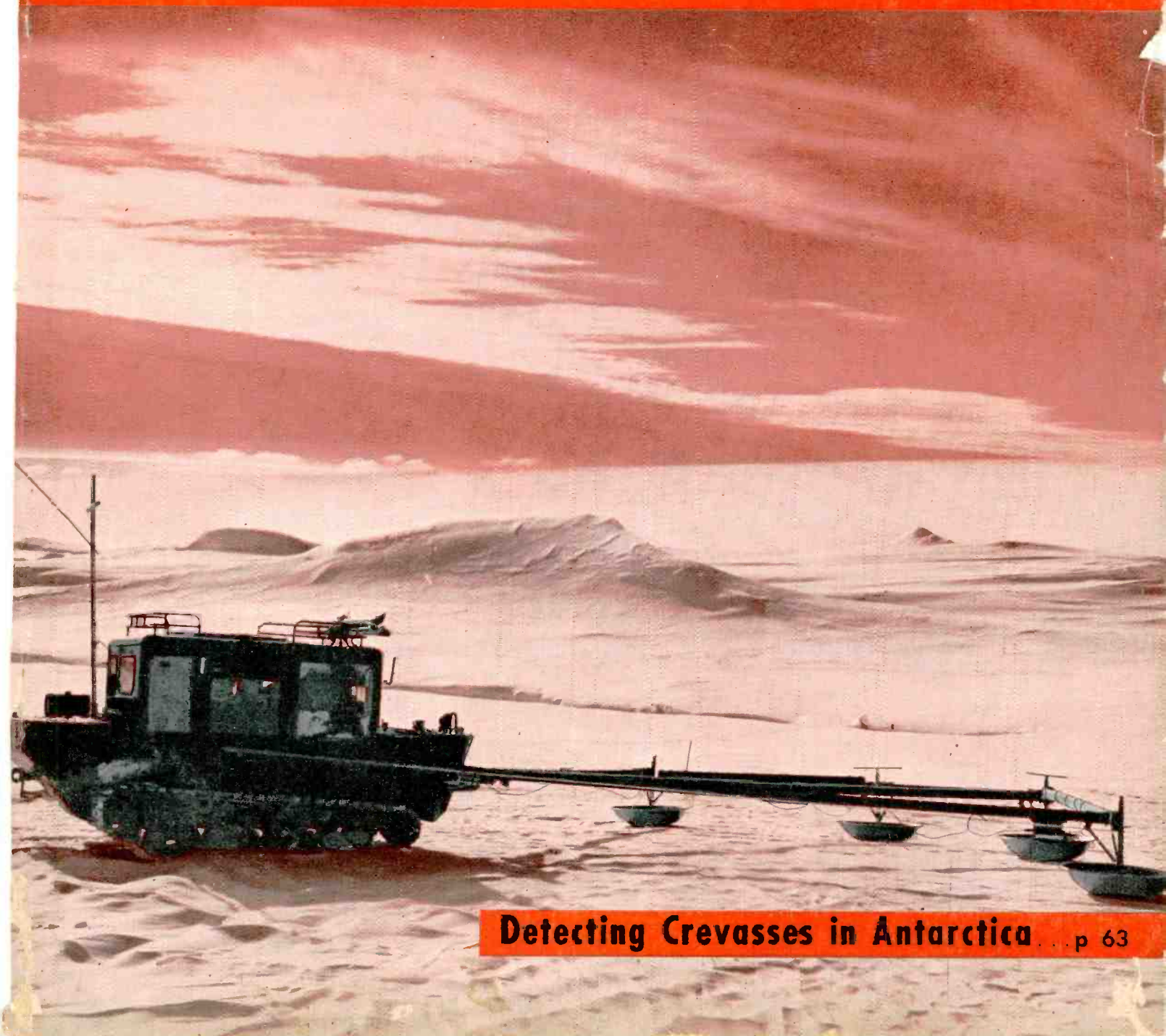
A McGRAW-HILL PUBLICATION · PRICE ONE DOLLAR JANUARY 17, 1958

electronics

engineering edition

Transistor Memory for Satellite ...p 66

Tropo Scatter Design Charts ...p 91



Detecting Crevasses in Antarctica ...p 63

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electronics engineering edition

A McGRAW-HILL PUBLICATION • VOL. 31 • NO. 3 • JANUARY 17, 1958

ISSUE AT A GLANCE

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electronics

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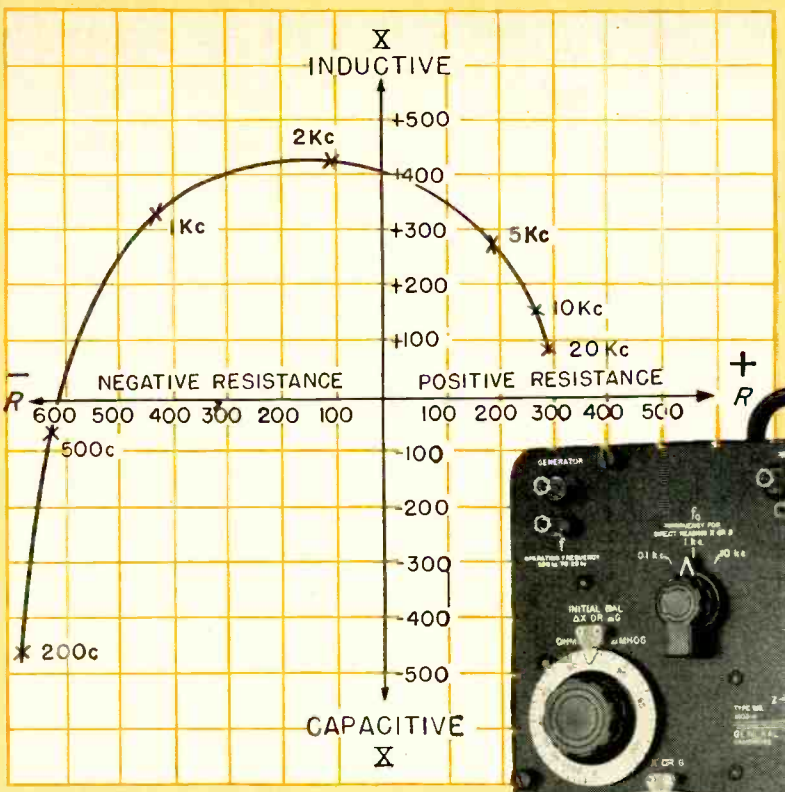
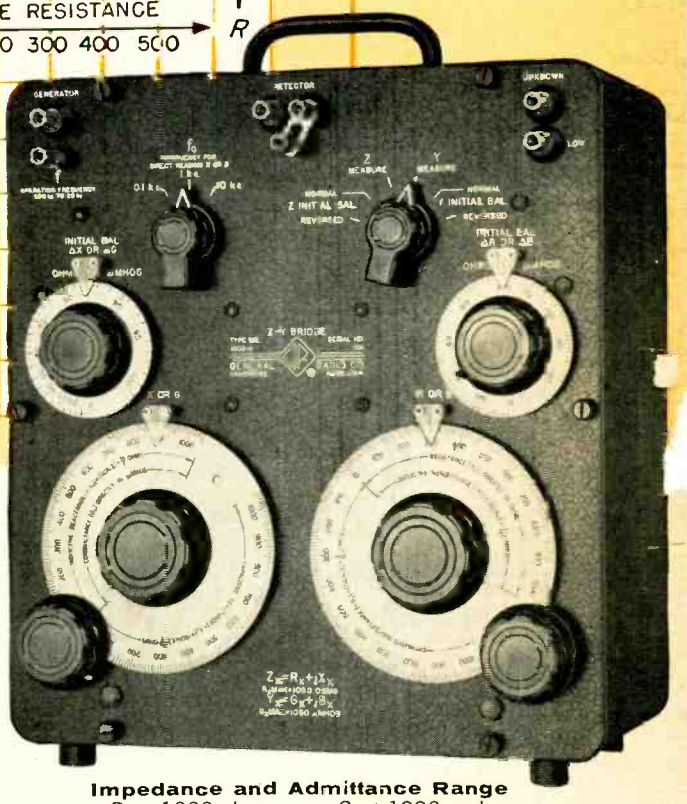


Impedance of Feedback Circuit . . . illustrates ability of the Z-Y Bridge to measure any impedance; quadrature components may be positive or negative, real or imaginary.



Measures Any Impedance . . .

. . . From 0 to ∞ ohms

. . . Positive or Negative

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. . . Over 20-cps to 20-kc Range

The General Radio Z-Y Bridge measures impedances from short circuit to open circuit, at small or large phase angle. Quadrature components, R & X or G & B, are measured directly at calibrated 100c, 1-kc, and 10-kc bridge positions. Basic accuracy is 1% over most of this range.

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R or G: $\pm(1\% + (2 \text{ ohm or } 2\ \mu\text{mho}))$
X or B: $\pm\left(1\% + \left(\frac{2f_o}{f} \text{ ohm or } \frac{2f}{f_o}\ \mu\text{mho}\right)\right)$
f is operating frequency, f_o is frequency setting of panel selector switch

Impedances of less than 100Ω (or 100 μmhos) can be measured on "Initial Balance" dials with considerably greater accuracy —
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X or B: $\pm\left(1\% + \left(\frac{0.2f_o}{f} \text{ ohm or } \frac{0.2f}{f_o}\ \mu\text{mho}\right)\right)$

Frequency Range — 20 cycles to 20 kc

Maximum Applied Voltage
130 volts, rms on bridge;
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(A policy statement by H. W. Mateer, Publisher of ***electronics***)

Many factors are significant in understanding why ***electronics*** is further augmenting its service to provide alternate Engineering and Business Editions in a weekly publishing cycle.

It is not possible to separate the interests of Engineering, Production and Management people engaged in electronics. This is probably a unique characteristic of our industry. We have been saying for years that management is derived from engineering, is part of engineering, and thus reads the technical material published by ***electronics***. Conversely, we knew back in 1952 that you, our readers, were becoming business-information minded.

To fill your need for topical, non-technical, interpreted business information, a department was conceived for ***electronics*** in February 1952 titled "Industry Report".

In January 1957 this coverage of business information was further expanded by publishing two Business Editions each month plus the regular Engineering Edition, which *continued* to contain commercial and marketing information.

Over the past year the usefulness of the Business Editions has been carefully measured. The editorial value of readership has been tested by every means at our disposal: READEX Reader Interest Scores; McGraw-Hill Reader Traffic Studies; extensive personal interviews in the field; special direct mail projects by the McGraw-Hill Research Department; and the Editor's continuing polling of his readers—and all this accumulated evidence points to a single conclusion: you need this Business Edition published every other week.

This research also established that your requirements now call for an increase in the frequency of receiving technical material.

To aid you in keeping abreast of technical news as well as non-technical news in a rapidly expanding and fast moving industry, ***electronics*** editorial output will be enlarged by the publication of technical material every two weeks instead of monthly.

The ***electronics*** Buyers' Guide, published in mid-June, continues to provide the number one market place for condensed catalog-type information on products and services. After seventeen years of continuous publishing, the Buyers' Guide enjoys a reputation second to none as the prime information source for products, materials and services in this market.

electronics has maintained leadership through 27 years of industry growth, and in 1958 both readers and advertisers will find added strength in the publication that continues to reflect community interests throughout the electronics industry—whether in engineering, production or management.

