCS)... BF36 Mar 25

|  |       |        |  |  |  |
|--|-------|--------|--|--|--|
| Teaching machine (Tutor) automatically simulates complex electronic gear, speeds development of technical personnel  | BF39  | Apr 22 |  |  |  |
| <b>TELEMETRY</b><br>(See also Communications, Military Electronics, and Space Electronics)   |       |        |  |  |  |
| Accurate pulse-code modulation system for missile telemetering being built   | EN11  | Jan 1  |  |  |  |
| Beryllium oxide heat sink solves problem of heat removal from tube anode in r-f telemetry power amplifier  | CM110 | May 20 |  |  |  |
| Circularly-polarized, high-gain antenna for handling large quantities of telemetry data from Tiroc Meteorological satellite  | TF57  | Apr 15 |  |  |  |
| Elliptically polarized X-band horn antenna has 3-dB and 6-dB beamwidths of 140 degrees   | TF50  | Mar 4  |  |  |  |
| High-speed digital plotter cuts time for reducing telemetered data   | TF41  | Jan 8  |  |  |  |
| Interlacing of two helical antennas improves overall radiation pattern of single helix   | TF99  | Apr 29 |  |  |  |
| Missile telemeter-radio interference: Cause and cure   | BF24  | Jan 8  |  |  |  |
| Pioneer V will be transmitting information over distance of 50 million miles in August, 1960   | BF49  | Mar 25 |  |  |  |
| Telemetry system, vhf, for eliminating communication blackout from plasma sheath formation during vehicle reentry  | TF105 | May 27 |  |  |  |
| Telemetry technique for studying car behavior developed  | BF42  | Mar 18 |  |  |  |
| Telemetry transmitter for ICBM operates through ionized plasma around re-entry missile   | BTW11 | Feb 12 |  |  |  |
| Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit   | TF68  | May 6  |  |  |  |
| Telephone and teleprinter R&D in Switzerland   | SR75  | Feb 12 |  |  |  |
| Test equipment for reliability checkout of Subroc antisubmarine telemetering system  | PC78  | Jan 29 |  |  |  |
| Tiroc transmits data with two 33-ounce off-the-shelf f-m telemetry transmitters  | BTW11 | Apr 15 |  |  |  |
| Titan flight test program will use pulse-code-modulation telemetry system  | BTW11 | Mar 4  |  |  |  |
| Transistorized low-pass filter-amplifier for subaudio frequencies used in missile telemetry  | TF88  | Jan 15 |  |  |  |
| Transistorized pulse height-to-time converter for earth satellite telemetry system   | TF82  | Jan 15 |  |  |  |
| Telephone submarine cable being run between Britain and Sweden   | EN11  | Jun 17 |  |  |  |
| <b>TELEVISION</b><br>(See also Broadcasting, Communications, Consumer Products, Receivers and Transmitters)  |       |        |  |  |  |
| Balanced-bridge and semiconductor diode circuits for one-tube oscillator-mixers in tv and fm tuners  | TF76  | Jan 15 |  |  |  |
| British tv and radio manufacturers break all sales records   | EN11  | Jan 15 |  |  |  |
| Closed-circuit tv for monitoring dental surgery and for assisting in diagnosis being studied   | RD92  | Jan 1  |  |  |  |
| Closed-circuit tv monitors quality during production of mesa transistors   | MR26  | Apr 8  |  |  |  |
| Color tv sales to rise \$10 million in 1960  | PC78  | Apr 22 |  |  |  |
| Computers and closed-circuit television are bringing office automation to Mideast banks and oil firms  | EN11  | Jul 1  |  |  |  |
| Electronics R&D in tv in France and Switzerland  | SR75  | Feb 12 |  |  |  |
| FCC plans to spend \$2 million to find out whether or not uhf tv can be rejuvenated  | BF32  | Jun 3  |  |  |  |
| FCC yearend report shows more than 1 1/2 million transmitters now on air in more than 50 services  | BF33  | Jan 22 |  |  |  |
| French compatible color tv system features sequential transmission of chrominance, uses one-line memory in receiver  | TF57  | May 6  |  |  |  |
| Graphical method of solving sweep oscillator multivibrator instability problems encountered in tv receivers  | TF55  | Feb 19 |  |  |  |
| International Ordinary Administrative Radio Conference re-allocates frequency spectrum and reports new regulations   | BF33  | Feb 19 |  |  |  |
| Israel to make a decision for or against establishing nation-wide tv net in 1960   | BF31  | Jan 22 |  |  |  |
| Japan adopts American NTSC standards to pave way for marketing transistorized color, and black and white tv set in U.S.  | BF27  | Jan 22 |  |  |  |
| Japan boosts tv set output for export  | BF48  | Feb 26 |  |  |  |
| Japanese—black-and-white-and color tv sets arriving in quantity in U.S. ports  | BF32  | Apr 29 |  |  |  |
| Japanese to emphasize development of crt tubes for color tv and video tape recorders   | EN11  | Feb 12 |  |  |  |
| Japanese tv set sales increase rapidly   | EN11  | Jan 15 |  |  |  |
| Japan's electronics industry concentrating on production of color tv sets  | EN11  | Jun 24 |  |  |  |
| Lab model thermoplastic recording system gives kinescope-quality b-w picture, green and red predominating color picture  | EN11  | Jan 22 |  |  |  |
| Lighter, smaller silver-cadmium portable tv battery capable of more than 2,000 operating hours available   | CM87  | Apr 15 |  |  |  |
| Magnetic recording of color television using time-correction circuits to reproduce hues faithfully   | TF76  | Jan 1  |  |  |  |
| Manufacturers expect continued increase in tv and audio market   | BF39  | Feb 5  |  |  |  |
| Microalloy diffused-base transistors used in tuner design for portable tv sets   | TF76  | Mar 18 |  |  |  |
| Miniature tv camera system transmitted high-resolution pictures from Redstone missile  | BTW11 | Mar 25 |  |  |  |
| Mobile tv recorder can be modified for American, UK or European standards  | PC94  | Jan 15 |  |  |  |
| New image orthicon tv camera tube improves resolution  | CM84  | Apr 8  |  |  |  |
| Non-newtonian color optics being used in color-reception system using two monochrome tubes shown at regional meeting of Society of Photographic Scientists and Engineers | EN11  | Jun 24 |  |  |  |
| Pay tv in Canada uses direct wire to give choice of three channels to viewers  | BF52  | Mar 18 |  |  |  |
| Pay tv to get three-year, \$10 million test if FCC approves  | BTW11 | Apr 15 |  |  |  |
| Plane and vehicle movements monitored by tv system   | BF44  | Mar 25 |  |  |  |
| Radio and TV production rise in Austria  | EN11  | Jun 10 |  |  |  |
| Remote transmitter generates control pulses during vertical blanking interval to control TV receiver   | TF79  | May 13 |  |  |  |
| Remote Underwater Manipulator (RUM), a converted Ontos tank, uses TV guide for exploring, installing and removing fixed sonar gear                                       | BF31  | Jun 17 |  |  |  |
| Retail sales of tv sets will rise 60 to 70 percent higher in 1970  | MR26  | May 27 |  |  |  |
| Satellite astronomical observatory with 50-inch telescope and television communication system planned by NSF and NASA  | BTW11 | Mar 18 |  |  |  |
| Self-powered portables, more color sets and additional remote control models focal points of 1960 TV market  | BF44  | May 13 |  |  |  |
| Six-month shakedown of instantaneous audiometer used to rate viewing habits in New York City completed   | BF44  | Apr 8  |  |  |  |
| Sixteen colleges in six midwestern states designated as communications network for Midwest Program on Airborne Television Instruction                                    | BF59  | May 20 |  |  |  |
| Slow-scan tv now considered as supplement to regular civilian amateur activities   | BF48  | Feb 12 |  |  |  |
| Soviets plan to triple tv set production by 1965   | BF51  | Jan 15 |  |  |  |
| Specially developed diffused-base mesa transistors permit design of low-noise tuners   | TF64  | Apr 8  |  |  |  |
| Super-power uhf ceramic-metal tube developed for possible long-range radar missile detection and intercontinental tv   | TF70  | Apr 8  |  |  |  |
| Technique for checking calibration of f-m and tv transmitter percentage-of-modulation monitors   | TF67  | Apr 15 |  |  |  |
| Television sparks growth of electronics industry in Japan  | SR53  | May 27 |  |  |  |
| Television tracking system records eye focus points and movements  | TF57  | Apr 22 |  |  |  |
| Thailand, Laos and Vietnam to have telecommunication network for radio and tv  | BF29  | Jan 1  |  |  |  |
| Thermoplastic recording of television signals provoking interest   | BF46  | Jan 15 |  |  |  |
| Transistorized TV receiver with 19-in. screen and rechargeable battery announced   | EN11  | Jun 3  |  |  |  |
| Transistorized tv set to be marketed by Japanese firm during 1960  | EN11  | Jan 8  |  |  |  |
| Transistorized video amplifier uses shunt feedback circuits to get 100 MC bandwidth  | TF73  | Apr 15 |  |  |  |
| Tunnel diodes will be used in preliminary circuit design of tv sets in two years   | TF159 | Mar 11 |  |  |  |
| Unconventional slow-scan TV chain assists astronomers in finding sunspots with balloon-borne optical telescope   | TF49  | Jun 17 |  |  |  |
| U.S. National Television Standards formally okayed by Japan's Electrowave Control Council  | EN11  | Jun 17 |  |  |  |
| Use of commercial uhf tv sets for reception of tv signals from aircraft for educational purposes discussed at winter meeting of AIEE                                     | BF28  | Feb 19 |  |  |  |
| Video band recorder-reproducer for analog and pulse signals to be produced   | EN11  | Mar 25 |  |  |  |
| Watchdog satellites to carry TV cameras and electrostatic tape recorders to check performance of other satellites  | BF35  | Jun 10 |  |  |  |
| What's new in cathode ray tubes  | SR55  | Apr 29 |  |  |  |
| Temperature of commercial tube cathodes measured using magnetic field parallel to retarding potential  | RD80  | Apr 15 |  |  |  |
| Terminations, coaxial cable and waveguide, characteristics and relative cost of  | TF50  | Jan 8  |  |  |  |
| Ternary compounds, predicting possible use as semiconductor materials  | TF103 | Feb 12 |  |  |  |
| Terrain mapping, frequency scanning antennas for ground mapping or scanning radar systems  | TF70  | May 6  |  |  |  |
| <b>TEST EQUIPMENT</b> (See also Instruments)   |       |        |  |  |  |
| Auto Company tests energy absorption of materials by measuring impact of steel ball of surface   | PC30  | Jun 17 |  |  |  |
| Automatic fault-finding system for testing battery control center of Hawk Weapons System   | TF60  | Jun 17 |  |  |  |
| Bridge circuit measures pulse response of armatures to pinpoint faults during production runs  | TF70  | Jun 10 |  |  |  |
| Control transformer tester aligns coarse-fine servo systems without precision synchros   | TF84  | Mar 18 |  |  |  |
| Current pulse generator for testing ferrite memory cores   | TF80  | Jan 1  |  |  |  |
| Dynamic tester evaluates transistors by their performance as component in oscillator circuit   | RD66  | Feb 19 |  |  |  |
| Electron tube tester automatically prepares test data in digital form for computer analysis  | PT74  | Feb 5  |  |  |  |
| FAA orders test monitoring control equipment to check out VORTAC air navigation system   | EN11  | Feb 26 |  |  |  |
| Mobile antenna radiating facility for aircraft flight-line testing (RADFAC)  | PC96  | Jan 15 |  |  |  |
| Mobile controller-recorder programs temperatures to test missile components  | PC34  | Jun 17 |  |  |  |
| Model test range will permit all-weather, interference-free testing of antenna radiation patterns  | RD64  | Jan 8  |  |  |  |
| Modern microwave test equipment  | SR67  | Jun 24 |  |  |  |
| Photographically-sensitized metal sheet makes custom labels for instrument and test equipment panels   | PT100 | Jan 1  |  |  |  |
| Production line tester for checking for contact chatter of electromagnet relays uses thyatron timing circuit   | TF94  | May 20 |  |  |  |
| Self-compensating fixture tests 24 capacitors at a time in an environmental test chamber   | PT72  | Jan 22 |  |  |  |
| Servocontrolled photocell monitors diameter of wire as it is drawn   | PT90  | Feb 26 |  |  |  |
| Shell-type transformer used to nondestructively test magnetic sheet material   | PT90  | Feb 26 |  |  |  |
| Test circuit for super-power uhf ceramic-metal tube  | TF70  | Apr 8  |  |  |  |
| Test circuit shows how to accurately measure gain and phase angle characteristics of closed-loop synchro, resolver and computer amplifiers                               | ERS88 | May 13 |  |  |  |
| Test equipment for reliability checkout of Subroc antisubmarine telemetering system  | PC78  | Jan 29 |  |  |  |
| Three-dimensional x-rays diagnose component failures more readily  | PT74  | Jan 22 |  |  |  |
| Transistorized monitor developed to test electrical contacts under shock and vibration conditions  | RD78  | Apr 8  |  |  |  |
| Transistorized overload circuit for production and maintenance testing of transistors with low d-c voltages  | RD125 | Feb 12 |  |  |  |
| Transistorized test set for measuring critical current in superconducting contacts of cryogenic circuits   | TF52  | Jan 22 |  |  |  |
| Wheel-shaped component carrier in oven makes 150 C tests of silicon diodes   | PT130 | Feb 12 |  |  |  |
| Wow-flutter indicator for precise measurement of tape recorder performance   | TF100 | Jun 24 |  |  |  |
| Thermal conductivity, determination of in evaluating three-element semiconductor   | TF103 | Feb 12 |  |  |  |
| Thermal design of receiving-type electron tubes  | SR55  | Apr 29 |  |  |  |
| Thermal infrared detectors, characteristics of   | TF72  | Apr 1  |  |  |  |
| Thermionic driver for boosting speed of conventional electromechanical counters  | TF112 | Feb 12 |  |  |  |
| Thermionics, new developments in direct conversion of heat to electric power without using moving parts  | TF159 | Mar 11 |  |  |  |
| <b>THERMOELECTRICITY</b><br>(See also Converters, Generators, and Power Sources and Supplies)  |       |        |  |  |  |
| Americans study Soviet-built heat-to-electricity converter   | BF48  | Apr 1  |  |  |  |
| Cesium cell converter working at high temperatures produces significant amounts of a-c electricity   | CM78  | Jan 29 |  |  |  |
| Measurement of thermoelectric power to evaluate three-element semiconductor materials  | TF103 | Feb 12 |  |  |  |
| New developments in direct conversion of heat to electric power without using moving parts   | TF159 | Mar 11 |  |  |  |
| Power amplifiers using electro-optical effects handle various combinations of electric radioactive and thermal power   | TF71  | Feb 26 |  |  |  |
| Researchers demonstrate experimental photo-generator for converting solar energy by photoelectric emission   | EN11  | May 27 |  |  |  |
| Thermoelectric cooling modules for electronic components in R&D stage  | RD68  | Feb 5  |  |  |  |
| Thermoelectric cooling now possible using new semiconductor materials  | CM85  | Feb 26 |  |  |  |
| Thermoelectric developments shown at IRE International Show and Convention   | EN11  | Apr 1  |  |  |  |
| Thermoelectric generator built which delivers 5 kw by direct conversion of heat into electricity without major moving parts  | RD96  | Jun 3  |  |  |  |
| Thermoelectric transistor cooler using Peltier effect gives wide-range temperature control   | TF71  | Jan 15 |  |  |  |
| Thermometry program for getting higher precision at low temperatures being expanded  | RD98  | Jun 3  |  |  |  |
| <b>THERMOPLASTICS</b><br>Lab model thermoplastic recording system gives kinescope-quality b-w picture, green and red predominating color picture                         | EN11  | Jan 22 |  |  |  |
| New tube produces velocity modulation gratings on thermoplastic recording tape   | EN11  | Jan 15 |  |  |  |
| Thermoplastic recording of television signals provoking interest   | BF46  | Jan 15 |  |  |  |
| Thickness measurement of wire, electronic gage for nondestructive measurement of   | TF109 | Feb 12 |  |  |  |
| <b>THIN FILMS</b><br>(See also Magnetics and Microminiaturization)   |       |        |  |  |  |
| Completely passive, balance modulator circuits using thin permalloy film described at 1960 Winter Convention on Military Electronic                                      | RD78  | Feb 26 |  |  |  |
| Electron beam device accurately drills small holes in evaporating masks used in micro-miniaturization  | TF71  | Jan 15 |  |  |  |
| Electronics R&D in thin film storage in England  | SR75  | Feb 12 |  |  |  |
| Magnetic thin film dots for computer memories  | PC184 | Mar 11 |  |  |  |
| Measuring switching speed of thin magnetic films using strip transmission line   | TF79  | Jun 3  |  |  |  |
| New developments in thin film techniques for microminiaturization  | TF159 | Mar 11 |  |  |  |
| Recent advances in preparing thin film ceramic dielectrics for microminiature capacitors   | CM96  | Jan 1  |  |  |  |
| Recent progress in solid state technology reported at 1960 Solid-State Circuits Conference   | TF39  | Mar 4  |  |  |  |
| Series of papers on thin films presented in IBM Journal  | CM78  | Jun 17 |  |  |  |
| Switching and storage circuits are made from crossed film cryotrons deposited on insulating superconductors  | TF55  | Jan 29 |  |  |  |
| Value of thin magnetic films in computer memory systems being explored by Case Institute of Technology   | BF53  | Feb 12 |  |  |  |
| Thyatron timing circuit used in production line tester for checking for contact chatter of electromagnet relays  | TF94  | May 20 |  |  |  |
| Thyatron control a milling machine by driving step motors in response to signals from a programmed tape  | TF174 | Mar 11 |  |  |  |
| Thyatron, what's new in development of   | SR55  | Apr 29 |  |  |  |
| Time and frequency signal broadcasts being coordinated by Britain and U.S.   | RD81  | Jun 10 |  |  |  |
| Time-correction circuits to reproduce hues faithfully in magnetic recording of color television  | TF76  | Jan 1  |  |  |  |
| Timing circuit for noise suppression factor display unit   | TF55  | Feb 5  |  |  |  |
| Timing circuit, thyatron, used in production line tester for checking for contact of electromagnet relays  | TF94  | May 20 |  |  |  |
| Timing circuits, adjustable, operate primarily as frequency dividers using a controlled rectifier and salarable reactor  | TF61  | May 6  |  |  |  |
| Timing light, circuit, transistorized, for camera control system used in rocket sled tests   | TF63  | Apr 1  |  |  |  |
| TIHMS (Thermionic Integrated Micromodulator) circuits demonstrated at IRE International Show and Convention  | BTW11 | Apr 1  |  |  |  |
| TIHMS (Thermionic Integrated Micromodulator) circuit, practicality of using small ceramic receiving tube in  | CM82  | Jun 10 |  |  |  |
| Tiroc guided into preselected circular orbit by command guidance system developed for Titan ICBM   | PC40  | Jun 3  |  |  |  |
| Tonometer, electronic, detects glaucoma by measuring pressure within eyeball   | TF115 | Feb 12 |  |  |  |
| Tooling standardization cuts most and design time  | PT88  | Jun 10 |  |  |  |
| Tote boxes and trays of special design speed assembly, reduce production costs   | PT88  | Mar 25 |  |  |  |
| <b>TRACKING &amp; ACQUISITION SYSTEMS</b><br>(See also Missiles, Radar, Rockets and Satellites)  |       |        |  |  |  |
| Broadband log-periodic antennas for monitoring and signal interception, direction finding, satellite tracking, radio astronomy and h-f communications uses               | TF58  | Jun 17 |  |  |  |
| Circularly-polarized, high-gain antenna for automatic tracking of Tiroc meteorological satellites  | TF57  | Apr 15 |  |  |  |
| Ground based missile roll control system used photosensitive or infrared detectors   | RD80  | Mar 25 |  |  |  |
| Interlacing of two helical antennas improves overall radiation pattern of single helix   | TF99  | Apr 29 |  |  |  |