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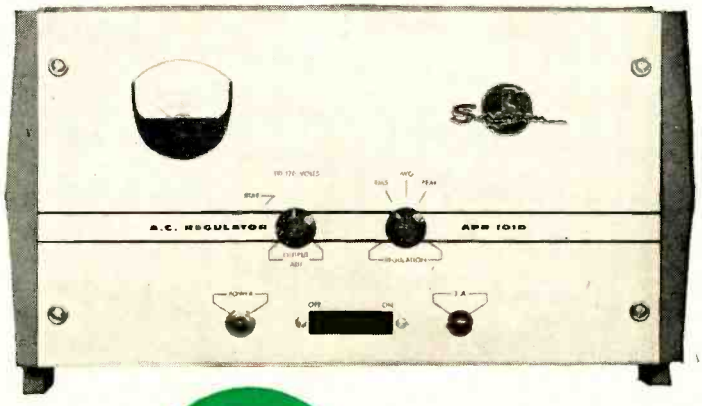

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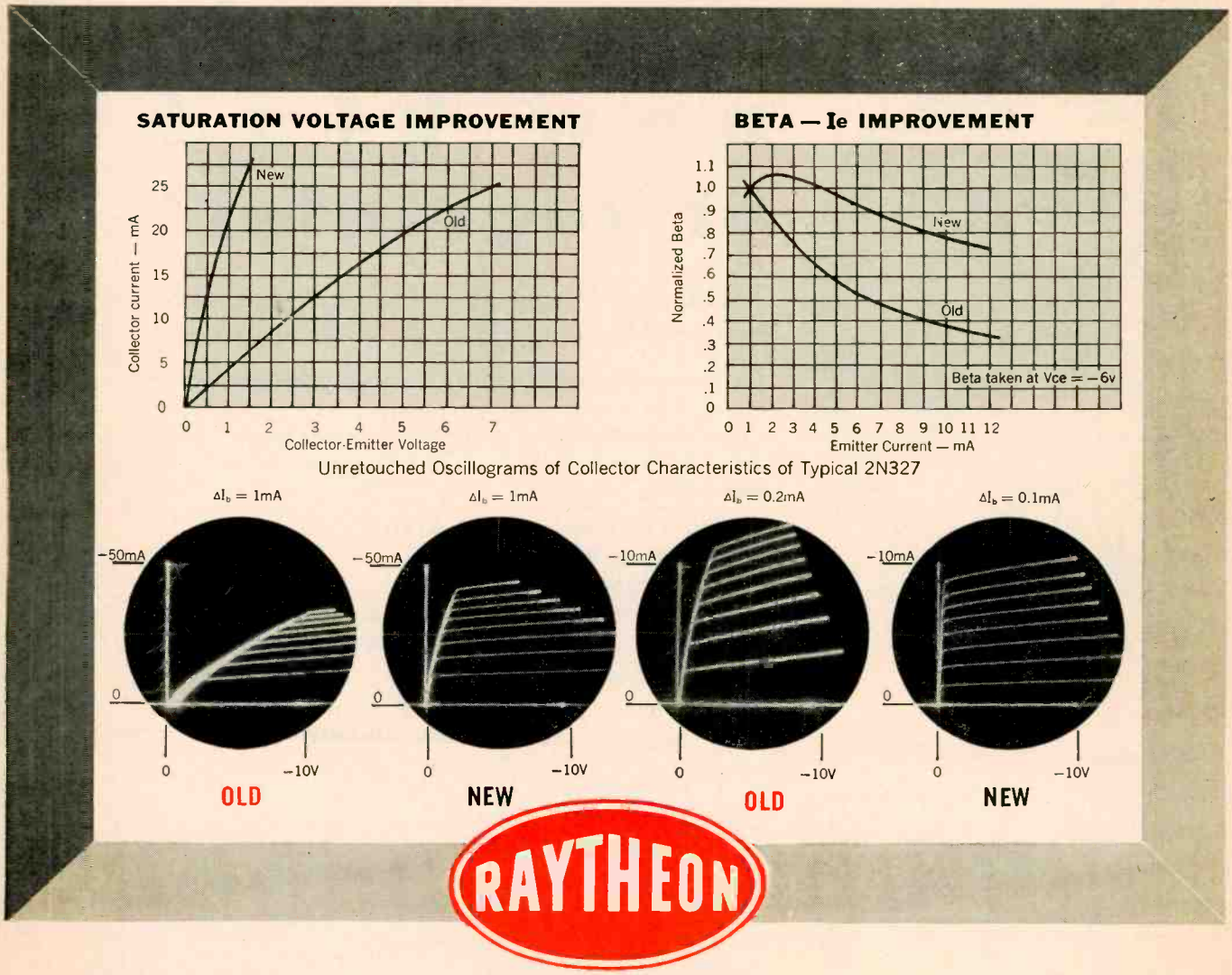

RAYTHEON

These "pictures" are worth a thousand words as evidence of

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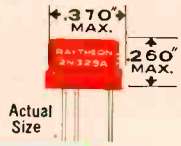
the result of Raytheon processing advances.



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Type	Reverse Current at—20V* Collector μA	Reverse Current at—20V* Emitter μA	Beta	Base Resistance ohms	Collector Resistance kilohms	Noise Figure db(max.)	Collector Capacity μμf	Alpha Freq Cutoff KC
2N327A	0.005	0.005	14	1200	500	30	65	200
2N328A	0.005	0.005	25	1400	500	30	65	300
2N329A	0.005	0.005	50	1500	500	30	65	400
2N330A	0.005	0.005	18	1300	500	15	65	250

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ELECTRONICS NEWSLETTER

● NEW SUBMARINE priority over aircraft carrier spells a big new military electronic market: nuclear power controls, missile guidance systems and even underwater television. **It's believed that the Navy's Polaris is designed to be launched from below the ocean's surface with the aid of an underwater tv system.**

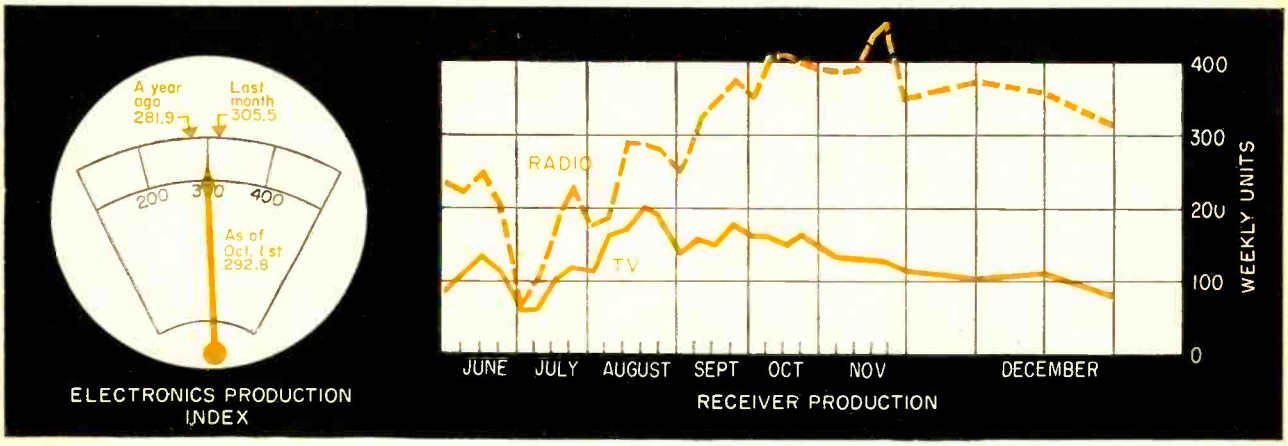
Such a system will probably consist of a lightweight underwater camera enclosure that could operate at 1,200 ft depth with lens control. It would also include a pan-and-tilt mechanism operated from a control panel inside the submarine.

● **Pentagon** decision to push development of atomic planes also means more spending for electronics and big problems for our industry to solve. **Design of specific electronic equipment for atomic planes has awaited the Defense Department decision on the type or types of planes to be built** (ELECTRONICS, Dec. 10, 1957 business edition).

Trick is to build components that will withstand radiation for a usable period, or components whose values change to a known and compensable degree under radiation. Transistors, for example, have sometimes been found to have fluctuating electrical characteristics after they have been exposed to nuclear radiation.

Simplest kind of maintenance will probably require three-dimensional tv, perhaps in color, and remote-controlled micromanipulation apparatus.

● **Miscellaneous:** Northrup Aircraft got an AF letter of intent last month for production of more than $70 million worth of Snark SM-62 intercontinental guided missiles and related equipment. Previous Snark contract, last summer, was for $73 million. . . . Meanwhile, 105 Air Force "missileairmen" have completed a Northrop instructional program and are being integrated into SAC's Snark-equipped first intercontinental guided missile squadron.



FIGURES OF THE WEEK

RECEIVER PRODUCTION

(Source: EIA)	Dec. 20, '57	Dec. 13, '57	Dec. 21, '56
Television sets, total	96,647	116,296	98,357
Radio sets, total	308,840	373,322	335,011
Auto sets	97,119	118,284	197,019

STOCK PRICE AVERAGES

(Source: Standard & Poor's)	Dec. 31, '57	Dec. 24, '57	Jan. 2, '57
Radio-tv & electronics	52.28	50.16	52.41
Radio broadcasters	51.77	51.22	65.55

FIGURES OF THE YEAR

Totals for first 10 months

	1957	1956	Percent Change
Receiving tube sales	388,738,000	390,357,000	—0.4
Transistor production	22,386,300	9,403,000	+138.1
Cathode-ray tube sales	8,304,181	9,233,780	—10.1
Television set production	5,251,153	6,050,052	—13.2
Radio set production	11,945,534	10,884,760	+9.7

LATEST MONTHLY FIGURES

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Aug. '57	July '57	Aug. '56
Prod. workers, comm. equip.	409,800-p	393,700-r	392,300
Av. wkly. earnings, comm.	$77.81 -p	$75.85 -r	$75.76
Av. wkly. earnings, radio	$75.81 -p	$75.24 -r	$73.75
Av. wkly. hours, comm.	39.9 -p	39.1 -r	40.3
Av. wkly. hours, radio	39.9 -p	39.6 -r	40.3

TRANSISTOR SALES

(Source: EIA)	Oct. '57	Sept. '57	Oct. '56
Unit sales	3,544,000	3,231,000	1,290,000
Value	$7,075,000	$6,993,000	$3,930,000

TUBE SALES

(Source: EIA)	Oct. '57	Sept. '57	Oct. '56
Receiving tubes, units	47,075,000	44,382,000	42,921,000
Receiving tubes, value	$38,421,000	$35,545,000	$34,362,000
Picture tubes, units	995,629	1,071,662	1,165,740
Picture tubes, value	$19,495,574	$20,819,036	$21,117,261

Air Plan Means More Business

A MULTIMILLION dollar air traffic control system which can store, process and present on demand complete positional information on all aircraft in a given area will provide R&D companies and electronic equipment manufacturers with still another outlet for their wares in 1958.

Basic system design calls for four electronic elements: data processing and display, communications, navigation, and data acquisition equipment. Only airborne equipment required is a conventional two-way radio.

First portion of the system put up for grabs by the government's Airways Modernization Board, which is responsible for the program, was the data processing and display element. This device will serve as a central computer to receive information from other elements of the system and automatically select proper departure time, route, altitude and arrival time for each aircraft while constantly updating radar information.

No less than 31 companies and institutions, either individually or as combines, submitted proposals to AMB on the element. Early this month, AMB chairman E. R. Quesada announced that General Precision Laboratory, subsidiary of General Precision Equipment Corporation, was selected for the initial prime contract negotiation. Subcontractors associated with GPL are Link Aviation and Librascope, also subsidiaries of GPE, and Pasker Instrument.

It is anticipated that the first data processing and display elements will be installed at Idlewild, LaGuardia and Newark airports and at adjacent military air bases by January 1959. Other similar geographic divisions will ultimately be established with a high-speed digital transmission system interconnecting each central computing station.

The AMB has launched a five-year program aimed at providing a significant operational improvement in the safety and traffic handling capacity by January 1963.

WASHINGTON OUTLOOK

THE JUSTICE DEPT.'s Anti-Trust division is investigating Pentagon policy on providing production equipment and facilities to military contractors and subs. The purpose: to determine whether the policy "tends to eliminate competition, create or strengthen monopoly, injure small business or otherwise promote undue concentration of economic power."

For military electronics suppliers—almost all of whom produce with some military-owned facilities—Justice's new investigation puts the spotlight on a controversy which has long troubled Congress, industry and officials in government.

The anti-trust investigation will concentrate on these problems:

1. The alleged tendency of major prime contractors to set up new production facilities—with government funds—despite existing facilities which are already available and idle in subcontractors' private shops.

This is a particular gripe of electronic suppliers to some airframe producers.

2. The use of government production gear for nondefense work.

There is an overall ban on such use but the government rules provide many loopholes. Since the ban went into effect four years ago, ODM has okayed 103 cases for civilian use of government tools—including many in electronics. And officials worry about the number of instances where this is done without the government's knowledge.

The competitive advantage to a producer making electronic parts or equipment using government equipment at a relatively low rental rate over one who must use privately financed capacity is obvious.