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|---|-------|--------|--|-------|--------|---|-------|--------|
| NASA gives \$30-million contract for worldwide tracking and communications net for Project Mercury  | BTW11 | Feb 5  | Selective calling system for aircraft data links removes necessity of continuously monitoring a communication channel                    | TF108 | Apr 29 | Micro-alloy diffused base transistor (MADT) fabrication improved using Etching by Transmitted Light (ETL) technique   | BTW11 | Apr 1  |
| NASA reports satellite tracking performance tied to size of antenna new   | BF33  | Apr 29 | Selective paging system uses coded transmission for voice intercommunications with up to 45 stations                                     | TF68  | Feb 26 | Multi-junction drift-field transistor simplifies design of portable and auto radios   | CM82  | Apr 22 |
| Optical-electronic active system for communications, navigation, and tracking, and acquisition applications   | TF71  | Jan 15 | Self-powered transistor oscilloscope has response from d-c to over 5 Mc  | TF80  | Mar 18 | New mode of transistor operation (combination tunneling and avalanche effect) being explored extensively by several companies                                   | BTW11 | Apr 22 |
| Maneuverable dish radar to scan and track ballistic missiles for BMEWS  | BF47  | Mar 18 | Single-transistor circuit forms efficient photoflash power converter   | TF57  | Jan 22 | New triple-diffused n-p-n silicon mesa devices designed for low-power high-speed switches slunk to pico size  | CM82  | Apr 8  |
| Monopulse tracking radars compared with sequential lobing and conical scan techniques   | TF51  | Apr 22 | Specialized diffused-base mesa transistors permit design of low-noise tuners   | TF64  | Apr 8  | Plastic type transistor developed by Soviet scientist   | EN11  | Jan 1  |
| Navy begins test on UDOFT (Universal Digital Operation Flight Trainer) used to simulate complicated jet flight conditions                                 | BF44  | Apr 15 | Steering transistor circuits control reversible decade counter generating error signals  | TF86  | Jan 1  | Respective merits of tubes and transistors discussed at winter meeting of AIEE  | BF28  | Feb 19 |
| Project Mercury satellite to be tracked by 50 antenna system  | BF33  | Mar 4  | Telemetry transmitter for investigating Van Allen radiation belt uses novel transistorized phase modulator circuit                       | TF68  | May 6  | Semiconducting industrial diamonds may find application as transistors  | RD76  | Apr 22 |
| Television tracking system records eye focus points and movements   | TF57  | Apr 22 | Three-stage silicon transistor amplifier with high-value circuit resistances operates with less than one milliwatt battery drain         | TF106 | Apr 29 | Services need inventions in component, transistor, antenna and instrument areas   | BF39  | Jan 22 |
| Tracking ship for measuring missile capabilities gets more radar equipment  | EN11  | Jan 1  | Transistor audio volume compressor for interview tape recorders  | TF62  | Jan 8  | Silicon transistors of mesa construction capable of handling 10, 20, 50 and 100 amp being investigated  | CM86  | Apr 1  |
| Transportable probe tracking facility (antenna and data collector) being tested for ARPA  | BF33  | Apr 29 | Transistor reverse-biasing technique raises breakdown point for switching indicator tubes  | TF48  | Jan 8  | Squeezer rapidly straightens bent or kinked transistor leads  | PT72  | Jan 8  |
| WWV adds experimental standard time code to regular broadcasts for simultaneous observations at widely separated locations                                | RD114 | Jun 24 | Transistorized automobile ignition system uses surface-gap spark plugs   | RD82  | Mar 25 | Technique of vapor-growing high resistivity collector films on a low-resistivity substrate (revealed at IRE-AIEE conference) may have far reaching implications | EN11  | Jun 24 |
| TRACTOR, a new magnetic tape system capable of storing 60 million characters is announced   | EN11  | May 6  | Transistorized circuits for guiding Able series space exploration probes   | TF60  | Jan 29 | Thermoelectric transistor cooler using Peltier effect gives wide-range temperature control  | TF71  | Jan 15 |
| Transceiver, binary data, permits computers to talk to each other at 2,400 bits per sec over phone lines  | EN11  | Jun 3  | Transistorized f-m modulator and demodulator, peak amplitude detector and audio selection gate for sonar student operator trainer        | TF65  | Mar 25 | Transistors developed which are almost flush with print circuit boards  | EN11  | May 20 |
| <b>TRANSDUCERS</b>  |       |        | Transistorized function generator eliminates need for d-c amplifier  | TF75  | Mar 25 | USSR claims to have made transistors from plastic fiber using bombardment techniques  | BF26  | Jan 28 |
| Inductor with ferrite core used in tonometer probe for detecting glaucoma by measuring pressure within eyeball  | TF115 | Feb 5  | Transistorized gear stars at National Motor Boat Show  | BF30  | Jan 22 | Vhf silicon transistor for high-power oscillators   | TF52  | Jan 22 |
| Material and backing-plate selection for sonar transducer design  | TF62  | Feb 26 | Transistorized high-power sound generating system used to replace mechanical siren alarms  | TF70  | Apr 15 | Translation machine using optical-electronic reader to recognize 1,000 Russian characters per second  | EN11  | Jun 10 |
| Passive, reversible, distributed-coupling transducer introduced at 3rd International Congress on Acoustics  | CM73  | Feb 5  | Transistorized inverters working at 1,250 cps power 40-watt fluorescent lamp off 24-v battery in British railway coaches                 | TF58  | Feb 5  | Transistor circuit, parametron, for digital computers Transmission line, strip, used to measure switching speed of thin magnetic film                           | TF79  | Jun 3  |
| Rugged ultrasonic transducer with novel vibrating system for indoor and outdoor remote control applications   | CM128 | May 27 | Transistorized monitor developed to test electrical contacts under shock and vibration conditions  | RD78  | Apr 8  | Transmission lines, biasing techniques permit small-area junction germanium diodes to switch microwaves in  | TF85  | Jan 15 |
| Single-disk barium titanate transducer for portable transistorized depth indicator  | TF50  | Feb 5  | Transistorized multiplex single-sideband suppressed carrier system capable of handling 600 voice channels announced                      | EN11  | Feb 19 | Transmission lines used in modern microwave systems   | SR67  | Jun 24 |
| Strain sensing element of whisker size and high strength gives 50 times greater sensitivity than present metallic devices                                 | BF11  | Feb 26 | Transistorized overload circuit for production and maintenance testing of transistors with low d-c voltages                              | RD125 | Feb 12 | <b>TRANSMITTERS</b><br>(See also Broadcasting, Communications, Consumer Products, Radar, Radio and Television)  |       |        |
| Ultrasonic flowmeter uses two crystal transducers for common-path beam direction to eliminate temperature errors  | RD78  | Apr 22 | Transistorized precision multi-range sweep generator for airborne radar system   | TF92  | Jan 15 | Circle diagram for impedance matching transmitter to antenna  | ERS73 | Jun 10 |
| Transfluxor (magnetic-electronic) oscillator retains last frequency setting many hours after control signal removal                                       | TF48  | Mar 4  | Transistorized pulse height-to-time converter for earth satellite telemetry system   | TF82  | Jan 15 | Double-sideband suppressed carrier transmitter for medium power operations  | TF47  | Feb 5  |
| Transformer, shell-type, used to nondestructively test magnetic sheet material  | PT90  | Feb 26 | Transistorized radiation monitor sounds alarm when alpha and beta radiation reaches preset level in nuclear-powered Navy vessels         | TF43  | Jan 22 | Frequency synthesizer uses solid-state tuner to provide stable, high-accuracy receivers and transmitters  | RD122 | Feb 12 |
| Transformers, linear differential, demodulators for   | ERS92 | Jun 3  | Transistorized radio beacon designed to function as aircraft crash position indicator  | TF54  | Jan 22 | Million-watt transmitter to be completed by year's end for Navy   | BF41  | Jan 29 |
| Transformers—review of Fourier and convolution integrals and graphical extension of convolution technique   | TF68  | Apr 1  | Transistorized sense amplifier, gate and inverter for Mobile Digital Computer (MOBIDIC)  | TF72  | Mar 25 | NBS studies automatic computation methods for determining best possible frequencies for radio transmitters used as road markers on air lanes                    | RD72  | Jun 17 |
| <b>TRANSISTOR CIRCUITS</b>  |       |        | Transistorized slicer measures amplitude probability density functions   | TF70  | Jan 29 | Portable Doppler radar for battlefield surveillance of enemy uses X-band transmitter  | TF67  | Mar 18 |
| Accurate and stable pulse height discriminator uses forward-biased shunt diode in input circuit   | TF89  | May 20 | Transistorized sub-scan TV chain for Stratoscope I   | TF49  | Jun 17 | Radar transmitter for antimissile Zeus being tested   | BF34  | May 27 |
| Analytical design of transistor push-pull amplifiers  | TF60  | Jun 10 | Transistorized subaudio swept signal generator for testing servos and related equipment and components                                   | TF67  | Apr 22 | Remote transmitter generates control pulses during vertical blanking interval to control TV receiver  | TF79  | May 13 |
| Battery-powered transistorized scale-of-64 counter for measuring radioactive tracers, improves reliability, reduced cost and weight                       | TF74  | May 6  | Transistorized test set for measuring critical current in superconducting contacts of cryogenic circuits                                 | TF52  | Jan 22 | Selective paging system uses coded transmission for voice intercommunications with up to 45 stations  | TF68  | Feb 26 |
| Choosing transistors for monostable multi-vibrators used as variable delay generators   | ERS58 | Jan 22 | Transistorized video amplifier uses shunt feedback circuits to get 100 Mc bandwidth  | TF73  | Apr 15 | Technique for checking calibration of f-m and t-v transmitter percentage-of-modulation monitors   | TF67  | Apr 15 |
| Combination flip-flop and bootstrap sweep generator gives same type waveforms as phantastrons   | TF177 | Mar 11 | Two transistor voltage amplifiers and latchtype relay provide overload protection for voltmeter  | RD92  | Mar 18 | Telemetry transmitter for ICBM operates through ionized plasma around re-entry missile  | BTW11 | Feb 12 |
| Data reduction speeded using transistorized pulse-height-to-digital signal converter  | TF58  | Jan 8  | Underwater camera flash and film-rewind circuits control picture taking at depths of 6 miles   | TF62  | Apr 8  | Tiros transmits data with two 33-ounce off-the-shelf f-m telemetry transmitters   | BTW11 | Apr 15 |
| D-c transistor amplifier for measurement of low-amplitude long-period surface waves of ocean  | TF85  | Jan 1  | Wide- and narrow band-feedback amplifiers made from new alloyed-emitter, pnp mesa transistor for low microwave region operation          | RD82  | Apr 15 | Transistorized radio beacon transmitter designed to function as aircraft crash position indicator   | TF54  | Jan 22 |
| Designing high-frequency, high-power transistor oscillator circuits   | TF52  | Jan 8  | <b>TRANSISTORS</b><br>(See also Semiconductors and Solid-State Physics)  |       |        | Transmitter for SAGE warning system provides 20-kw output level   | PC34  | Apr 22 |
| Direct record and reproduce transistor amplifiers for wideband magnetic tape instrumentation recorder   | TF44  | Jan 8  | Alloyed-emitter, pnp mesa transistor operates in low microwave region and is mounted in coaxial shell                                    | RD82  | Apr 15 | Transponders, special, for aircraft identification system   | PC37  | Jan 8  |
| Expandable random-access solid-state memories operate over 15 to 55 C temperature range, require only 3 percent supplies                                  | TF164 | Mar 11 | Automated transistor assembly systems turns out n-p-n alloy junction transistors for computers at transistors for microminiaturization   | TF71  | Jan 1  | Transponders, uhf beacon, in Tiro I improves radar data quality, provides horizon-to-horizon coverage   | RD96  | May 13 |
| Extensive transistorization of portable radar permits silent surveillance of enemy movement   | TF67  | Mar 18 | Automatic alloy boat loaders boost transistor production   | PT122 | Jun 24 | <b>TRANSPORTATION</b><br>(See also Automobile Electronics and Aviation)   |       |        |
| Five-transistor line voltage regulator uses Zener diodes  | TF64  | Feb 5  | British approaches to producing flat-plate rate of 1,800 per hour  | BTW11 | Feb 19 | New IBM solid-state business data processor order by Southern Railway   | EN11  | Feb 12 |
| Flow rate of jet fuel containing radioactive tracer measured by simultaneously gated oscillator and radiation detector                                    | TF58  | Feb 19 | Brush plating and air-operated masking jig speed precision soldering of transistor tabs  | PT70  | Mar 4  | Solar-powered call system gives drivers choice of emergency highway service   | PC53  | Jun 3  |
| Generator-regulator for autos uses only semi-conductors and resistors   | TF52  | Feb 19 | Cadmium sulphide field-effect phototransistors used successfully in oscillator, multivibrator, amplifier and radiation detector circuits | EN11  | Feb 26 | Sophisticated electronic gear on ships may mean use of more solid-state power supplies  | EN11  | Feb 12 |
| Indicator triode-transistor flip-flops are coupled to form shift register   | TF52  | Feb 5  | Caseless mesa microtransistor 15 mils thick by 25 mils square to be marketed at mid-year   | BTW11 | Mar 25 | Transistorized inverters working at 1,250 cps power 40-watt fluorescent lamp off 24-v battery in British railway coaches  | TF58  | Feb 5  |
| Insuring stability in precision time delay multi-vibrators used in radar and industrial electronics   | TF73  | Apr 8  | Closed-circuit tv monitors quality during production of mesa transistors   | PT86  | Apr 8  | Traveling-wave cathode ray tubes, what's new in   | SR55  | Apr 29 |
| Linear circuits used to obtain precise voltage regulation of output of transistorized d-c to a-c inverter   | TF61  | Apr 15 | Counterattacks to petition for import curbs on Japanese transistors are registered in Washington   | BF42  | Jan 15 | Traveling-wave tubes, what's new in   | SR55  | Apr 29 |
| Magnetic shift register core-transistor pulse amplifier and blocking oscillator   | TF80  | Jan 15 | Dutch market their first electronic computer which uses transistors and ferrite cores  | BTW11 | Feb 12 | Trays and tote boxes of special design speed assembly, reduce production costs  | PT88  | Mar 25 |
| Microalloy diffused-base transistors used in tuner design for portable tv sets  | TF76  | Mar 18 | Dynamic tester evaluates transistors by their performance as component in oscillator circuit   | RD66  | Feb 19 | Trend of manufacturers to step up efforts to make own components  | BTW11 | Mar 18 |
| Parallel-to-serial converter for solid-state character generator used in VIDAC (Visual Information Display and Control) system                            | TF55  | Jun 10 | Electronics R&D in semiconductors and transistors in England, Sweden, Israel and Japan   | SR75  | Feb 12 | Trigger circuit, ferromagnetic, for electro-luminescent typewriter  | TF49  | Jan 22 |
| Peak voltmeter uses transistorized flip-flop comparison and adjustment circuit to charge storage capacitor during substantial part of interspike interval | TF57  | Jun 17 | Fully automatic electrochemical machine assembles alloy-junction transistors of high uniformity and quality                              | TF57  | Mar 25 | Triodes, temperature-insensitive solid-state dielectric   | TF59  | Feb 26 |
| Portable transistorized depth indicator for locating fish doesn't need crt  | TF50  | Feb 5  | Germanium diffused base transistor with open circuit base connection serves as inductive negative resistance diode in microcircuits      | TF60  | Apr 22 | Triplex switch Nixie tubes by means of transistor reverse-biasing technique which raises breakdown point  | TF48  | Jan 8  |
| Portable transistorized sound level meter for measuring noise   | TF64  | Jun 17 | Germans concentrate on semiconductor and vacuum tube development   | BF49  | May 13 | <b>TUBES</b> (See also specific tube types)   |       |        |
| Reciprocal circuit gives output which is inversely proportional to input for use with analog computers and control systems                                | TF92  | May 20 | Gold-antimony alloy gives more even control of semiconductor doping  | CM71  | Jan 22 | Astrakon, a small light amplifier tube, increases light-gathering ability of telescopes, permits viewing of high-energy particle tracks                         | PC82  | Jun 10 |
| Selecting power transistors to give required switching speed, gain and current-carrying capacity in computer switching applications                       | TF44  | Mar 4  | High-purity silicon dielectric for potting transistors is nonmelting and grease-like   | CM84  | Apr 15 | Beryllium oxide heat sink solves problem of heat removal from tube anode in f-f telemetry power amplifier   | CM110 | May 20 |
|   |       |        | High-speed transistor switch for computer logic circuit performs at micro-energy levels  | CM98  | May 13 | Cold-cathode ring-counter drives numerical indicator  | TF80  | Apr 1  |
|   |       |        |  |       |        | Controversy shaping up as to merits of bonded or unbonded picture tubes   | BF44  | May 13 |
|   |       |        |  |       |        | Electron sealing process using optically-ground and mated glass stem and envelopes to extend military tube life   | EN11  | May 6  |