3. The lack of uniformity in tool leasing policies up to now.

Military procurement officers have allowed tool rentals under a wide range of contracts with different types of provisions of terms, purchase options, installation charges, maintenance and the like.

Because of these variations in leasing arrangements, it has been possible for one producer to have a competitive advantage over another —particularly in cases where major contractors have been allowed a price offset on the end-item rather than a cash rental payment. A recent Office of Defense Mobilization directive sets up uniform rental rates—ranging from 1 percent to 2½ percent of the equipment's acquisition cost, depending on its age—and leasing rules, which theoretically should correct the situation. But some officials grumble about foot-dragging by the military in putting the new rules into effect.

- **Justice's investigation**—the trust-busters prefer the term "survey" —is being made under the provision of the Defense Production Act of 1950 requiring quarterly reports to Congress on the law's possible impact on anti-trust procedures. The Defense Production Act is the basic law giving the President power to mobilize U.S. industrial capacity for defense preparedness. It includes authority for expansion of production facilities through federal incentives, priorities and allocations, and the like.

- **In February, the Attorney General will report his findings to Congress—plus recommendations, if necessary, on how to eliminate anti-trust implications from the program.**

Lambda power supplies have varied uses in the North Carolina Works of the Western Electric Company. This representative installation includes among its components eight Lambda Com-Pak power supplies.

Western Electric uses standard Lambda supplies to power defense system tests

NEW **COM-PAK®** POWER SUPPLIES SAVE VALUABLE PANEL SPACE
Models through 1.5 amperes
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Lambda power supplies provide Western Electric Company with power for testing components of the United States continental air defense system.

These are standard Lambda models, supplied from stock, with front-panel modifications only.

Available for immediate delivery, Lambda power supplies from stock also are being used in major rocket and missile programs.

Your request will bring the current Lambda catalog by return mail. It covers the complete new space-saving Com-Pak series, as well as other rack, bench and portable models, for all needs through 1.5 amperes.

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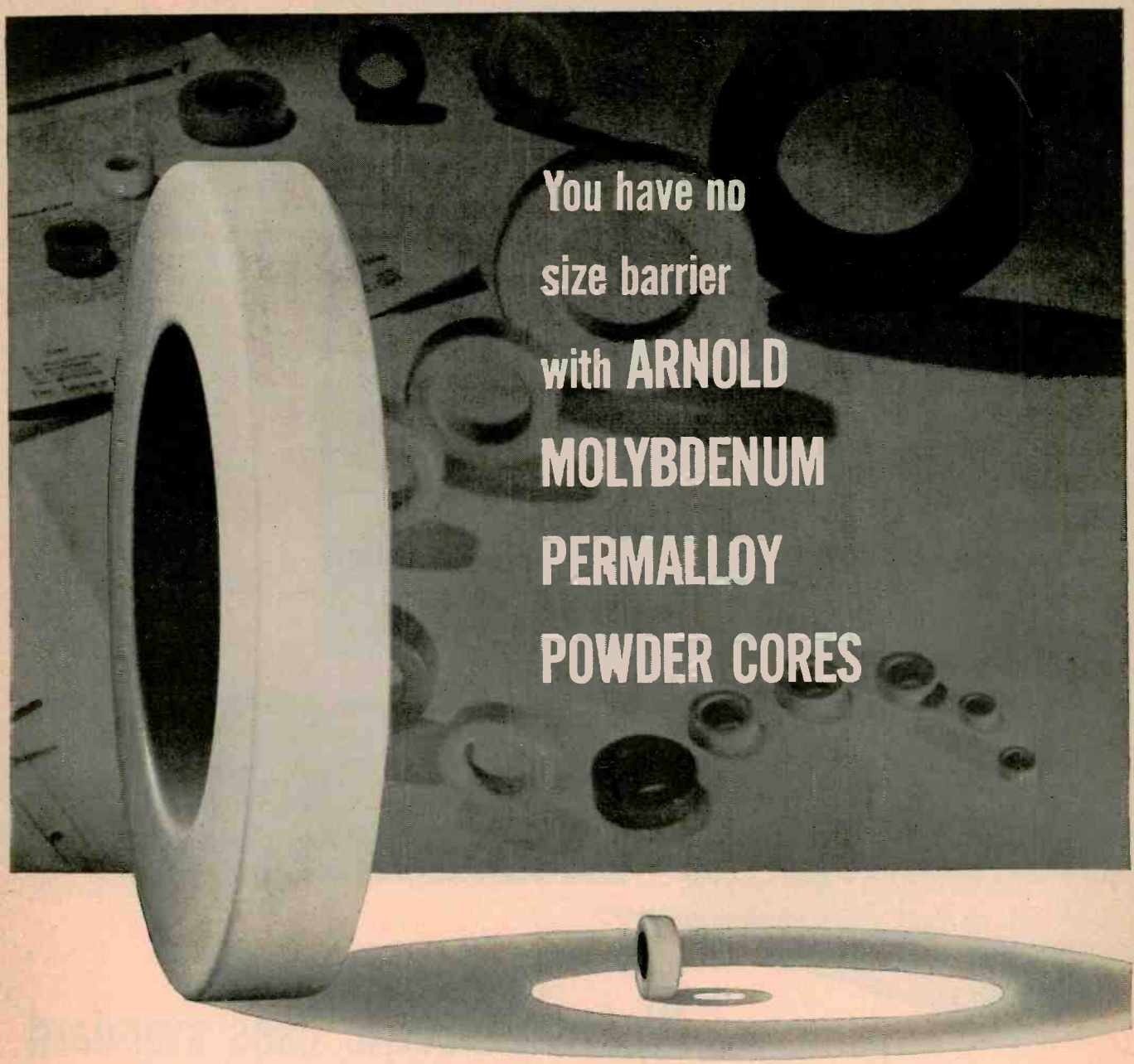

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As long ago as 1953 Arnold pioneered and developed for production use the small "Cheerio" core illustrated above. Today, hundreds of thousands of Arnold "Cheerio" cores are filling the requirement for miniaturization in circuit design in industrial and military applications. And even smaller sizes are now under development at the Arnold Engineering Company.

Arnold also is the exclusive producer of the largest 125 Mu core commercially available. A huge 2,000 ton press is required for its manufacture and insures its uniform physical and magnetic properties. This big core is also offered in the other three standard permeabilities of 60, 26 and 14 Mu.

Most core sizes can be furnished with a controlled temperature coefficient of inductance in the range of 30° F to 130° F. Many can be supplied temperature stabilized over the wide range covered by the MIL-T-27 specification of -55° C to +85° C . . . another of the special features only Arnold provides. ● Let us handle all your magnetic materials requirements from the most extensive line in the industry: Powder cores, tape cores, cast or sintered Alnico permanent magnets, and special magnetic materials.

WSW 6951

For more information write for Bulletin PC-104B

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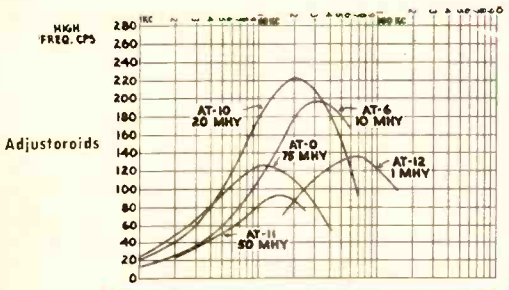
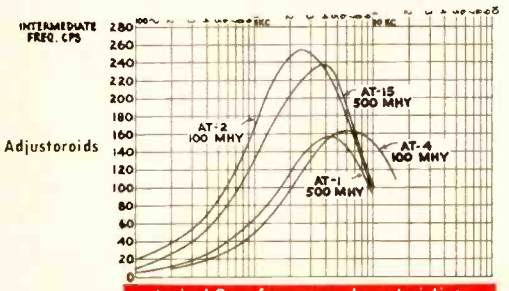
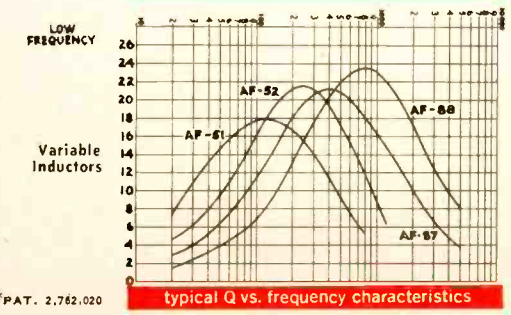


typical Q vs. frequency characteristics



typical Q vs. frequency characteristics



typical Q vs. frequency characteristics

*PAT. 2,762,020

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New **Burnell Adjustoroids** possess in addition to all the outstanding characteristics of non-adjustable **toroids:**

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	Length/ Dia.	Width	Hgt.	Wt.	Useful Freq. Range	Max Q	Max L in hys
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AT-1	1 3/4	1 3/4	1 1/4"	7 1/4 oz	2 kc to 10 kc	4 kc	15 hys
AT-2	2 3/4	2 3/4	2 1/4"	24 oz	Below 2.5 kc	2.5 kc	125 hys
AT-4	1 19/64		1 1/4"	4 oz	1 kc to 16 kc	6 kc	15 hys
AT-6	1 1/16		1"	2 oz	10 kc to 100 kc	30 kc	.75 hys
AT-10	1 19/64		1 1/4"	4 oz	3 kc to 50 kc	20 kc	.75 hys
AT-11	45/64	45/64	3/4"	.83 oz	2 kc to 25 kc	15 kc	5 hys
AT-12	45/64	45/64	3/4"	.83 oz	15 kc to 150 kc	60 kc	.5 hys
AT-15	1 31/32		1 7/8"	14 oz	Below 5 kc	4 kc	125 hys
AF-51	1 19/64		2"	5 oz	30 cps to 500 cps	120 cps	1000 hys
AF-52	1 19/64		2"	5 oz	50 cps to 1 kc	250 cps	1000 hys
AF-87	45/64	45/64	1 1/4"	1.7 oz	90 cps to 2 kc	400 cps	80 hys
AF-88	45/64	45/64	1 1/4"	1.7 oz	1.6 kc to 4 kc	800 cps	42 hys

Burnell & Co., Inc.
first in toroids, filters and related networks

EASTERN DIVISION
10 PELHAM PARKWAY
PELHAM MANOR, N. Y.
PELHAM 8-5000
TELETYPE: PELHAM 3633

PACIFIC DIVISION
720 MISSION STREET
SOUTH PASADENA, CALIFORNIA
RYAN 1-2841
TELETYPE: PASACAL 7578

DEPT. E-1

Forces' Upkeep $20 Million Daily

THIS COUNTRY's armed forces now spend $20 million daily to maintain electronic equipment.

Disclosure of this figure was a highlight of the EIA-sponsored Electronic Equipment Maintainability Session held a short while ago at the University of Southern California.

Another point made by several speakers: the maintainability factor must be kept constantly in mind so provisions for maintenance can be incorporated in the design without adding greatly to cost or detracting from performance of the gear.

R. M. Ranftl of Hughes Aircraft, speaking on "Designed Maintainability," suggested locating equipment in central racks within the airframe for easy accessibility; placing companion pieces adjacent to each other with all front panels facing out; standardization and use of modular construction; clear identification of all equipment.

EIA's Military Equipment Panel outlined a 14-point program for designers to improve maintainability. In brief, they are:

1. Spell out all environmental and operational hazards before choosing components. 2. Find out what conditions every component must withstand. 3. Choose components that meet accepted performance standards.

4. Choose parts that meet all circuit needs . . . note their limitations, too. 5. Check with the maker to see if each part will work in its spot. 6. Derate capacitors and resistors for heat using EIA or JAN-MIL factors.

7. Compensate for known component limitations. 8. Build in safety factors to meet variable conditions. 9. Use fuses, meters, etc., to protect equipment in case of accident. 10. Place parts to keep temperature as low as possible.

11. Make components easily accessible. 12. Add blowers if needed to keep heat down. 13. Add more electrical insulation wherever needed. 14. Check circuit operation with electron tubes chosen at random.

MILITARY ELECTRONICS

• **Progress in inertial guidance** systems is eliminating the need for auxiliary systems detectable by the enemy in several ballistic and guided missiles. USAF is dropping the radio command system from IRBM Thor and using A. C. Spark Plug's pure inertial system.