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|--|--------------|--|--|--|--|
| Experimental magnetrons for 32, 12, 8 and 4mm wavelengths give peak outputs of 1, 100, 70, 80 and 40 kw, respectively  | CM96 Mar 18  |  |  |  |  |
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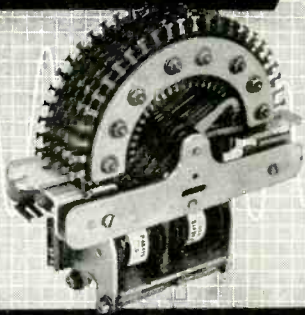
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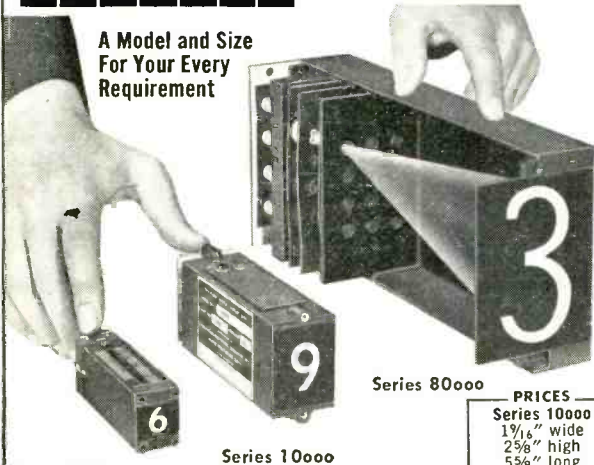
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- Digit style of your choice
- Colored digits of your choice
- Individual units may be group assembled for panel mounting

WRITE TODAY FOR COMPLETE DETAILED SPECIFICATIONS  
Representatives in principal cities



**INDUSTRIAL ELECTRONIC ENGINEERS, INC.**  
5528 Vineland Avenue, North Hollywood, California

CIRCLE 204 ON READER SERVICE CARD

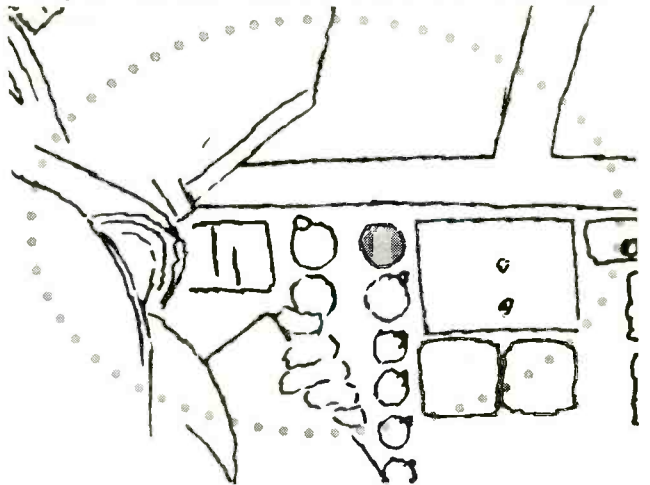
electronics • JULY 1, 1960

NEW FROM **ITT**:  
...THE **SMALLEST...**



...**LIGHTEST**

AND **BRIGHTEST**  
DIRECT VIEW STORAGE TUBE  
YOU CAN GET....ANYWHERE



### FW-211 IATRON

WEIGHT: 13 Ounces.  
MAX. VOLTAGE REQ.: 4500 Volts.  
BRIGHTNESS: 1500 Foot Lamberts.  
PERSISTENCE: Operator control-  
table up to 30 sec.  
FOCUS and DEFLECTION: Electro-  
static.



The new ITT FW-211 IATRON is a major advance in weight and size reduction for direct view storage tubes.

This new tube is small enough and light enough to be installed in the crowded panels of even the most sophisticated aircraft or research vehicles for radar or infrared data presentation.

The FW-211 offers the additional advantages of low power requirements and high brilliance for good visibility even in direct sunlight. It also features ITT's exclusive coaxial gun design which eliminates all possibility of trapezoidal distortion.

Other IATRON types and sizes are also available.



Laboratories

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION  
3701 E. Pontiac Street • Fort Wayne, Indiana

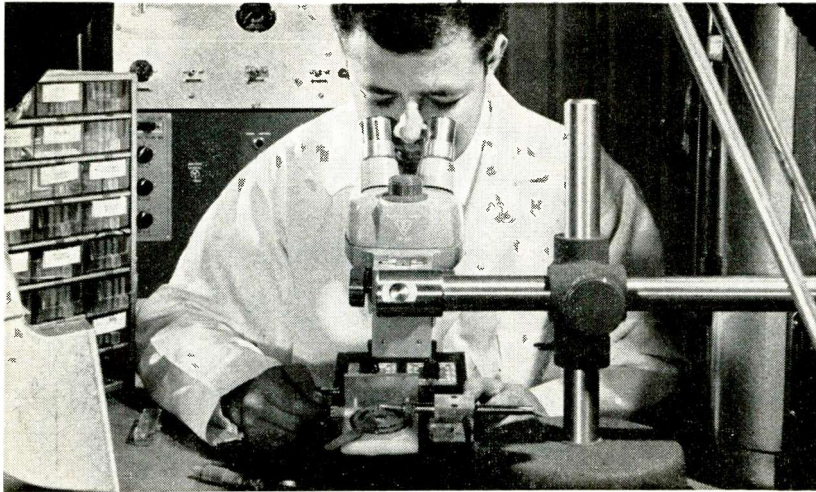
SEND FOR COMPLETE  
FW-211 IATRON DATA



CIRCLE 101 ON READER SERVICE CARD

101

# New On The Market



## Micromodule Kit

### CUTS DESIGN TIME

SELF-CONTAINED micromodule laboratory kit is available for less than \$8,000 from RCA Semiconductor and Materials Div., Somerville, N. J.

Engineers can design and fabricate micromodules and electronic circuits with packing densities of several hundred thousand parts per cubic foot. The kit enables manufacturers and engineers to experiment with micromodules in their own laboratories with a speed that is not now possible because of demand on RCA facilities. Design time may be reduced from weeks to days.

With exact tolerances and specifications already built into the experimental circuit RCA facili-

ties can be used for mass production. Ten feet of work bench and a tank of nitrogen are the only additional equipment needed.

Micromodule laboratory kits start with the completed wafers and include all equipment necessary to build and test up to ten modules with the exact values, configurations and densities desired. Included are an air-abrader, an automatic control device to shut off the air-abrader, curing oven, vacuum dust collector, 10 to 20 power stereo-zoom lens microscope, parts cabinet, heat sink, encapsulation mold, other support elements and design handbook.

**CIRCLE 301 ON READER SERVICE CARD**

time standards and simplifies data gathering of drift rates, or time or frequency differences between oscillators in widely separated systems. Propagation path errors can be averaged out and doppler errors are virtually eliminated.

The clock has a 10 microsecond time comparison capability, resulting primarily from a directly calibrated, precision phase shifter and a jitter-free optical gating system. Regenerative dividers, a phase-stable motor and precision gear train provide fail-safe pulse counting operation.

Only 7 inches high, the unit is conservatively designed with premium components. It is fully transistorized and meets all perform-

ance requirements of MIL-E-16400. Price is \$2,500; delivery is 6 weeks.

**CIRCLE 302 ON READER SERVICE CARD**

## Nuvisor Oscillator Kits

### THREE BLOCKING OSCILLATORS

TEST KITS of 6 standard nuvisorized blocking oscillator units are available for research, breadboarding and experimental laboratory applications. Manufacturer is Mini-Rad, Inc., 7416-E Varna Ave., North Hollywood, California.

Units in the MBO (monostable blocking oscillator) kit provide a complete range of output pulse widths from 0.05 to 25  $\mu$ sec.; the ABO (astable blocking oscillator) kit contains 6 units which provide



output pulse (free running) repetition rates from 1 to 1,000,000 pps; the six units of the CBO (counting blocking oscillator) kit provide a d-c control pulse repetition rate countdown from 1 to 1 to 10 to 1 over an input pulse repetition range of 100 to 1,000,000 pps.

Units are furnished either nuvisorized or transistorized, in kits containing all of one type, or mixed at prices from \$125 to \$475 for a kit of six units.

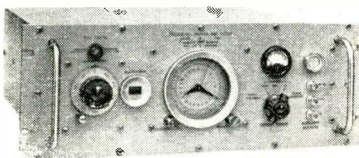
**CIRCLE 303 ON READER SERVICE CARD**

## Absorber Ceramics

### FOR MICROWAVE APPLICATIONS

A NEW microwave absorber ceramic, CFI Body Series 1000, is now available in commercial quantities. The high-power ceramics are well suited for microwave use over a broad frequency range for high and low-power applications. They are available from Ceramics for Industry, Cottage Place, Mineola, N. Y.

A typical high-power absorber ceramic, CFI-1003, exhibits excep-



## Frequency Divider

### AND CLOCK

A FREQUENCY DIVIDER and clock, for precise time comparisons between stable oscillators and standard WWV or other transmitted time signals, is available from Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, Calif.

The instrument, model 113AR, permits adjustment of frequency or



**NOW! 2 GREAT NEW  
AMPLIFIERS**

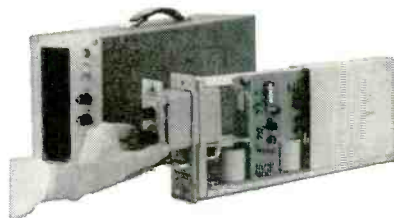
**Model A14**—High input source impedance for operational applications.

**Model A15**—Noise level less than 1 microvolt!

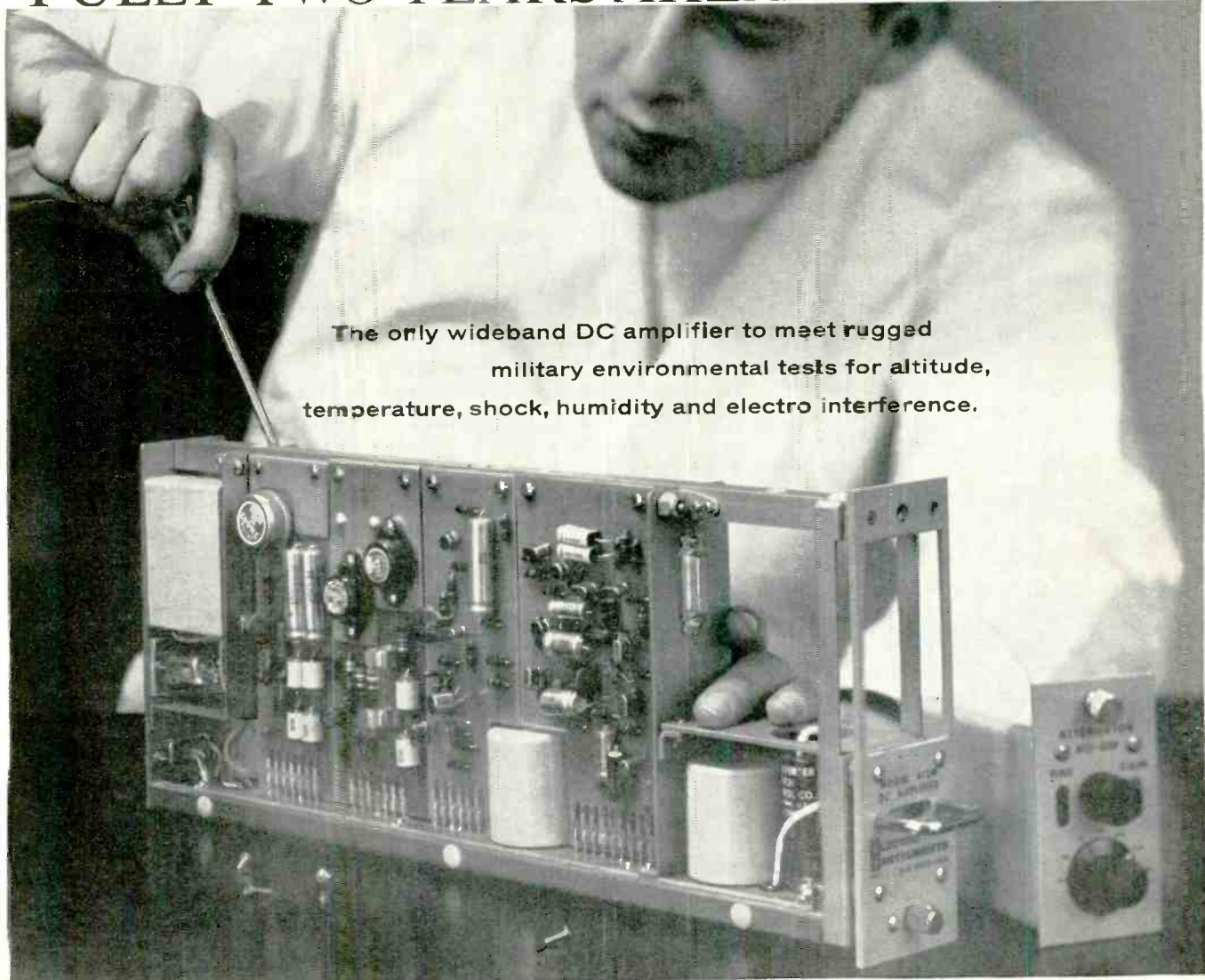
Totally transistorized—dissipates only 7 watts.  
Long term drift less than 2 microvolts.  
.01% linearity and stability.  
100 megohms input impedance—40 milliohms output impedance.  
1 db DC to 10 KC.  
Noise less than 10 microvolts wideband.  
Single ended or differential input.  
Operates to specifications from 0° to 50° C.  
Self-contained power supply—operates on any line frequency from 50-400 cps.  
Mil-type chopper gives unmatched reliability for the life of the instrument.  
7" x 19" panel accommodates 8 instruments.

**Plug-in attenuators** of the A12 provide convenience, flexibility and economy. Special variations, gain settings, etc., can be tailored to your system at no extra cost.

# Electro Instruments Model A12 D.C. Amplifier



## FULLY TWO YEARS AHEAD of the FIELD!



The only wideband DC amplifier to meet rugged military environmental tests for altitude, temperature, shock, humidity and electro interference.

# Electro Instruments, Inc.



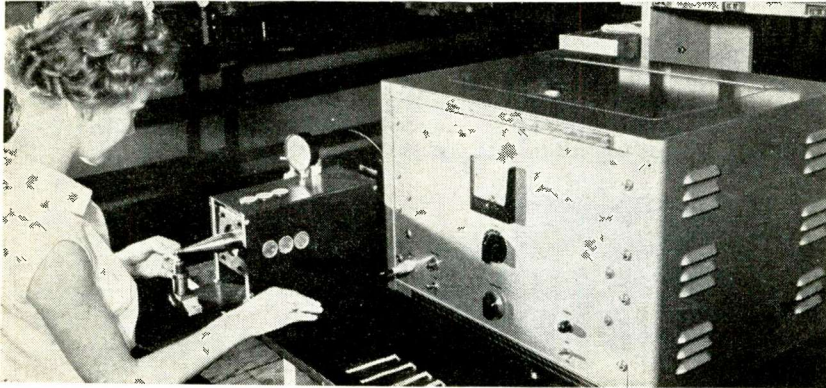
3540 AERO COURT  
SAN DIEGO 11, CALIF.



tionally high losses of 9.05 db per cm at 25 C and minimum attenuation over an extremely wide range of frequencies. In addition, CFI-1003 is stable at temperatures in excess of 1,000 C in both low and high power systems.

These microwave absorber ceramics are being used in mode suppressor, level-set and variable attenuators and termination applications.

**CIRCLE 304 ON READER SERVICE CARD**



## Ultrasonic Spot Welder

### SELF-TUNING CIRCUIT

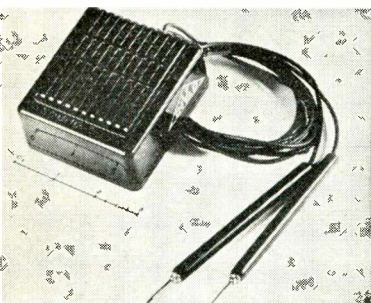
AN ULTRASONIC spot welder with a high temperature high efficiency transducer construction and a self-tuning circuit is announced by International Ultrasonics, Inc., Rahway, N. J. an affiliate of Aero Supply Mfg. Co., Inc. Self-tuning assures weld uniformity and minimizes need for operator skill.

The spot welder is used for joining similar or dis-similar metals, of equal or different thickness. The top piece may be up to 0.006 in. in thickness with no limit on thickness of the bottom piece; materials as thin as 0.00025 in. have been joined. Typical applications include joining leads to capacitor foil, joining foil tape for foil-wound transformers,

attaching leads to transformer tape, making lead connections to transistors and diodes and making attachments to copper and aluminum printed circuit boards.

The 100-watt generator operates on 50-60 cps, 115 volt a-c; nominal frequency is 40 Kc; automatic timer is variable between 0.1 and 5 seconds. The welding head is supplied for bench mounting but can be built into handling or assembly machinery. Clamping is by air cylinder; interchangeable tips are provided for fine, medium and heavy welding.