If Arma's all-inertial system for the ICBM Titan proves sufficiently reliable, it is conceivable that the radio command system will be dropped from Titan.

A.C. Spark Plug is currently working on all-inertial systems for both Navy's Regulus II and USAF's Matador.

ICBM Atlas is still operating with radio command to date.

• **While Army's Jupiter** was making its public appearance at Chicago's Auto Show, Chrysler got a $30 million production contract for the missile.

Jupiter "C", not to be confused with Jupiter, is basically a Redstone modified to provide longer range, higher velocity and was made to test Jupiter components. The "C", in multistage form, will launch Army satellite.

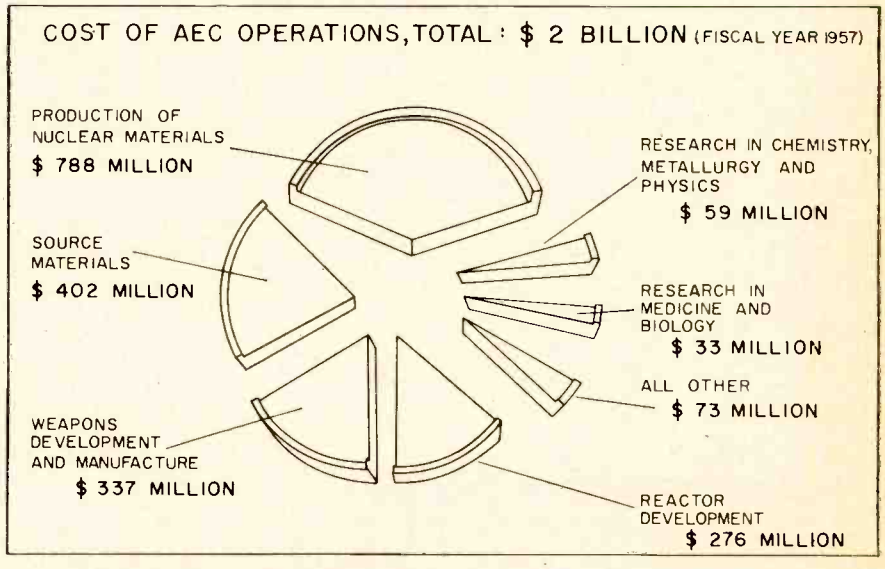
• **CAA has awarded** a $4,691,000 contract to Texas Instruments for airport surveillance radar systems to be installed at 14 sites.

The systems will have built-in circular polarization, improved moving target indicator.

• **The roll stabilization** and high capacity automatic steering systems made by Sperry and used on the USS Compass Island, experimental launching ship for Polaris, "are considered to be production quality rather than experimental," says ship's captain Cdr. James Dare.

"The steering systems have fast rudder drive with improved angle and rate sensing devices," Dare said. "Time to put rudder from 35 degrees right to 35 degrees left at 20 knots is 12 seconds."

AEC Costs Up $400 Million



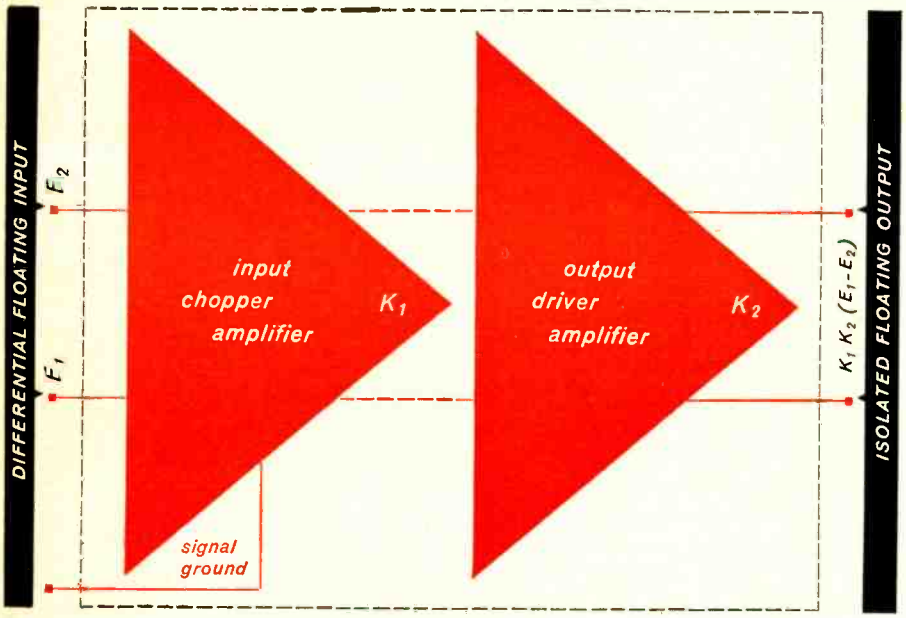
Materials production, reactors, weapons take bigger shares

IT COST $2 BILLION to operate the Atomic Energy Commission in fiscal year 1957. This is $400 million higher than fiscal 1956, double 1954 and almost five times the AEC outlay in fiscal 1950.

While AEC does not outline total instrumentation costs in its unclassified financial reports, it probably bought over $12 million in electronics.

A previous study showed AEC and its contractors spent about 0.6 percent of the total budget on in-

New! KIN TEL's true differential DC amplifier...

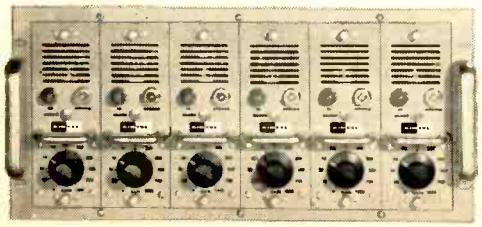


completely isolates input from output!

AMPLIFY MICROVOLT-LEVEL DATA SIGNALS New transistorized differential DC amplifiers provide extremely high common-mode rejection, very low drift, high output capability, and excellent stability and linearity... all unaffected by load or gain changes. Ideal for thermocouple amplification, they eliminate ground loop problems; allow the use of a common transducer power supply; permit longer cable runs; drive grounded, ungrounded or balanced loads, and can be used inverting or non-inverting. The 114A is the *perfect instrumentation amplifier.*

BRIEF SPECIFICATIONS – 114A DIFFERENTIAL DC AMPLIFIER

- 120 db common-mode rejection from DC to 60 cps.
- Gain of 10 to 1000 in 5 steps, continuous variation between steps.
- Gain accuracy 1.0% DC 10 cps, 3% to 30 cps, 3 db down at 120 cps.
- DC gain stability and linearity 0.1%.
- <5 μv noise; <5 μv drift at gain of 100 or above.
- Maximum output capability 10V at 10 MA.
- 100 K ohm input, <1 ohm output Z (min. load res. 20 ohms, max. load cap. 1.0 μf).



Six KIN TEL amplifiers in compact 19" rack mountable module.

STANDARD WIDEBAND DC AMPLIFIERS can be used single-ended or for floating input applications. An operational version permits the user to employ his own feedback networks to limit bandwidth, generate transfer functions, obtain specific gains and perform integrations. Specifications for the 111 series, Wideband DC Amplifiers include: <2 μv drift; <5 μv noise. ±35 V, ±40 MA output. 100 K ohm input, 1 ohm output Z; 1.0 μf allowable output cable capacity. 0 to 1000 gain in ten steps, with continuous 1 to 2 times variation of each step. Gain accuracy (freq. response) ±1.0% DC to 2 KC, <3 db down at 40 KC.

ALL KIN TEL DC AMPLIFIERS feature integral power supplies, convenient plug-in mounting and KIN TEL's proven chopper feedback amplifier circuitry for unsurpassed stability, accuracy and reliability. They have accumulated over 500 years of operating time, and in one installation alone have logged over a million hours of trouble-free operation. Records like this are the result of stringent quality controls, thorough testing and calibration, and years of experience in the design and manufacture of thousands of chopper stabilized DC amplifiers.

FOR GREATER ACCURACY, SIMPLICITY, RELIABILITY, and the elimination of carrier system balance problems, replace complex carrier systems with a KIN TEL packaged "plug-in" DC instrumentation system — complete from input transducer to output device.

Over 10,000 KIN TEL instruments in use today!

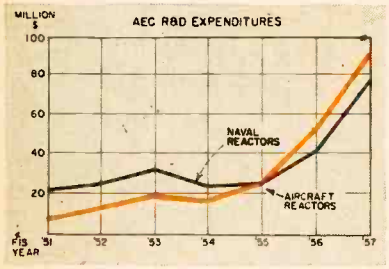
Representatives in all major cities.
Write today for demonstration or literature.
5725 Kearny Villa Road, San Diego 11, California, Phone: BRowning 7-6700.

KIN TEL

A Division of Cohu Electronics Inc.

struments during 1950-54. Dollar value of instruments increased yearly from $2.4 million to $6 million by 1954.

Expenses for nuclear materials and weapons took most of the budget again in 1957. But reactors

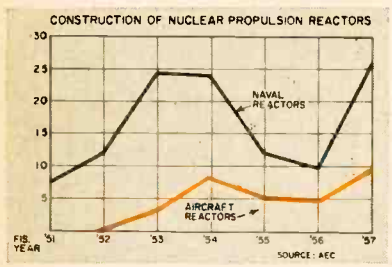


AEC spends more on aircraft reactor R&D

R&D was stepped up 62 percent, from $170 million in 1956 to $276 million in 1957.

Biggest reactor outlays were for development of experimental power reactors, $57 million, up $11 million; naval propulsion, $100 million, up $51 million, and aircraft propulsion, $87 million, up $35 million.

Propulsion reactors are con-



Building of aircraft reactors is hardly off the ground.

sidered the most fruitful market for reactor instrumentation. The Navy is converting to nuclear ships, contracts for a merchant ship have been let and the nuclear aircraft and missiles programs are gaining needed support.

The accompanying charts show that AEC is spending more on aircraft reactor R&D than it ever spent on naval reactors. The total of $100 million for naval reactors includes a charge of $20.5 million for retirement of the obsolete Seawolf prototype.

Nuclear weapons development, manufacturing, testing and maintenance costs increased from $281 million in 1956 to $337 million in 1957.

FINANCIAL ROUNDUP

• **Securities and Exchange Commission's** latest quarterly report of planned capital expenditures shows slight increase in contrast to pattern of decreased expenditures shown in mid-year survey. Annual expenditures during third quarter of 1957 were at annual rate of 37¼ billion, compared with $37 billion rate for first half of year. Actual capital outlays for 1957 are expected to top $37 billion, six percent more than 1956 total of $35 billion. Peeking into the first quarter of 1958, SEC surveyors see plant and equipment outlays at annual rate of $35½ billion, only five percent less than 1957.

• **Capital Cities Television Corp.** completes public sale of 52,000 shares of capital stock at $5.75 per share. Capital operates a radio and tv broadcasting business in the Albany-Schenectady-Troy area of New York State. Subsidiary, Durham Broadcasting Enterprises, owns a tv station in Durham, N. C. CBS news commentator Lowell J. Thomas is Capital's largest stockholder. Money from stock sale will be used to retire $220,000 loan and for corporate purposes.

• **C & C Television** of New York City receives option to buy 87½ percent of stock of **Skiatron TV, Inc.** and **Skiatron International Corp.** from Matthew Fox. Option, subject to stockholder approval, places C & C Television in position of deciding in next 3½ years if it wants to gain control of Skiatron's subscription tv system.

• **Fort Pitt Industries**, diversified midwestern brewer, is getting out of the beer business to put all of its efforts into its **J. P. Seeburg Division** in Chicago, Ill. Freed funds will be used to retire debt, further expand electronic and guided missile phases of Seeburg business. Seeburg also makes juke boxes, other electronic gear.

• **Sprague Electric**, North Adams, Mass., drops prices 25 percent on its solid-electrolyte tantalum electrolytic capacitors. In production just a little over one and one-half years, the new capacitors have been widely used in transistorized circuits of missiles, computers, ammunition fuses, radar and aircraft electronics.