**CIRCLE 305 ON READER SERVICE CARD**



## Continuity Tester

### HAS VARIABLE TONE

AN INEXPENSIVE continuity tester, the CIRCUITESTER for produc-

tion line or lab wiring continuity checks is announced by Invar Electronics Corp., 323 W. Washington Blvd., Pasadena, California. The tester is a transistorized buzzer which gives an audible tone when path resistance is less than 0.5 ohm. Path resistance changes between 0.5 ohm and 15 ohms change the pitch of the buzzer substantially, and above 15 ohms path resistance there is no tone. The device tests for direct wire paths and is not sensitive to paths through inductances or capacitors. Low operating current prevents damage to sensitive components such as transistors

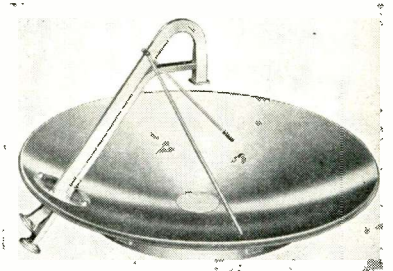
and diodes and extend the tester battery life.

**CIRCLE 306 ON READER SERVICE CARD**

## Polarized Antennas

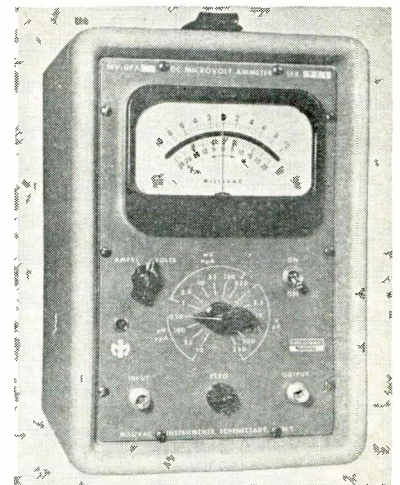
### ELIMINATE CIRCULATORS

A SERIES of dual polarized 6 Gc antennas is offered by Andrew Corporation, P. O. Box 807, Chicago 42, Illinois. The antennas combine two microwave signals in a single antenna, with the two signals fed to the antenna by independent waveguides. This design eliminates the need for circulators and reduces tower windloading, installation and maintenance cost.



Mechanical specifications of these antennas are similar to those for comparable sizes of the Andrew plane-polarized 6 Gc antennas; units are offered in 4, 6, 8 and 10 foot sizes.

**CIRCLE 307 ON READER SERVICE CARD**



## Micromicro Ammeter

### ALSO MEASURES MICROVOLTS

MILLIVAC INSTRUMENTS, Division of Cohu Electronics, Inc., Box 997, Schenectady, New York, announces the new MV-07A d-c microvolt and



A slight electrical potential exists between all objects.

It can raise the dickens inside a hi-fi tube!

To live with it in your amplifier you must either—  
lose gain, accept distortion, or use tubes that have

Controlled Contact Potential.

## **DOESN'T SOMEBODY CONTROL CONTACT POTENTIAL IN HI-FI TUBES?**

### **YES...GENERAL ELECTRIC!**

We select the materials, make the tubes  
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All General Electric hi-fi amplifier  
tubes are controlled for low

Contact Potential. Use them.

They're the BEST.



**6EU7  
12AX7  
7025  
7247**

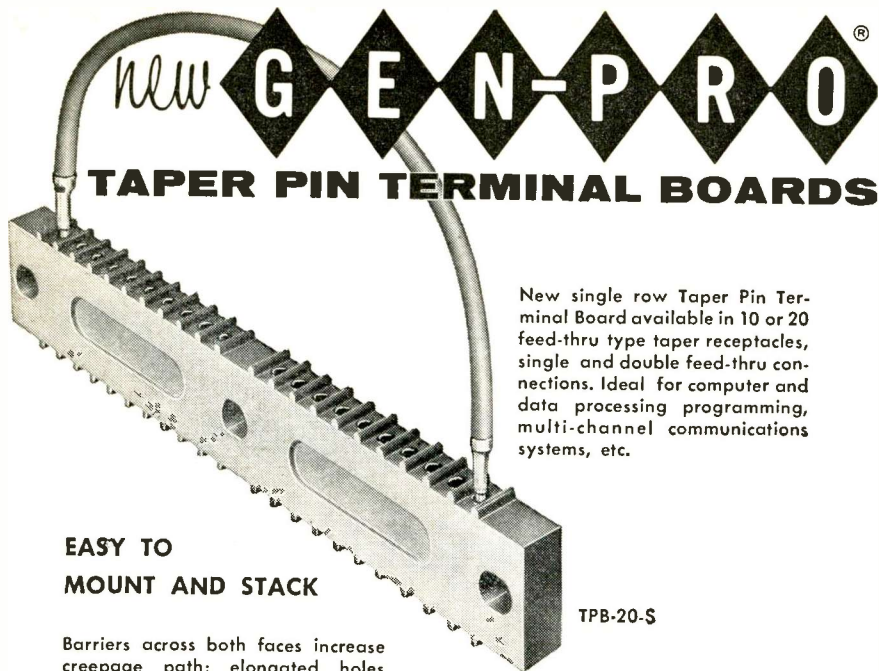
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Dallas: RI 7-4296  
San Francisco: DI 2-7201  
Los Angeles: GR 9-7765

*Leadership in audio*

**GENERAL  ELECTRIC**

411-201



## TAPER PIN TERMINAL BOARDS

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.

TPB-20-S

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

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## Electrical Coil Windings

... WIRE SIZES #6 TO #56

For 43 Years... specializing in all types of coils to customers' specifications. Design or engineering assistance available on request.

## COTO-COIL CO., INC.

SINCE 1917

65 Pavilion Avenue Providence 5, Rhode Island

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## ELECTROMECHANICAL SWITCHES FOR TELEMETERING SYSTEMS!

Specifications, performances, applications for typical electromechanical commutators for long-range sampling, programming. Quick comparisons let you know what's going on... see

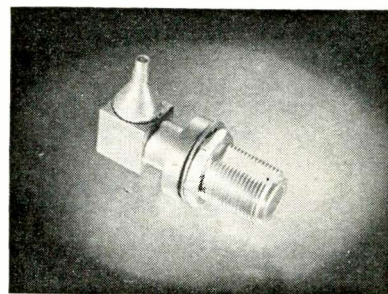
October 2nd, 1959 issue (did you miss it?). Another reason to subscribe to electronics (or renew your subscription). Fill in Reader Service Card box. Easy to use. Postage free.

FIND WHAT YOU NEED IN...

# electronics

micromicro ammeter. The instrument has full-scale ranges from 10  $\mu\text{v}$  to 250 v and 10  $\mu\mu\text{a}$  to 250  $\mu\text{a}$ . Voltage as low as 1  $\mu\text{v}$  d-c and current to 1  $\mu\mu\text{a}$  are measured with long term drifts of 2  $\mu\text{v}$  and 2  $\mu\mu\text{a}$ . Individual range calibration controls provide 2 percent full-scale accuracy for all voltage ranges except the lowest, 0-10  $\mu\text{v}$  (3 percent); 3 percent accuracy for all current ranges. Cascode input stage provides an excellent signal-to-noise ratio while a twin T-filter cuts down the bandpass for further noise reduction.

CIRCLE 308 ON READER SERVICE CARD



### Bulkhead Adapter

FOR COAXIAL CABLE

SEAELECTRO CORP., 139 Hoyt St., Mamaroneck, N. Y., announces a new right-angle bulkhead coaxial cable adapter. The new ConheX product permits bulkhead connections between large-size coaxial transmission lines to miniaturized coaxial cable, through a regular Conhex cable connector. Impedance of the unit is 50 ohms, and it is designed for minimum power losses.

CIRCLE 309 ON READER SERVICE CARD



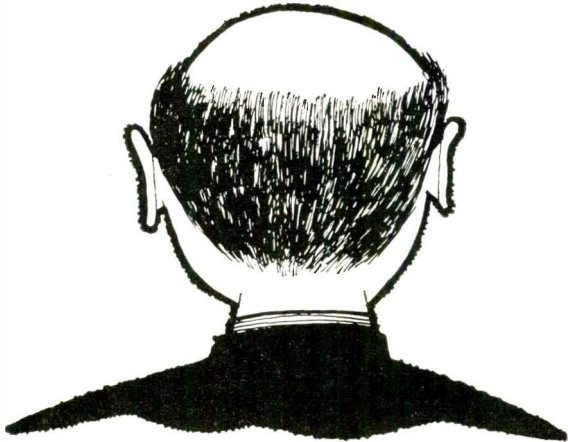
### Selenium Diodes

SUBMINIATURE

RADIO RECEPTOR CO., 240 Wythe Ave., Brooklyn, N. Y., has announced new and smaller plastic encapsulated selenium diodes. Priced at only 13 to 30 cents, they come



IT'S  
WHAT'S  
IN  
HERE  
THAT  
COUNTS



Do you know, for instance... which electronic stocks are hottest? Who's in the news and why? About "Three Approaches to Microminiaturization"? About the newest product ideas hitting the market? What's up in production? Opportunities overseas? What's going on in Washington?

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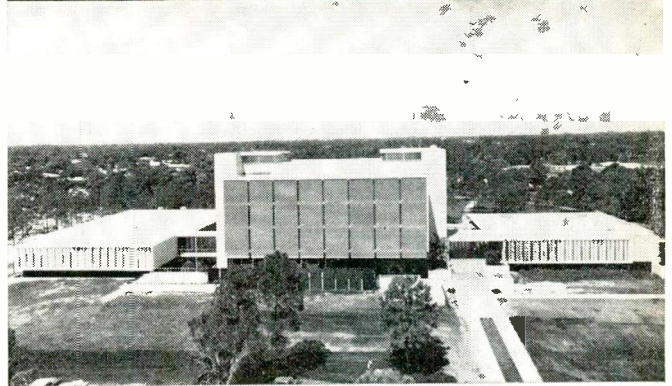
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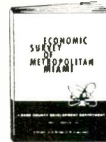
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 Mail reply to: *electronics*, 330 West 42nd Street, New York 36, N. Y.

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ADVANCED GRADUATE TRAINING**



The University of Miami's School of Engineering offers the latest in research and advanced educational facilities in the engineering fields of: architectural, civil, electrical, mechanical and engineering science.

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This important survey will be mailed to you free of charge — in strictest confidence — if you write, on your letterhead, to the address listed below.

Write: K. Richard Welsh, Director

**DADE COUNTY DEVELOPMENT DEPARTMENT**  
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**Lepel**

**HIGH FREQUENCY INDUCTION  
HEATING EQUIPMENT**  
*For* Hardening • Annealing • Soldering  
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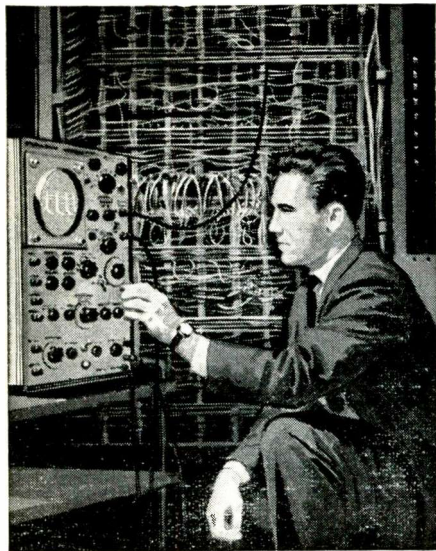
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1 kw; 2½ kw; 5 kw; 10 kw;  
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**SPARK GAP CONVERTERS:**  
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The Crosley Division of Avco Corporation has openings for electronic engineers with from two to ten years' experience for unusually responsible positions involving digital computer and data processing equipment design.

At Crosley, all projects offer engineers of talent and capability unlimited challenge and definite authority. An alert, aggressive management team provides maximum support and backing to each of the outstanding professional teams working on the frontiers of data processing for industrial systems.

Now is your opportunity to grow your own career in this new and exciting field. Experienced personnel can choose:

- transistorized circuit design
- digital systems design
- logic design

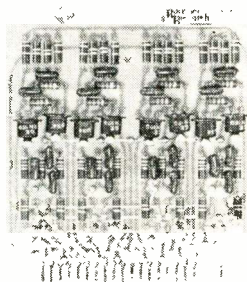
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Administrative Personnel  
Department E-710  
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1329 Arlington Street  
Cincinnati 25, Ohio  
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**Avco** // **Crosley**

in eight types, with peak voltage ranges up to 400 v at 3.75 ma. Maximum case length is 0.188 in. for all types, with widths ranging from 0.188 in. for the 50 and 100 piv units to 0.350 in. for the 350 and 400 piv units. They are capable of operating in ambient temperatures from  $-50^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  without derating. Diodes are color coded for identification of type and indication of polarity.

**CIRCLE 310 ON READER SERVICE CARD**

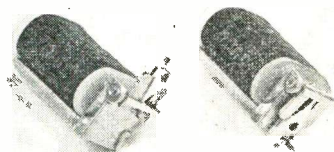


### Converter

#### ANALOG-TO-DIGITAL

RANSOM RESEARCH, 323 W. Seventh St., San Pedro, Calif. Model 301 analog to digital converter is intended for use as the heart of an analog to digital system. It will convert any input voltage of  $-0.999$  v full scale to three decimal digits with an overall accuracy of  $\pm 1$  digit, or an equivalent of  $\pm 1$  mv. Conversion time is 1 millisecond for any input. The instrument consists of a rack mounting card file which contains plug-in printed circuit computer elements which include the power supply and reference voltages. This modular construction permits the addition of many optional features and easy maintenance.

**CIRCLE 311 ON READER SERVICE CARD**



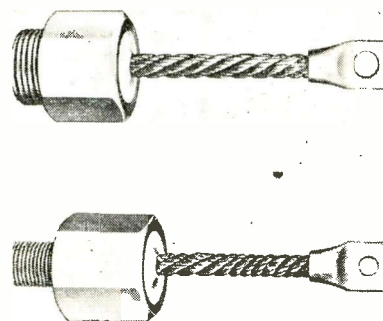
### Solenoid Actuator

#### COMPACT AND LIGHT

JAMES CUNNINGHAM SON & CO., INC., 103 Litchfield St., Rochester 8, N. Y., announces the type L13 elec-

tromagnetic d-c actuator designed for optimum power output. It is available with both push and pull linkages and has application in reciprocating motion, vibration generators, rotary step motion, model actuators, remote switches, valve actuators, computers and automated equipment. The actuator utilizes a patented linkage system which magnifies the original air-gap movement in a 8 to 1 ratio, thereby delivering maximum pull and stroke from small input. Unit has a life of 100 million operations and is capable of 7 millisecond operating time at normal voltages. The actuator may be set for either push or pull by simply reversing the position of the arm. It has a maximum stroke of 0.125 in., exerting a pull of 100 to 550 grams. Type L13 features a nylon coil bobbin, fungus resistant components, light weight construction (50 grams) and a low input of 1.5 w.

**CIRCLE 312 ON READER SERVICE CARD**



### Silicon Rectifiers

#### TWO NEW STYLES

SYNTRON CO., 241 Lexington Ave., Homer City, Pa. Styles ES-51 and ET-51 silicon power rectifiers have peak forward voltages of 1.25 v maximum at 200 amperes. The peak inverse current is 50 ma at  $100^{\circ}\text{C}$  case temperature. The thermal drop is  $0.50^{\circ}\text{C}/\text{w}$  maximum from junction to case. Temperature range is  $-35^{\circ}\text{C}$  to  $+120^{\circ}\text{C}$  (case) and  $-35^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (junction). Mounting torque for style ES-51 is 800 in.-lb maximum and for ET-51 it is 1,000 in.-lb maximum. Overall length for ES-51 is  $5\frac{1}{2}$  in. maximum and ET-51 is 5 in. maximum. Piv ranges from 100 to 400 v in 100 v steps.

**CIRCLE 313 ON READER SERVICE CARD**



## Literature of the Week

**MULTIPLEXER** Radiation Inc., Melbourne, Fla. A four-page brochure describes "Radiplex 89," a low-level switching multiplexer which features flexibility, compactness and economy.

CIRCLE 325 ON READER SERVICE CARD

**THERMOSET MATERIALS** Fiberite Corp., Winona, Minn. A new comparative chart for compression molders and for transfer molders shows the mechanical, electrical and thermal properties of all general purpose thermoset materials comparatively.

CIRCLE 326 ON READER SERVICE CARD

**SURGE TEST ADAPTER** Wallson Associates, Inc., 912 Westfield Ave., Elizabeth, N. J. Technical data sheet 107 contains a detailed description of the model 142A completely self-contained 75 ampere surge test adapter.

CIRCLE 327 ON READER SERVICE CARD

**SEALED LIMIT SWITCHES** Micro Switch, Freeport, Ill. Data sheet No. 171 presents two pages of information on the new 400 EN series sub-subminiature sealed limit switches.

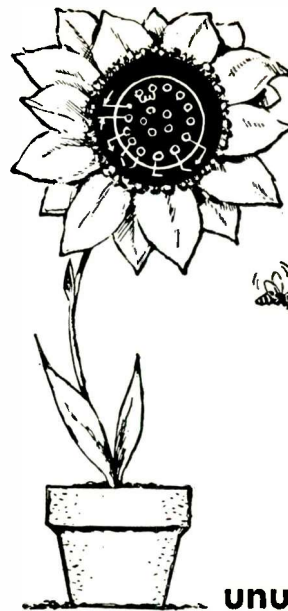
CIRCLE 328 ON READER SERVICE CARD

**TRANSISTORIZED POWER SUPPLIES** Electrodynamic Instrument Corp., 1841 Old Spanish Trail, Houston 25, Texas, has published a brochure on a line of transistorized power supplies. It contains information and specifications on d-c/d-c converters, d-c/a-c inverters, and a-c/d-c power supplies for laboratory, airborne, mobile, communications and automation applications.

CIRCLE 329 ON READER SERVICE CARD

**DIGITAL TRANSDUCERS** Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif. Bulletin No. 150 illustrates and describes the DX-100 series digital transducer which receives pressure, flow or temperature variables and provides a digital output in the form of contact closures for data recording or transmission.

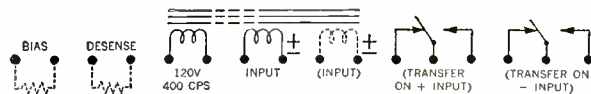
CIRCLE 330 ON READER SERVICE CARD



## unusual potting, push-pull design increase stability of new 400-cycle magnetic amplifier relay

If you pried the base off the can of this new magnetic amplifier relay (which you probably wouldn't after paying good money for a hermetically sealed device) you might be surprised. Sitting there in quiet intimacy would be an isolation transformer, reactor, one or two relays and sundry other items — all immersed in a transparent, slightly wiggly material, just like grapes in a gelatin salad. The compound is selected for its ability to soak up shock, vibration and thermal expansion. In that order, the specs for this device are 100 g's, 10 g to 55 cps,  $-55^{\circ}$  to  $+100^{\circ}$ C.

What you can do with the Series 8300 is the same thing you can almost do with any good transistor- or meter-relay — except this one will work on DC inputs as low as  $0.2 \mu\text{w}$ , and remain stable (circuit is push-pull) under  $\pm 10\%$  variations in line voltage, frequency, and the  $155^{\circ}$  spread mentioned earlier. Standard models also have single or dual coils, a contact rating of 1 amp. at 28 VDC/120 VAC, resistive, for at least 100,000 operations, and terminals for connecting bias and desensing resistors. The connection schematic looks like this, but has the circular floral arrangement as pictured:



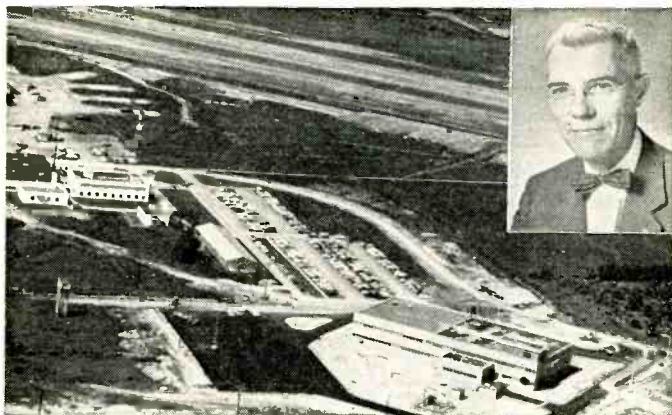
If you have an application that demands an even fancier version with such features as DPDT output contacts, higher vibration and load ratings (and less sensitivity), built-in DC power supplies, reference sources, etc., we may be able to do something for you on a special order basis. First, however, it would probably be a good idea to see our  $5 \pm 20\%$ -page Series 8300 Preliminary Bulletin — collated, stapled, 3-hole punched and unpotted.



# SIGMA

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

AN AFFILIATE OF THE FISHER-PIERCE CO. (since 1939)



## GE's Advanced Electronics Center

GENERAL ELECTRIC'S Light Military Electronic Department has just added a new million-dollar research and development building (lower right in photo above) to its Advanced Electronics Center on the edge of the Tompkins County airport near Ithaca, N. Y.

Managed by Harry Mayer (inset), the Center constitutes the first occupant of Cornell University's Industry Research Park. Employing 376 scientific, technical and administrative people on its permanent staff and many specialized consultants, the Center is actively investigating anti-jamming frequency-diversity radar, contact analog displays with which it is hoped the flying of complex airplanes can be simplified and the so-called "Roberts Rumble" effect

having to do with the reception of signals well in the aftermath of passing satellites.

Other current in-house programs include automatic message authentication, study of the ionosphere from above, the possibility of applying a photo input of high resolution to thermoplastic tape, natural noise at high altitudes and in space, tracking ground-launched missiles from satellites, development of infrared equipment to sense colors and thermocouple energy converters.

The Center works primarily on contracts received direct or through its parent department from government agencies but also cooperates with other GE divisions, and occasionally with other firms, on projects of an advanced nature.



### Jordan Electronics Hires Beltz

ROBERT BELTZ has joined the Jordan Electronics Division of The Victoreen Instrument Co., as senior engineer.

Jordan Electronics, Alhambra, Calif., is developer and manufacturer of electronic devices for missiles and aircraft including a programmer which schedules all events of missile flights.

Beltz came to Jordan from Hughes Aircraft Co. where he was a staff engineer. He previously was an engineer with Western Design and Mfg. Co.; Vard, Inc.; and Electrolfilm Corp.

### Amperex Promotes

#### Two Key Men

EDWARD FEINBERG has been promoted to the position of product

manager, industrial and government semiconductors and special purpose tubes, at Amperex Electronic Corp., Hicksville, L. I., N. Y. He previously was assistant product manager of the same department.

Promotion of Edward Meagher to the position of product manager, entertainment tubes and semiconductors, is also announced. He was previously sales engineer in Amperex's Chicago office.

Amperex Electronic Corp. is engaged in the research and development, manufacture and sale of electron tubes and semiconductors for communications, defense and industry.

Both promotions are part of Amperex's current expansion program, which also includes the acquisition of a new plant in Slatersville, R. I., for the manufacture of transistors and diodes.



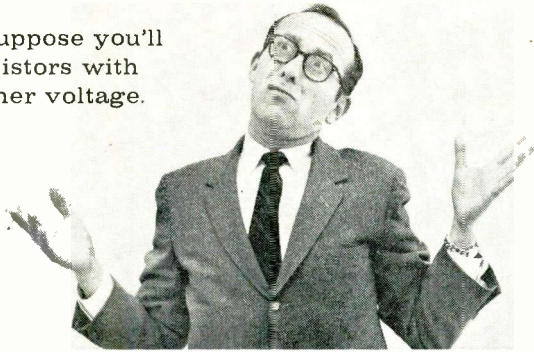
### Petruschke Joins Assembly Products

APPOINTMENT of Reinhold Petruschke to the newly-created position of chief industrial engineer at Assembly Products, Inc., Chesterland, O., has been announced. He will be in charge of production of all parts and sub-assemblies for the company's meter-relays, panel meters and complete controls. He will also be responsible for plant maintenance, job evaluation, new employee testing, and administration of the bonus plans.

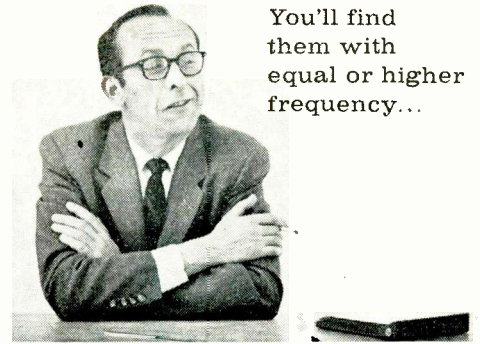
Before joining Assembly Products, Petruschke was production manager of the phonograph plant at the V-M Corp., Benton Harbor, Mich.



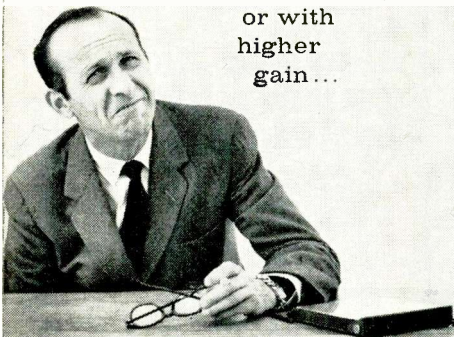
Yes, I suppose you'll find transistors with higher voltage.



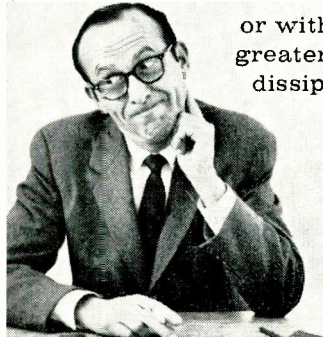
You'll find them with equal or higher frequency...



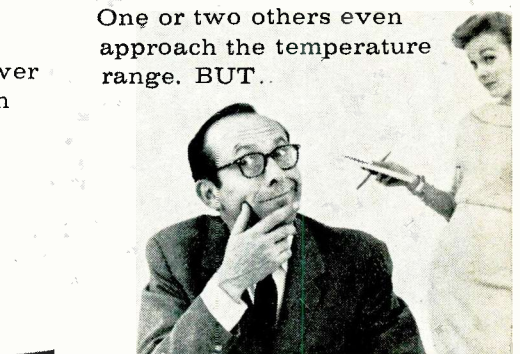
or with higher gain...



or with greater power dissipation

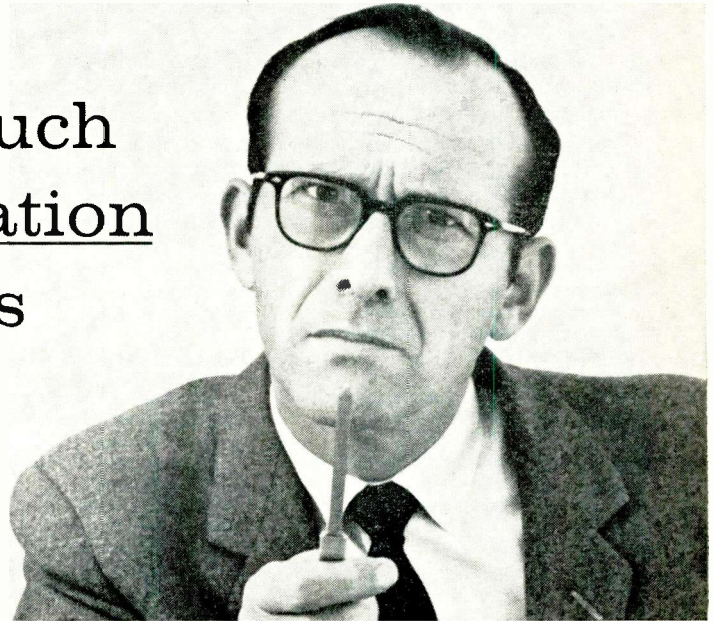


One or two others even approach the temperature range. BUT..



no other transistor has such an ideal combination of parameters

as the Hughes 2N1196 or 2N1197 transistor amplifier



No other transistor gives you such ideal parameters, no other gives you such reliability. These Hughes high-frequency devices meet or exceed every possible amplifying requirement of a PNP silicon transistor. They have high operating voltage, high temperature rating, high alpha cutoff frequency, high gain at high frequencies, low collector shunt capacitance, good power dissipation, and low signal distortion. In a 5000-hour storage-life test at 200°C, the units re-proved their ruggedness and reliability by showing no significant changes in the beta or leakage current.