DIVIDENDS: **Packard-Bell**, 12½¢ payable Jan. 25; **Avco**, 10¢ Feb. 20; **Howard W. Sams**, 12¢ plus 12¢ extra, both Jan. 25; **Daystrom**, 30¢ Feb. 14; **General Dynamics**, 50¢ Feb. 10¢; **American Cable & Radio**, 30¢ Jan. 28; **Bell & Howell**, 2½ percent in stock payable Jan. 27; **Oxford Electric**, 10¢ in cash and 10 percent in stock, payable Jan. 24.

Network Plans Rural Step-up

A-M RADIO, currently a bonanza for rural and small-city broadcasters, may soon get help from f-m radio in providing higher-fidelity program material.

Mutual Broadcasting System has announced plans to use f-m to overcome fidelity limitations of class-C telephone lines, now used to supply network program material to many a-m stations.

MBS affiliated f-m stations on the edge of MBS class-A a-m service areas will feed program material to smaller a-m stations.

The f-m stations will multiplex the rebroadcasted signal, which will then be picked up by special equipment at the a-m stations. The a-m stations will convert the signal to a-m and broadcast it over their regular facilities.

As a sidelight, this leads MBS to announce plans for actual ownership of broadcast facilities. The plan, moreover, is seen as a revenue source for many f-m stations now relying on sister a-m stations for operational funds. It's also a new step other networks may take.

MBS intends to obtain the FCC maximum of seven f-m licenses. Application for the first station has been made.

...applied to weather radar

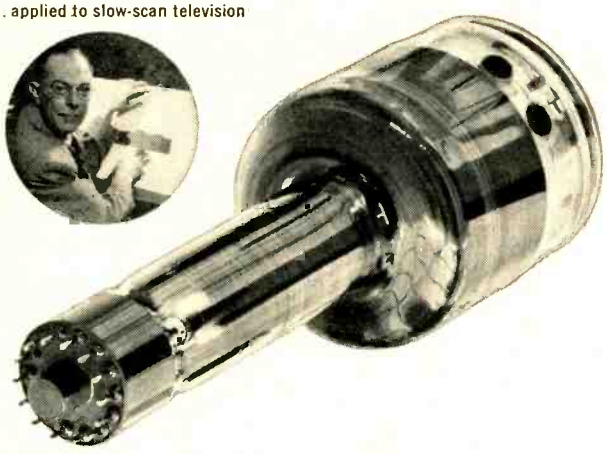
MAGNETIC DEFLECTION 5" DIAMETER

Representative applications: plan position indicator information; slow-scan television. (Complies with Aeronautical Radio, Inc. specifications.)

Announcing the...

HUGHES FAMILY OF TONOTRON* DISPLAY TUBES

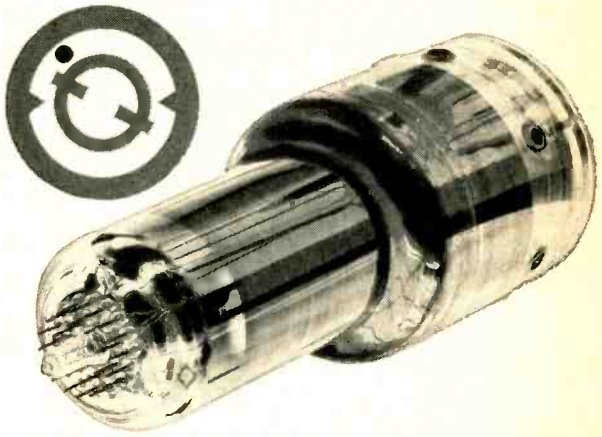
...applied to slow-scan television



ELECTROSTATIC DEFLECTION 5" DIAMETER

Representative applications: "B" scan radar, oscillography, armament control radar.

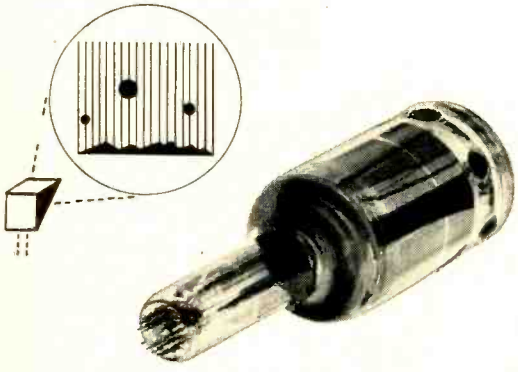
...applied to complex radar systems



ELECTROSTATIC DEFLECTION 5" DIAMETER

With two writing guns. Representative applications: multiple "B" scan radar, oscillography, and armament control radar.

...applied to "B" scan projection



ELECTROSTATIC DEFLECTION 3" DIAMETER

Representative applications: optical projection systems, miniature radar indicators.

High brightness, multiple halftones, superior storage uniformity, controllable persistence, and compact design are the outstanding characteristics of the Hughes TONOTRON electron tube. All TONOTRON tubes present a complete scale of grey shades for high-fidelity picture reproduction. Hughes offers the only complete line of cathode-ray storage tubes, including the infinite persistence tubes—TYPOTRON® Type 6577 (character-writing storage tube) and the MEMOTRON® Type 6498 (oscillograph storage tube).

Complete technical information—specifications, operating characteristics, suggested circuitry, etc., will be sent you on request. Write: HUGHES PRODUCTS, Electron Tubes, International Airport Station, Los Angeles 45, California.

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Portable Tv Uses 31 Transistors

CHICAGO—A PORTABLE 14-in. picture tube, cordless tv, powered by two twelve volt nickel-cadmium rechargable batteries, has just been unveiled here by Motorola, Inc. The unit has 31 transistors and utilizes 10 watt power consumption.

Battery life is 6 hours. A monopole 4½ ft antenna is used. Edward Taylor, executive v-p, consumer products, says "the unit is not a laboratory freak. We can start building them right away if the economics make it feasible. We want to encourage component manufacturers to get behind this."

As yet, it is too costly to produce. Weight of the entire unit with batteries is 32 lbs. Unit takes 17 seconds for warmup time. Excessive power in some portions of the tv receiver have been eliminated by a "scan-magnifier," a Motorola invention kept under wraps.

Price of the unit was not disclosed. Taylor said the unit will play in a plane, train, etc. Batteries will withstand 2,000 separate recharges for an estimated 12,000 hours of life. Estimated cost of operation of the tv is 4/10 of 1 cent per hour.

A 90 degree tube is used. No printed circuits. Taylor says, "printed circuits will be a part of it when we get rolling."

MEETINGS AHEAD

JANUARY						
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
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26	27	28	29	30	31	

FEBRUARY						
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MARCH						
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23/30	24/31	25	26	27	28	29

Jan. 20, 27; Feb. 3, 10, 17, 24: Lecture Series on Modern Communications, AIEE, IRE, Univ. of Penn., Philadelphia, Pa. Contact: Mr. S. Sharp, Franklin Inst., Phila., Pa.

Jan. 22-24: Electronic Industries Assoc. (formerly RETMA) 1958 Conference on Automation, Auditorium of Arizona State College, Tempe (Phoenix) Arizona.

Jan. 27: Four Corners District of A.S.T.M., technical sessions planned for New Mexico, Arizona, Utah and Colorado. Contact: J. L. Abbott, 1902 Richmond N. E., Albuquerque, New Mexico.

Jan. 27-28: Sixth Scintillation Counter Symposium, IRE, AIEE, AEC, NBS, Hotel Shoreham, Wash., D. C.

Feb. 3-7: American Institute of Electrical Engineers, Winter Meeting, Hotel Statler, N.Y.C.

Feb. 7-8: American Society for Quality Control, "Management By Exception", Administrative Application Division, ASQC, Second Annual Conf., Hotel Carter, Cleveland, Ohio.

Feb. 18: 14th Annual Quality Control Clinic, Rochester Society for Quality Control, War Memorial, Rochester, N. Y.

Feb. 20-21: Conf. of Transistor and Solid State Circuits, PGCT, AIEE, U. of Penn., Phila., Pa.

Mar. 18-19: Conf. on Extremely High Temperatures, AFCRC, Air Force Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass.

Mar. 24-27: IRE National Convention All Prof. Groups, Waldorf-Astoria Hotel and N. Y. Coliseum, N. Y. C.

Mar. 24-27: Fourth International Instrument Show, Caxton Hall, Westminster, London, S. W. 1.

New Market In Private Weather Forecasting?

AT LEAST TWO electronics firms have just redesigned erstwhile military equipment for the growing private weather forecasting market.

This market includes almost anyone who might suffer heavy losses due to unexpected storm violence.

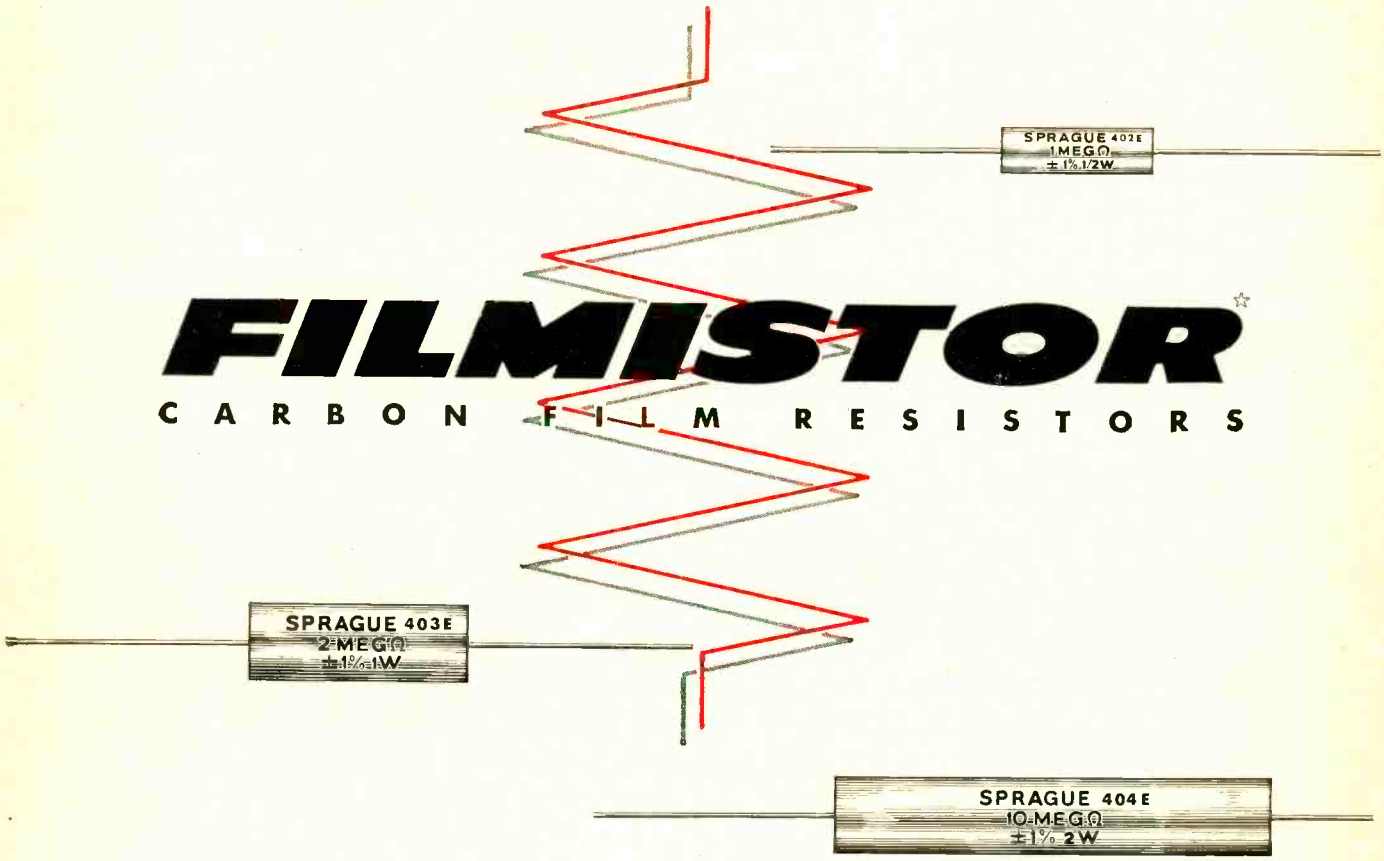
RCA and Bendix have redesigned their airborne weather radar surveillance systems to fit the needs of ground-based stations for up-to-the-minute information about local weather conditions. The new ground weather radar systems were adapted from the RCA AVQ-10 and the Bendix RDR-1 airborne units first designed for the military.

These developments were announced independently but almost simultaneously by Arthur L. Malcarney, executive vice president of RCA Defense Electronic Products, and C. I. Rice, Aviation products manager of Bendix Aviation's radio division.

Pointing to the projected use of RCA's radar on construction projects, Malcarney said these operations are particularly vulnerable to storms because of insufficient knowledge of unexpected weather conditions, and that losses could be reduced and completion schedules improved by dependence on information supplied by radar.

Other typical applications of private weather radar, he said, are agricultural areas, airports, dam sites, flight test and training activities, harbor applications and marine salvage, etc.

The new Bendix system, according to Rice, utilizes most components of the Bendix RDR-1 system now being used by 18 airlines. Repackaging the unit for ground operation was relatively simple and inexpensive, he said.



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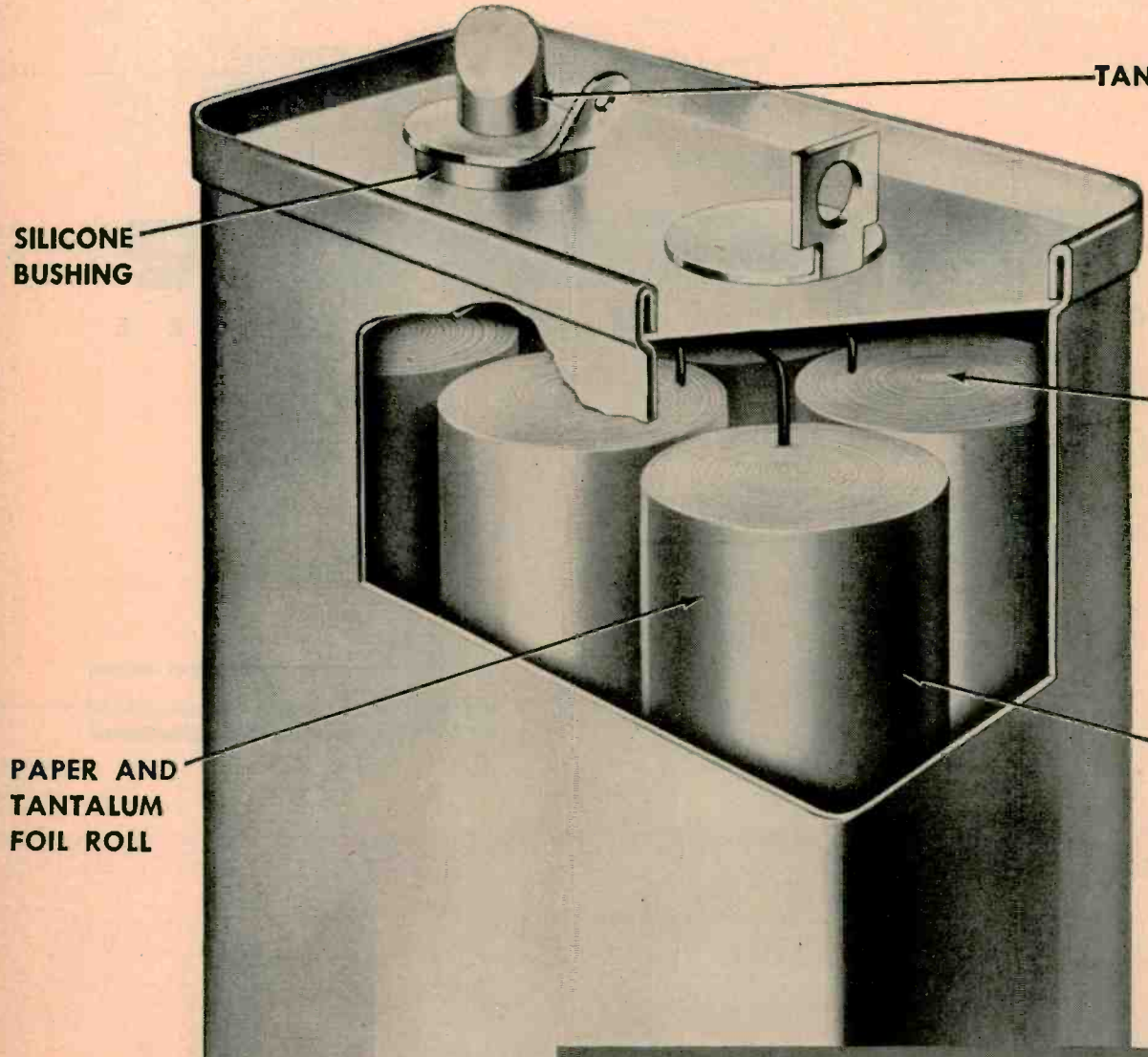
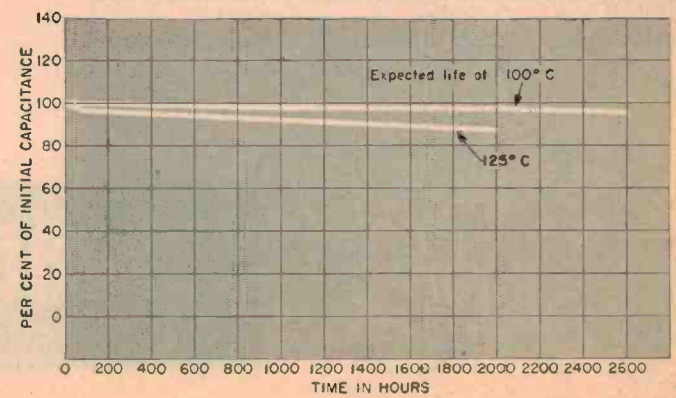
General Electric announces . . . .



LIFE TESTS OF TYPICAL 50 VDC KSR UNITS



After operating at 125°C for 2000 hours, capacitance of a typical KSR unit is reduced only 12%.

. . new KSR† Tantalytic* Capacitors

KING SIZE RECTANGULAR units offer thousands of microfarads in lighter, smaller cases

Now General Electric offers a completely new Tantalytic capacitor for use in computers, missiles, radar, and airborne electronic equipment—the King Size Rectangular Capacitor. This unit offers more joules per size, weight, and cost than any other tantalum capacitor available.

On a volt-microfarad basis, the new KSR's are 40% lighter, 30% smaller, and 40% less expensive than other 125°C rectangular capacitors. Compared with 125°C cylindrical designs, KSR's may be as much as 50% lighter, 30% smaller, and 15% lower in cost.

Like other General Electric Tantalytic capacitors, the KSR units offer "bulk capacitance," i.e., high volt-microfarads in an extremely small case. Now, one King Size Rectangular capacitor can often be used where several lower rated units were needed before. As a result of this bulk capacitance, costly connections are reduced and extra mounting brackets are eliminated.

† Trade-mark of General Electric Co.

In addition to the great size and weight advantages, the KSR capacitors offer these outstanding features:

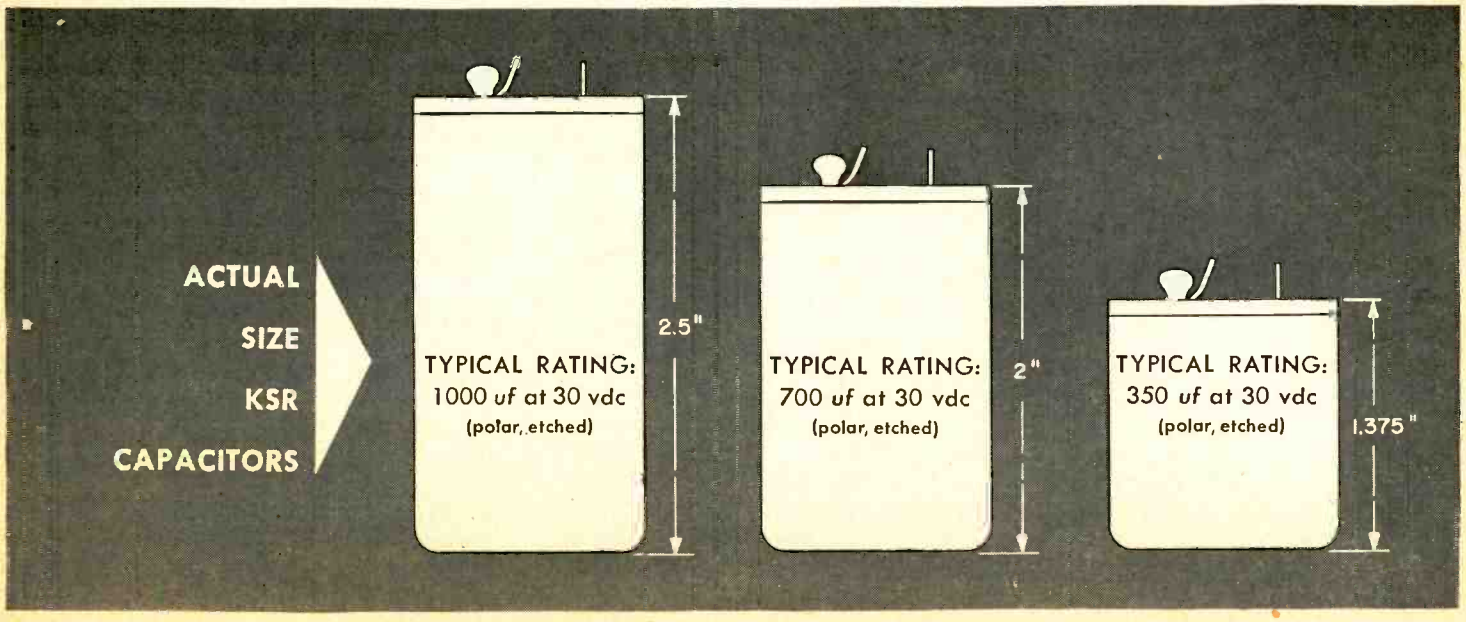
- **High reliability from −55°C to +125°C.**
- **Polar or non-polar construction; plain or etched foil.**
- **Long operating life at 125°C; extra long life at 85°C.**
- **Excellent shock and vibration characteristics.**
- **Non-acid electrolyte for long shelf life.**
- **Dual temperature and voltage ratings.**

KSR Tantalytic capacitors are now available in three case sizes: 1.375 inches, 2 inches, and 2.5 inches in height. All three have the same base size: 1.316 inches by .75 inch. For more information on these new capacitors or for assistance with your capacitor applications, contact your General Electric Apparatus Sales Office. Or write to General Electric Co., Section 449-1, Schenectady, N.Y.

* Registered trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC



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Here are four new CBS technical publications on tubes and semiconductors. Each is especially designed to make life easier for electronic technicians and engineers:

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compact, comprehensive ready-reference data by and for the electronic service technician. Only $1.50 net.