The Hughes 2N1196 & 2N1197 transistors were originally developed in conjunction with the U.S. Army Signal Corps on an IPS contract for military devices, and meet the exacting requirements of MIL-T-19500A.

Now they're available for you. If you need high-frequency, double-diffused, mesa transistors for i.f. amplifiers, h.f. amplifiers, oscillators, for communication telemetering, or similar electronic equipment, order from Hughes today. Just call or write your nearest Hughes Semiconductor sales office or authorized distributor—or write Hughes Semiconductor Division, Marketing Department, 500 Superior Avenue, Newport Beach, California.



| SPECIFICATIONS @ 25°C                                |               |                |                |
|--|---------------|----------------|----------------|
| ABSOLUTE MAXIMUM RATING                              | 2N1196        | 2N1197         | Units          |
| $V_{CE0}$ @ $I_{C0} = -100 \mu A$                    | -70           | -70            | volts max      |
| $V_{CB0}$ @ $I_{C0} = -100 \mu A$                    | -70           | -70            | volts max      |
| $V_{EB0}$ @ $I_{E0} = -100 \mu A$                    | -4            | -4             | volts max      |
| ELECTRICAL CHARACTERISTICS                           |               |                |                |
| P.G. @ $V_{CE} = -10v, I_C = 2mA$                    | 28<br>@ 4.3MC | 22<br>@ 12.5MC | db typ         |
| $F_{\alpha B}$ @ $V_{CE} = -10v, I_C = 2mA$          | 45            | 55             | MC typ         |
| $C_{\alpha B}$ @ $V_{CE} = -10v, I_C = 0, f = 140KC$ | 3             | 3              | $\mu s$ Id typ |
| $h_{FE}$ @ $V_{CE} = -10v, I_C = 2mA, f = 1KC$       | .9            | .94            | typ            |

350 mW dissipation in Free Air  
Operating temperature range -65°C to +200°C

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SEMICONDUCTOR DIVISION  
HUGHES AIRCRAFT COMPANY





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Motorola engineers are the most stimulated and enthusiastic individuals you'll find anywhere. And, for sound reasons.

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- Electronic countermeasure systems
- Military communications equipment design
- Pulse circuit design
- IF strip design
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- 2-WAY RADIO COMMUNICATIONS
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- Antenna design
- Selective signaling
- Transistor applications
- Crystal engineering
- Sales engineering
- Design of VHF & UHF FM communications in portable or subminiature development
- Microwave field engineers
- Transistor switching circuit design
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- Home radio design
- New product design
- Auto radio design
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- Semi-conductor device development
- Semi-conductor application work

Also Splendid Opportunities in:

Phoenix, Arizona and Riverside, California

Send Complete Resumé to:

MR. L. B. WRENN  
Engineering Personnel Mgr.  
Dept. D  
4501 Augusta Blvd.  
Chicago 51, Illinois



**MOTOROLA Inc.**



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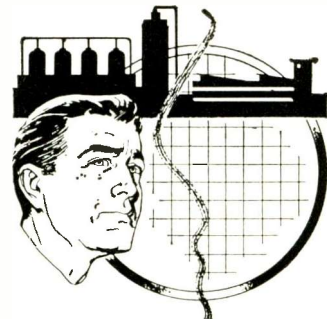
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- ▶ **ELECTRONIC ENGINEERS**
- ▶ **ELECTRICAL ENGINEERS**
- ▶ **MECHANICAL ENGINEERS**

Singer-Bridgeport assures you the rare combination of security and genuine ground-floor opportunity that is vital to your professional growth. Your projects receive strong support from Singer-Bridgeport's integrated organization which has the advantages of development, production, assembly and environmental test facilities.

Send your resume in strict confidence to Mr. Fred Corbett, Supervisor of Employment

**SINGER-BRIDGEPORT**  
A DIVISION OF THE SINGER MANUFACTURING COMPANY  
915 Pembroke Street Bridgeport 8, Conn.



## Creative Opening for an Electronics Engineer in Controls Development

This career opportunity requires experience in electronic circuit design and a familiarity with vacuum tube and solid state components. Join a newly formed select group where individual initiative and achievement are quickly recognized.

At RIG you will find the rare combination of career advancement plus interesting assignments to match your training.

Send resume to:  
Director of Engineering

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RIDGEFIELD INSTRUMENT GROUP

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# active programs in 19 critical electronic areas



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To Participate In Significant  
Advances at  
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Division of General Dynamics*

Top-calibre research and development teams at Stromberg-Carlson are tackling the prime problem areas in electronics affecting commercial communities and national defense. Programs and R & D staffs are expanding, backed by the vast resources of General Dynamics and the Stromberg-Carlson engineer-oriented management.

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**AERONUTRONIC** a Division of Ford Motor Company  
has immediate openings in  
**ELECTRONICS ACTIVITY OF  
TACTICAL WEAPON SYSTEMS OPERATIONS**  
**for ELECTRONICS ENGINEERS**

**TO WORK IN**

- IR Development
- Instrumentation Development
- Transistor Circuit Development
- Electronic Systems

Immediate expansion of new and existing programs is creating outstanding opportunities in R&D and PRODUCTION on advanced programs such as :

- Shillelagh, surface-to-surface tactical missile
- Air Cushion Vehicles
- Anti-submarine Warfare
- Air-to-surface tactical weapons

Positions are at interim facilities in Santa Ana near Aeronutronic's new \$22 million Engineering and Research Center now being completed at Newport Beach, Southern California—the West's most ideal location for living, working and year 'round recreation.

Experienced engineers with demonstrated ability are invited to share in research and development work—work that is challenging and stimulating as well as exceptionally rewarding. Send inquiries and resumes to Mr. John Starbuck, Dept. 5

TACTICAL WEAPON  
SYSTEMS OPERATIONS

**AERONUTRONIC**  
a Division of FORD MOTOR COMPANY

FORD ROAD, NEWPORT BEACH, CALIFORNIA



**MARKET RESEARCH ENGINEER**

Continued growth of the 3M Company has created an opportunity in the Electrical Products Division. Electrical engineering or physics degree preferred. Three to five years experience with a manufacturing company in sales, market research, or product development very helpful. You will be responsible for search and evaluation of markets for new products. You will be expected to keep abreast of design trends in electrical equipment and electronic apparatus through attendance at professional society meetings and calls on research directors and advance planning engineers of customers. You must be capable of conducting market research studies for new and improved products with particular emphasis on size, geographical distribution, and growth potential. Ability to evaluate competitive product developments.

Location in St. Paul, Minnesota, provides easy access to nation's outstanding hunting and fishing areas. Salary commensurate with training and experience. Advancement based on individual merit.

Write or send resume to:

Technical Employment Manager  
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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.

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1530 Chestnut Street, Philadelphia 2, Pa.  
Established 1943



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\$2.40 a line, minimum 3 lines. To feature advance payment count 5 average words as a line. BOX NUMBERS count as one line additional in undisplayed ads.

**MEASUREMENTS CORP. Pulse Generator**



MEAS. CORP. MOD. 79-B Pulse Generator, 60-100,000 cy pulses 1/2-40 uses wd. and + sync pulses delayed 1/2 period. Can pulse modulate an external RF source and can be synched by an external sine source. This is the model preceding the current catalog model which sells for \$495.00. Brand new in original packing, with instruction book, #0 lbs fob Harrisburg, Pa. . . . . \$97.50

**0.1% SORENSEN Line Voltage Regulator**

=5000S brand new at a low surplus price! Output is adjustable 110-120 volts and holds the pre-set voltage to +0.1% at line frequency, or to -0.25% if the line frequency drifts 5%. Taps for 50 or 60 cy., 1 phase. Regulates against line changes of 95-130 V, and against load changes from 0 to 5000 VA. Because of the low price, it is very smart planning to use it for lower-power applications which may later be expanded to 5 KVA. Max. harmonics less than 3%. Recovery time 0.15 seconds. In rack cabinet 28" h. 22" wd. 15" dp. Net wt 190 lbs. Note that input to control circuit can be moved to critical point of use of power, to compensate for line drop. Shpg wt 285 lbs. FOB Utica, N. Y. warehouse. Packed for export. (13 cu ft.) Catalog net price is \$695.00. less spares. Our price, new, in original packing, with spares, O.K. WITH SPARES, is only . . . . . \$349.50

FOR OPERATION ON 230 OR 460 VOLTS: Max. input at nominal 115 volts when 5 KVA is used, is 71 amps (8165 VA). For use on 460/230 V lines, an 8 1/2 KVA isolating step-down transformer is required. We can get it wound to order in Los Angeles, 1 ph., fully cased, boxed for shipment: 60 cy. \$155.00, shpg wt 160 lbs. 50/60 cy: \$170.00, shpg wt 175 lbs. Check your local winders; you may do as well or better. If not, order from us FOB Los Ang.

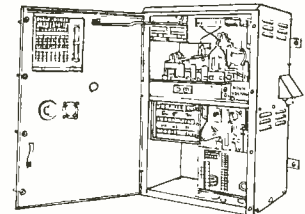
Circle Readers Service Card for our new listing of budget stretchers selected for you from surplus.

**R. E. GOODHEART CO.**

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**HARD and SOFT MAGNETRON PULSERS...**



... at bargain basement prices! Will drive dozens of types of Magnetrons up to 250 kw. from \$675.00

Phone: Walker 5-6000



**LIBERTY ELECTRONICS, INC.**

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Cables: TELSERSUP

**CIRCLE 461 ON READER SERVICE CARD**

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For an up-to-date listing of such equipment see Searchlight Section of June 10th.

An employment advertisement in this EMPLOYMENT OPPORTUNITIES section will help you find the engineers you need. It's an inexpensive, time-saving method of selecting competent personnel for every engineering job.



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## HERMETICALLY SEALED MIL-T-27A PULSE TRANSFORMERS

- Maximum power efficiency and optimum pulse performance.
- For use in blocking oscillator, interstage coupling and low level output circuits.
- Ruggedized construction — Grade 4.
- Series or parallel connection of windings for optimum turns ratio.



| Cat. No. | MIL Type  | Pulse Voltage Kilovolts | Char. Imp. Ohms |
|----------|-----------|-------------------------|-----------------|
| MPT- 1   | TF4RX35YY | 0.25/0.25/0.25          | 250             |
| MPT- 2   | TF4RX35YY | 0.25/0.25               | 250             |
| MPT- 3   | TF4RX35YY | 0.5/0.5/0.5             | 250             |
| MPT- 4   | TF4RX35YY | 0.5/0.5                 | 250             |
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| MPT- 6   | TF4RX35YY | 0.5/0.5                 | 500             |
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| MPT- 8   | TF4RX35YY | 0.7/0.7                 | 200             |
| MPT- 9   | TF4RX35YY | 1.0/1.0/1.0             | 200             |
| MPT-10   | TF4RX35YY | 1.0/1.0                 | 200             |
| MPT-11   | TF4RX35YY | 1.0/1.0/1.0             | 500             |
| MPT-12   | TF4RX35YY | 0.15/0.15/0.3/0.3       | 700             |



## Ruggedized, MIL STANDARD POWER & FILAMENT TRANSFORMERS

Primary 105/115/125 V 50-60~

| Cat. No. | Appl.        | MIL Std. | MIL Type     |
|----------|--------------|----------|--------------|
| MGP 1    | Plate & Fil. | 90026    | TF4RX03HA001 |
| MGP 2    | Plate & Fil. | 90027    | TF4RX03JB002 |
| MGP 3    | Plate & Fil. | 90028    | TF4RX03KB006 |
| MGP 4    | Plate & Fil. | 90029    | TF4RX03LB003 |
| MGP 5    | Plate & Fil. | 90030    | TF4RX03MB004 |
| MGP 6    | Plate        | 90031    | TF4RX02KB001 |
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| MGP 8    | Plate        | 90036    | TF4RX02NB003 |
| MGF 1    | Filament     | 90016    | TF4RX01EB002 |
| MGF 2    | Filament     | 90017    | TF4RX01GB003 |
| MGF 3    | Filament     | 90018    | TF4RX01FB004 |
| MGF 4    | Filament     | 90019    | TF4RX01HB005 |
| MGF 5    | Filament     | 90020    | TF4RX01FB006 |
| MGF 6    | Filament     | 90021    | TF4RX01GB007 |
| MGF 7    | Filament     | 90022    | TF4RX01JB008 |
| MGF 8    | Filament     | 90023    | TF4RX01KB009 |
| MGF 9    | Filament     | 90024    | TF4RX01JB012 |
| MGF 10   | Filament     | 90025    | TF4RX01KB013 |