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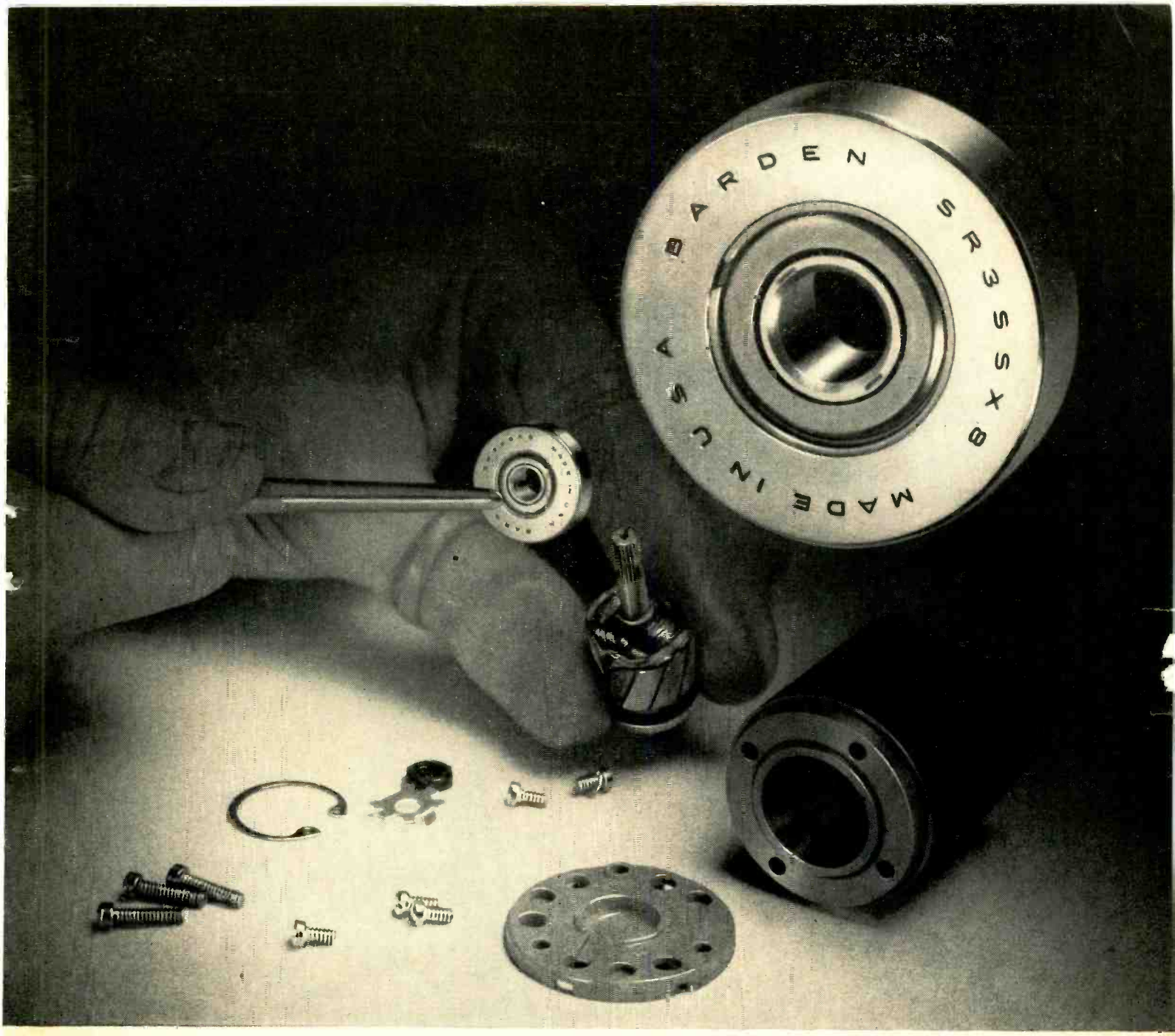


Barden Precision SR3SSX8 bearings as used in a synchro transmitter/receiver.

BARDEN *functional testing assures precision performance*

The SmoothRator, an electronic performance tester, was developed by Barden to check vibration as a measure of overall functional quality. A standard quality control instrument at Barden, the SmoothRator is also used by many leading component and systems manufacturers.

Precision-built synchros require small, uniform air gaps and consistently low torque to provide accurate response to a generated signal.

Barden Precision low torque bearings assure the required air gap by close control of radial play and concentricity. The SR3SSX8 has an extra large O.D. which eliminates the need for end caps, increasing air gap accuracy and reducing synchro complexity and cost.

From research and design, through quality controlled production, functional testing and application engineering each *Barden Precision* bearing is planned for performance. *Barden Precision* means not only dimensional accuracy but performance to match the demands of the application.

Barden Precision bearings must pass rigid functional tests on the SmoothRator, the Torkintegrator and other Barden-developed or standard test devices. This functional testing is your assurance of consistent precision performance.

Your product needs *Barden Precision* if it has critical requirements for accuracy, torque, vibration, temperature or high speed. For less difficult applications, Barden *predictable* performance can cut your rejection rates and teardown costs.

THE BARDEN CORPORATION

45 East Franklin Street, Danbury, Connecticut

Western office: 3850 Wilshire Boulevard, Los Angeles 5, California

SPECIFY BARDEN PRECISION BALL BEARINGS FOR: INSTRUMENTS • AIRCRAFT ACCESSORIES • COMPUTERS AND RECORDERS • MACHINE TOOL AND TEXTILE SPINDLES • OTHER PRECISION APPLICATIONS

CIRCLE 13 READERS SERVICE CARD

PROBLEM:

Servicing the "heart" of a low, desk-mounted chassis.

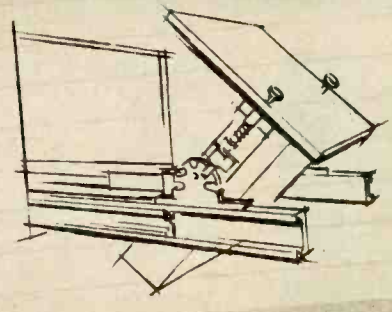
SOLUTION:

Specification of Grant tilting slides to pivot the chassis over for "on-top" servicing.

The Soroban Engineering Company recently completed a repackaging program of their Perforated Tape Sequencer for Digital Control of Analogue Computers. This sequencer is a vital component of the Automatic Digital Input-Output Device (the ADIOD System) used at the White Sands Proving Grounds in New Mexico. Tape readers and their associated equipment are mounted within the desk, on Grant three-section tilt slides. These provide quick accessibility to every part of the chassis. Some of the equipment requiring servicing and adjustment is mounted underneath the chassis and Grant Slides are used to tilt the unit, bringing the bottom-mounted equipment into the view of the operator for easier servicing.

Grant No. 363-P2Y Slides
recommended for
loads up to 200 lbs./pair

Courtesy Soroban Engineering, Inc.



GRANT
INDUSTRIAL SLIDES

23 High Street, West Nyack, New York
944 Long Beach Avenue, Los Angeles, California

Write for complete technical data on the wide range of Grant Slides.

In our 50 years of manufacturing dispersions of colloidal graphite, we've seen the unique anti-friction properties of this basic material make lubricating problems disappear as if by "black magic". As an additive to lubricating oils and greases, as a parting agent in many kinds of casting and as a dry-film lubricant in diverse fields of metal working . . . in application after application . . . it has proved literally more valuable than gold.

Dr. Edward Goodrich Acheson's invention of colloidal graphite over 50 years ago has been followed by a constantly expanding program of fundamental research and product development. Today, with over 50 different dispersions already in use, three laboratory groups at Acheson are pressing toward perfection of whole new families of dispersions and their applications.

The custom dispersing of solids requires specialized facilities and production techniques. Why not take advantage of Acheson's 50 years of leadership in this field?

You will be interested in the number of different dispersed solids, in addition to graphite, that are being used successfully today in industry. Our Products List gives you, in quick-reading chart form, a résumé of Acheson 'dag'® brand dispersions and their typical applications. Send for your copy. Address Department E-18.

ACHESON *Colloids Company*
PORT HURON, MICHIGAN
A division of Acheson Industries, Inc.
Also Acheson Industries (Europe) Ltd. and affiliates, London, England

Offices in:
Boston • Chicago • Cleveland • Dayton • Detroit • Los Angeles • Milwaukee
New York • Philadelphia • Pittsburgh • Rochester • St. Louis • Toronto

"But J.B., just because I didn't specify IRC components?"

IRC

INTERNATIONAL RESISTANCE COMPANY

401 North Broad Street, Philadelphia 8, Pennsylvania

In Canada: International Resistance Company, Ltd., Toronto, Licensee

THE THERMOELEMENT *simply plugs-in*

No need returning the Model 622 for thermoelement replacement; nor wiring a new one in. A spare element, or one immediately available for the individual instrument, can be instantly *plugged in*. Replacement units are furnished with correction curves to maintain the guaranteed high accuracy with original scale calibration. This is just one of several exclusive design features which make Model 622 more convenient, more flexible in use. And coupled with its *proved* high accuracy and stability, it remains the outstanding favorite for all high frequency problems. Available as thermo milliammeters and thermo voltmeters; and thermo ammeters, (external thermoelement type). Also as d-c voltmeters, millivoltmeters, milliammeters, microammeters, electrolysis volt-millivoltmeters, and as high accuracy rectifier type a-c instruments. Write for bulletin A20. Weston Electrical Instrument Corp., Newark 12, N.J.

WESTON

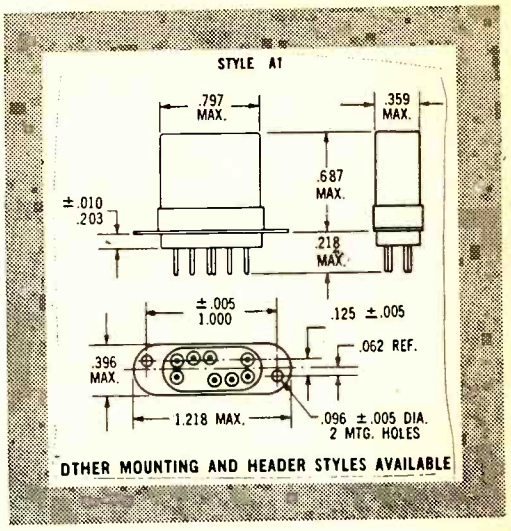
MODEL 622

portable

THERMO INSTRUMENTS


STOPPED IN HIS TRACKS...

Now! A West Coast Office
For Immediate Service



BY THE NEW POWRMITE®

Filtors new and greatly advanced micro-miniature relay.

Filtors, the leading specialists in the development and manufacture of sub-miniature relays is proud to announce the addition of the new Powrmite micro-miniature relay to its existing line of traditionally outstanding relays.

In every field of achievement there is always one leader. In relays with highest available reliability the leader is Filtors, Incorporated. All of the experience and know how gained in attaining its position of leadership have gone into making Filtors new Powrmite micro-miniature relay *truly reliable*—again the leader in a field of many.

MICRO-MINIATURE SPECIFICATIONS

AMBIENT TEMPERATURE RANGE	—65°C. TO +125°C.
DIELECTRIC STRENGTH	1000 VOLTS. (750 VOLTS BETWEEN OPEN CONTACTS).
INSULATION RESISTANCE	10,000 MEGOHMS MINIMUM AT 25°C.
CONTACT ARRANGEMENT	2C (2 POLE DOUBLE THROW).
CONTACT RATING	2 AMPS RESISTIVE AT 28 VOLTS DC OR DRY CIRCUITS.
SHOCK	50 Gs 11 MILLISECONDS.
VIBRATION	10 — 55 CPS AT .06 AMPLITUDE. 55 — 2000 CPS AT 20 G.
PICK-UP TIME	7 MILLISECONDS MAXIMUM AT NOMINAL COIL. VOLTAGE, 25°C. TEMPERATURE.
RELEASE TIME	7 MILLISECONDS MAXIMUM.
NOMINAL COIL VOLTAGE	26.5 VOLTS DC.
COIL RESISTANCE	550 OHMS ±10% AT 25°C.
ALTITUDE	70,000 FEET.
DUTY	CONTINUOUS.
PICK-UP	RELAY SHALL PICK-UP WHEN COIL VOLTAGE IS 18 VOLTS DC OR LESS OVER THE AMBIENT TEMPERATURE RANGE.

Leading manufacturers of hermetically sealed micro and sub-miniature relays.

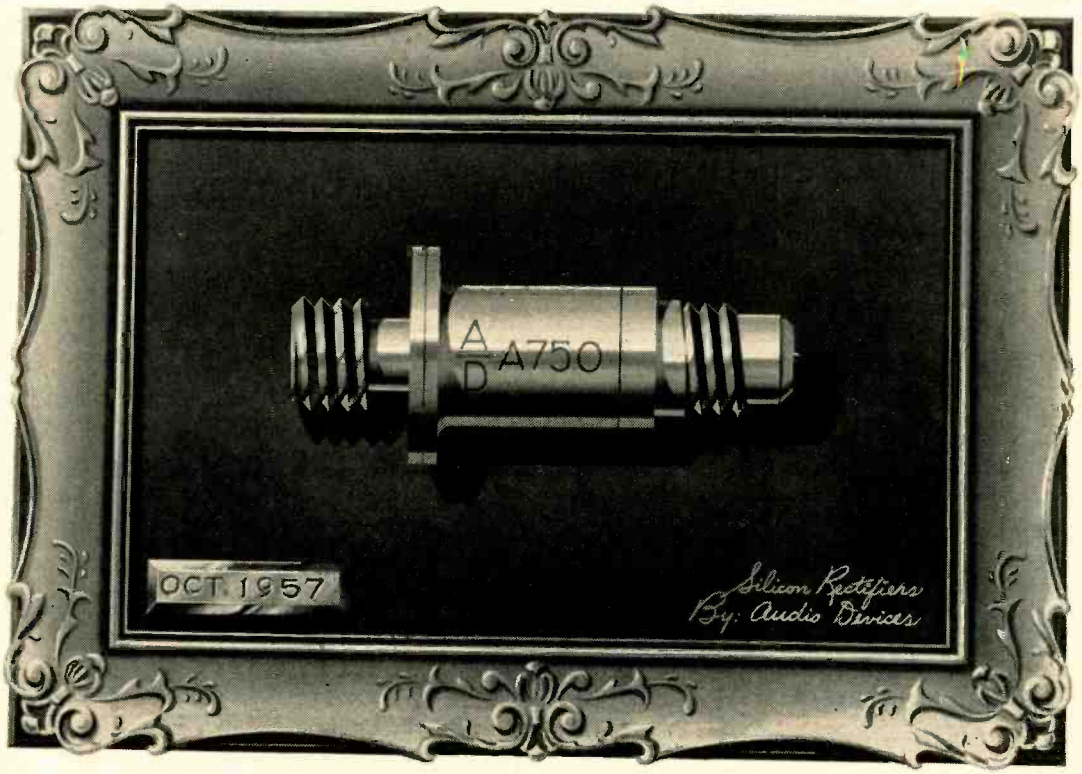
FILTORS, INC.