## Ruggedized, MIL STANDARD AUDIO TRANSFORMERS

| Cat. No. | Imped. level—ohms                                     | Appl.      | MIL Std. | MIL Type     |
|----------|---|------------|----------|--------------|
| MGA 1    | Pri. 10,000 C.T.<br>Sec. 900 Split<br>Sec. 900 & C.T. | Interstage | 90000    | TF4RX15AJ001 |
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| MGA 3    | Pri. 600 Split<br>Sec. 135,000 C.T.                   | Input      | 90002    | TF4RX10AJ001 |
| MGA 4    | Pri. 600 Split<br>Sec. 600 Split                      | Matching   | 90003    | TF4RX16AJ001 |
| MGA 5    | Pri. 7,600 Tap<br>@ 4,800<br>Sec. 600 Split           | Output     | 90004    | TF4RX13AJ001 |
| MGA 6    | Pri. 7,600 Tap<br>@ 4,800<br>Sec. 4, 8, 16            | Output     | 90005    | TF4RX13AJ002 |
| MGA 7    | Pri. 15,000 C.T.<br>Sec. 600 Split                    | Output     | 90006    | TF4RX13AJ003 |
| MGA 8    | Pri. 24,000 C.T.<br>Sec. 600 Split                    | Output     | 90007    | TF4RX13AJ004 |
| MGA 9    | Pri. 60,000 C.T.<br>Sec. 600 Split                    | Output     | 90008    | TF4RX13AJ005 |

**FREED TRANSFORMER CO., INC.**  
1760 Weirfield St., Brooklyn (Ridgewood) 27, N. Y.  
CIRCLE 115 ON READER SERVICE CARD

# Truth in Advertising



ON FEBRUARY 17th, 1927, three years before this magazine was founded, James H. McGraw, founder of the McGraw-Hill Publishing Company, received the Harvard Advertising Awards Gold Medal for services to advertising. In his acceptance address Mr. McGraw said:

*"Primarily the function of advertising as a business force is to interpret or expand a personality, whether of a product or of a service or of an industry."*

He also said,

*"It is evident, therefore, that the industrial division of the business press has an important beneficial effect on the profit margin. Its reading pages are a textbook of economy in manufacture; its advertising pages a textbook of equipment for doing jobs at lower cost."*

Last year 1,169 advertisers placed 5,096 advertisements between the covers of ELECTRONICS. Between those same covers were 3,029 pages of editorial material. The editorial staff monitored the truthfulness of the editorial pages. The truth in advertising was largely in the hands of the advertisers. Our business department exercised all possible vigilance, but to monitor each specification, each parameter of each product, would obviously be impossible in this multiple product field.

Each advertisement is accepted for publication in ELECTRONICS subject to the following:

*Advertisers and advertising agencies assume liability for all content (including text, representations, illustrations, or of any sketch, map, labels, trademark or other copyrighted matter) of advertisements printed, and also assume responsibility for any claims arising therefrom made against the publisher. The publisher reserves the right to reject any advertising that does not conform to publication standards.*

For the most part, manufacturers in the electronics industry have cooperated, with a remarkable degree of self-censorship, to preserve truth in their advertising pages. There have been astonishingly few exceptions through the years. For this we thank them. And we charge them at the same time with the continuation of this discipline. If relaxed, it would introduce nonbelievability and create the kind of a personality which could be damaging to their industry, and their profit position.

Should you, by the way, wish a copy of James H. McGraw's speech "The Function of Business Paper Advertising" circle number 250 on the Reader Service card. We'll be happy to mail it. No charge, of course.

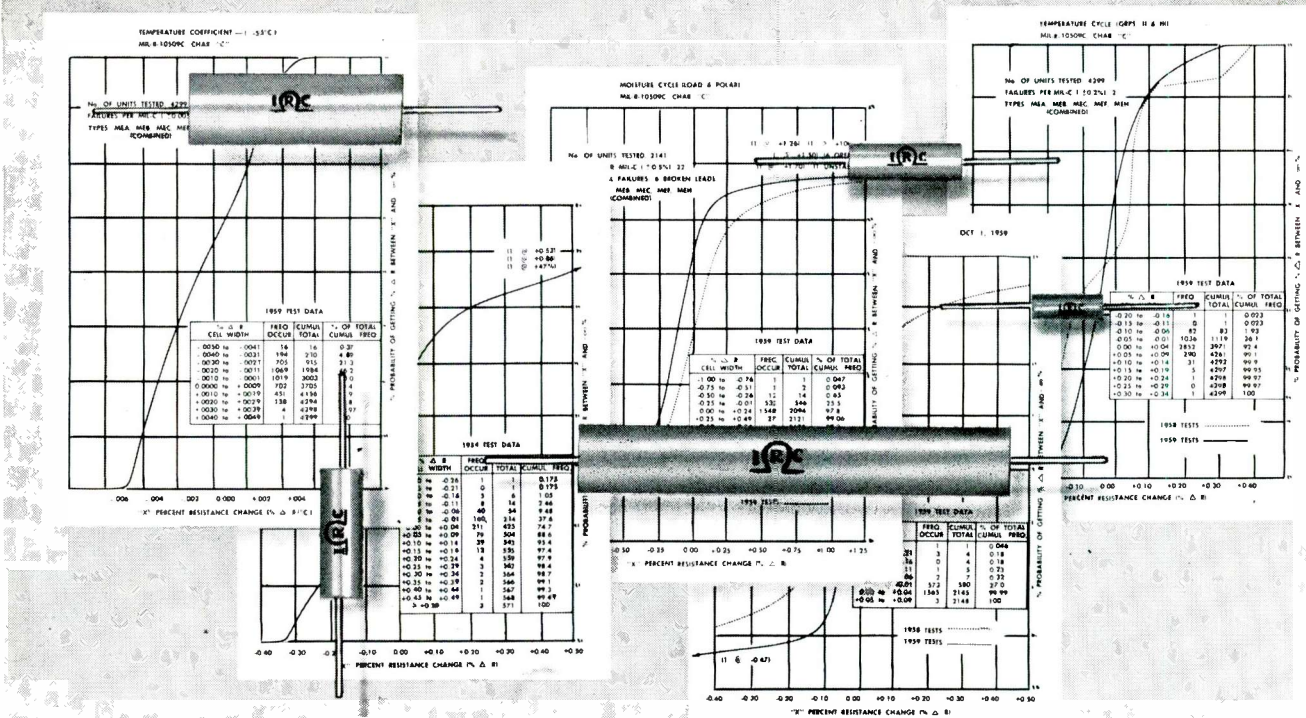
*James H. McGraw*

PUBLISHER



In PRECISION FILM RESISTORS

if it's news, expect it first from IRC



## New tests confirm high reliability and stability of IRC Molded Metal Film Resistors

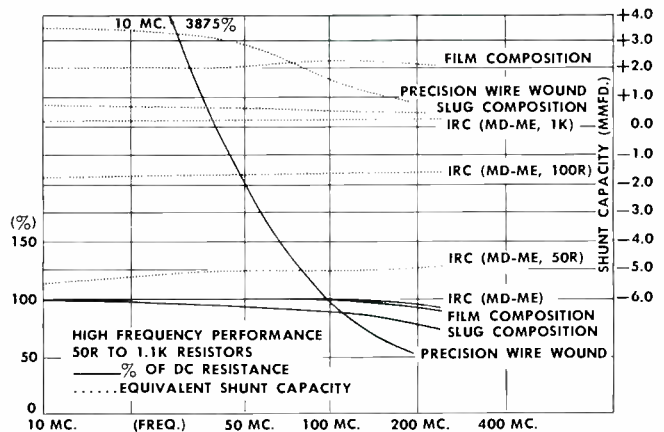
IRC has completed a new series of tests upon 7500 molded metal film resistors. The charted results are presented in a booklet just released: "Performance and Reliability of IRC Molded Metal Film Resistors."

This booklet is a sequel to IRC's report on a similar series of tests conducted in 1958. Where data are comparable, the earlier results are plotted against the new findings.

Tests are based upon MIL-R-10509C specifications, and are presented through the use of the probability technique. They include Temperature Cycle, Low Temperature Operation, Short Time Overload, Terminal Strength, Dielectric Strength, Effect of Soldering, Moisture Resistance, Temperature Coefficient and Load Life. Noise characteristics, shelf and operational stability, and high frequency characteristics are also reported and graphed.

The tests encompass IRC's full line of Molded Metal Film Resistors—5 types: 1/8, 1/4, 1/2, 1 and 2 watts. The overall superiority of these advanced precision film resistors is shown conclusively. Their capability to provide high reliability over extended periods is confirmed again by this rigorous series of tests.

### TYPICAL HIGH FREQUENCY PERFORMANCE OF IRC MOLDED METAL FILM RESISTORS

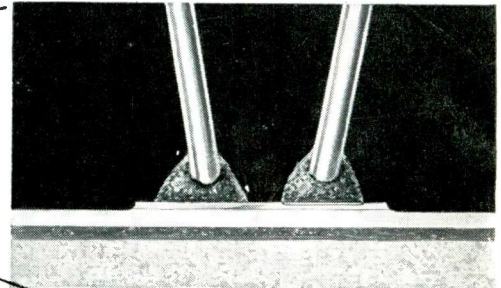
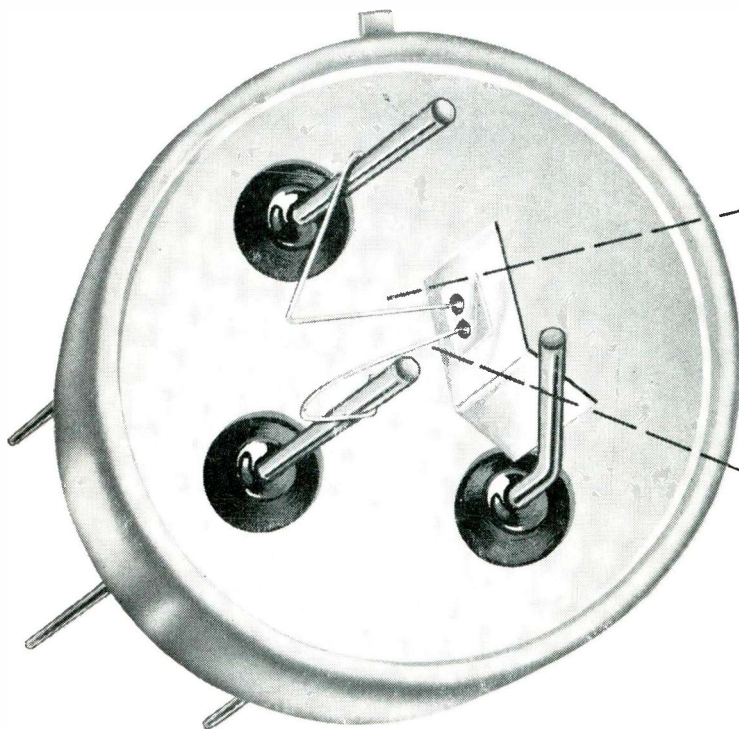


A booklet is reserved for your company and available by request on your company letterhead or through your local IRC representative. For product data, write for Bulletin B-3. International Resistance Co., Dept. 376, 401 N. Broad St., Philadelphia 8, Pa.



Leading supplier to manufacturers of electronic equipment

# Rugged all the way...inside and out



Here is the secret of MESA construction. Narrow base layer diffused into collector body makes the entire transistor structure a solid rugged block, as shown in this cross section.

## RCA-2N1300 and 2N1301 **MESA** COMPUTER TRANSISTORS

Now you can see why RCA-2N1300 and 2N1301 germanium P-N-P diffused-junction Mesa computer transistors achieve and maintain top performance at high frequencies. From base to case, reliability is built in for today's high-speed switching applications.

Ruggedness and reliability are inherent in the RCA-2N1300 and 2N1301 Mesa Computer Transistors. They are specifically designed, constructed, and tested to assure extra dependability.

Through rugged Mesa construction RCA achieves the extremely narrow base-width necessary for switching speeds up to 10 Mc without sacrificing mechanical strength. Mesa construction provides high dissipation capabilities and assures long and dependable performance under the most severe field conditions.

RCA's diffused-junction process provides a flat, precise junction assuring exceptional uniformity of electrical characteristics from unit to unit. This dif-

fused-junction process in combination with RCA's mesa-construction technique makes possible the high collector-breakdown-voltage and punch-through-voltage rating of these devices.

As a result of these features plus built-in ruggedness, the RCA-2N1300 and 2N1301 can meet the stringent mechanical and environmental requirements of the basic military specification MIL-T-19500A.

Call your RCA representative today and get the complete story on these low-cost extra reliable types. For further technical information, write RCA Commercial Engineering, G-19-NN-1, Somerville, New Jersey.



**RADIO CORPORATION OF AMERICA**

SEMICONDUCTOR AND MATERIALS DIVISION

SOMERVILLE, N. J.

ANOTHER WAY RCA SERVES YOU THROUGH ELECTRONICS

East: 744 Broad St., Newark, N. J., HUmboldt 5-3900 • Northeast: 64 "A" St., Needham Heights 94, Mass., HILlcrest 4-7200 • East Central: 714 New Center Bldg., Detroit 2, Mich., TRinity 5-5600 • Central: Suite 1154, Merchandise Mart Plaza, Chicago, Ill., WHitehall 4-2900 • West: 6355 East Washington Blvd., Los Angeles, Calif., RAymond 3-8361 • Southwest: 7905 Empire Freeway, Dallas 7, Texas, FLEetwood 7-8167 • Gov't: 224 N. WilkinSon Street, Dayton, Ohio, BALdwin 6-2366; 1625 "K" Street, N.W., Washington, D.C. FEderal 7-8500

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