Main office and plant: Port Washington, N. Y., POrt Washington 7-8220
West coast office: 13273 Ventura Blvd., Studio City, Cal., STanley 3-2770

CIRCLE 18 READERS SERVICE CARD

IT'S NEW!

A Masterpiece...



...a Silicon Rectifier which SCREWS and PLUGS in too!

for powering your Radio/Television/and Electronic Devices

Write for further information on Replacement Kits, Power Rectifiers for Military and Commercial uses.

AUDIO DEVICES, INC. | Rectifier Division

620 EAST DYER ROAD • SANTA ANA • CALIFORNIA

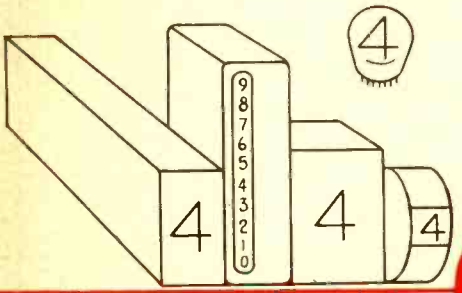
INQUIRE DEPT. E-1/17

only NIXIE® indicating tubes

HAVE THESE EXCLUSIVE FEATURES

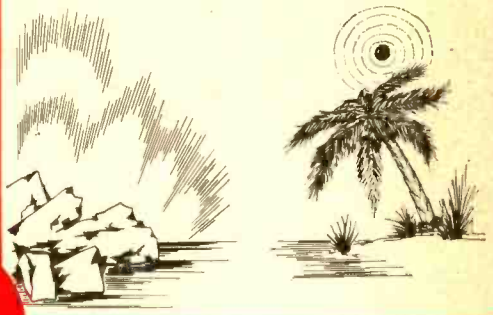
MOST READABLE DEVICE

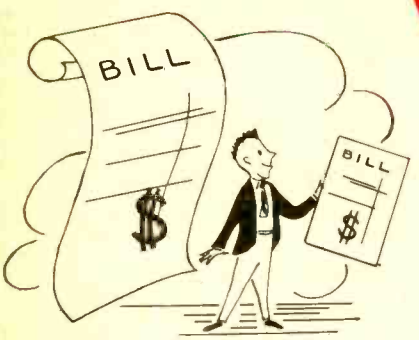
SMALLEST VOLUME FOR NUMBER SIZE



LIGHTEST WEIGHT

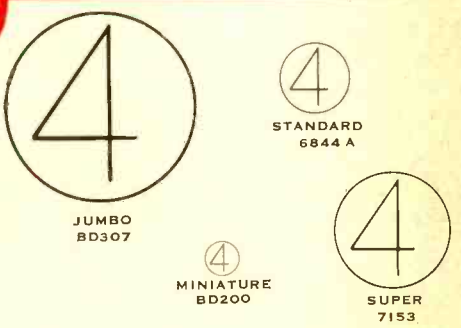
MAXIMUM TEMPERATURE SHOCK AND VIBRATION SPECS





LOWEST COST

LOWEST POWER



MOST READABLE FOR NUMBER SIZE

SOME TYPICAL NIXIE® APPLICATIONS

- INDUSTRIAL CONTROL
- INSTRUMENTATION
- COUNTERS
- COMPUTERS
- MILITARY ELECTRONIC INDICATOR
- CHANNEL INDICATORS
- INDICATOR BOARDS
- DIGITAL VOLTMETERS
- PAGING SYSTEMS
- ELEVATORS
- RADAR

Compare these all-electronic readout tubes with anything on the market today . . . for price, for performance, for reliability. You'll find that the Burroughs Nixie® is the most "perfect" indicating tube ever mass-produced.

These gas-filled, cold cathode tubes contain ten digits or letters. Any individual number or letter can be easily selected and displayed in a common viewing area.

Other Nixie® advantages are: Long life — Unlimited rate of change — Multiple remote indications from one driving circuit — Production uniformity from tube to tube and number to number — Perfectly formed numbers, precisely aligned — rugged construction — Simple plug-in stem, hidden tabulations — Human engineered for Performance, Appearance and Reliability.

Write for information on these and other tube styles

® REG. TRADEMARK

ANOTHER ELECTRONIC CONTRIBUTION BY

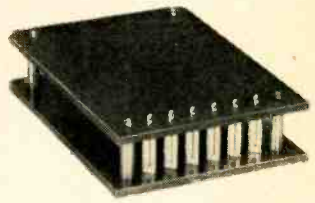
Burroughs Corporation

ELECTRONIC TUBE DIVISION

Plainfield, New Jersey

CN

FROM SERIES 5300
BOARD-TO-BOARD
P. C. CONNECTORS



5301 shown. For others in series, specs and data, request Bulletin 108.

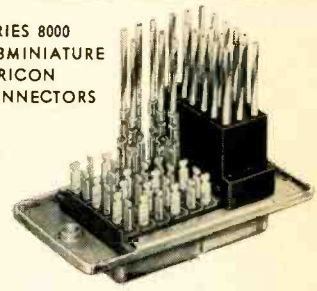
Reliability makes the difference when everything else is equal . . .

. . . but you (as a manufacturer, design or development engineer) are not as much interested in what may be "equal" as what may be "superior." Hence, we respectfully call your attention to Elco components for the reliability-factor which is causing their selection when everything else may possibly be equal.

Shown on this page are but four of our products finding their way into electronic and electrical end-products . . . after precise, exacting and unprejudiced tests in laboratory, application and performance. Many, many other Elco sockets, shields and connectors—including the world-famous Varicon Connector—have become the "reliability" prototypes for a vast and varied list of subminiature and printed circuit applications by industry and government.

Why don't you write us—on your Company letterhead, please—specifying the types of components in which you are interested. We will be pleased to send Catalogs and/or Bulletins by return mail—thereby employing one of our nation's earliest and unequalled "reliability" prototypes—Uncle Sam's good, grey couriers.

SERIES 8000
SUBMINIATURE
VARICON
CONNECTORS



48-double-tier with honeycomb insulator shown. Other single and double tier models, 8 to 80 contact in Bulletin 107.

SERIES 3300
COMBINATION
TRANSISTOR
SOCKETS

Standard and stand-off types available; with flat saddle or mounting rings. Bulletin 105-A.

SERIES 7000
SUBMINIATURE
PRINTED CIRCUIT
VARICON
CONNECTORS

Maximum number of contacts in minimum space. Available taper-tab, wire wrap and P. C. staked contacts; 17, 23, 29, 35, 41 contact units. Bulletin 106.

IF IT'S NEW . . . IF IT'S NEWS

. . . IT'S FROM ELCO CORPORATION

"M" STREET BELOW ERIE, PHILADELPHIA 24, PA., CUmberland 9-5500

What you should know about SAVBIT

A SPECIAL ALLOY AVAILABLE ONLY IN ERSIN Multicore FIVE-CORE SOLDER

Unretouched photos of three soldering iron tips of exact make and model!

Although this tip has been constantly resurfaced, it is now at the end of its useful life, having made only 7,500 soldered joints using a standard tin/lead alloy.

This tip has been used for making 1,000 soldered joints, using a standard tin/lead alloy.

This tip has been used for making more than 10,000 soldered joints with Ersin Multicore SAVBIT ALLOY. Note that it shows virtually no wear!

COMPARATIVE tests made on assembly lines of large and small electronics plants have proven that startling production efficiencies and economies are realized when the wear and erosion of copper soldering iron tips is curbed. These tests have been made with solders having pure tin/lead alloys, and the new Ersin Multicore *copper-loaded* SAVBIT ALLOY. As shown in the unretouched photographs above, the use of SAVBIT reduced tip wear by 90%! Equally as important . . . a higher standard of soldering quality is assured since the copper tip remains in excellent condition for a much longer period of time.

	Before Soldering	During Soldering	After Soldering
In soldering with straight tin/lead alloys . . .	Tin/Lead Solder — Copper Tip Solder contacted by copper tip . . .	Molten Tin/Lead/Copper — Copper Tip absorbs tip metal to saturation . . .	Tin/Lead/Copper Joint — Copper Tip and wears out tip rapidly!
Whereas . . . In soldering with new SAVBIT ALLOY . . .	Tin/Lead/Copper Solder — Copper Tip Copper-saturated SAVBIT solder . . .	Molten Tin/Lead/Copper — Copper Tip cannot borrow copper from the iron . . .	Tin/Lead/Copper Joint — Copper Tip which receives hardly any wear.

THIS EXPLAINS HOW SAVBIT ALLOY STOPS THE WEARING OUT OF COPPER TIPS

IMPORTANT

SAVBIT is one of a number of alloys developed for the Industry by Multicore. In addition to SAVBIT, Ersin Multicore, the world's finest cored solder, is also available in all the standard tin/lead alloys and diameters, in 1 lb. cartons and 7 lb. reels. Multicore contains 5 cores of exclusive, high speed, non-corrosive Ersin Flux. This great solder, so widely imitated, has never been equalled for speed of operation, effective prevention of rejects and, in the long run, lowest cost for superior results.

Available in 14, 16 and 18 gauge.

B.I.C. ENDORSED QUALITY

SAVBIT ALLOY has been impressively proven on the assembly line. We urge you to write for full information.

Multicore's SAVBIT ALLOY development is entirely new and different—and it is patented. As shown in the illustration above, SAVBIT ALLOY contains its own copper and therefore will not take the copper of the soldering iron tip into the molten solution during soldering. This absorption of copper when any standard alloy is used, is a basic reason for the wearing out of expensive copper tips, and the constant refinishing which adds to maintenance costs on the assembly line.

Like all Multicore Solders, SAVBIT contains five cores of non-corrosive Ersin Flux, providing thinner wall construction, which results in more rapid wetting of metals and increases the speed of the soldering operation. Of greater tensile and shear strength, the electrical conductivity of SAVBIT, like all Multicore alloys, is excellent.

Address U.S.A. inquiries on company letterhead to Dept. MA 168.

MULTICORE SALES CORPORATION
PORT WASHINGTON, N. Y.

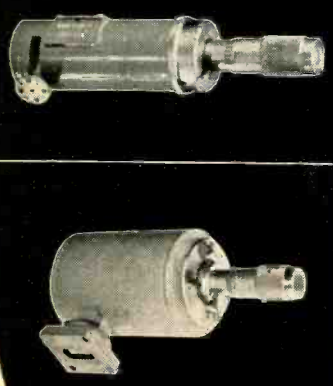
Canadian Inquiries:
Charles W. Pointon Ltd.
6 Alcina Ave., Toronto, Canada

Inquiries regarding other territories:
Multicore Solders Ltd.
Hemel Hempstead, Herts., England

CIRCLE 22 READERS SERVICE CARD

new D-B broad band precision cavity wavemeters

—*solve 3 measuring problems*



Fewer Instruments Needed. Each DE MORNAY-BONARDI instrument covers an unusually wide segment of the total range, and measures the entire frequency band within that range. Only eleven sizes serve from 2.6 KMC to 90 KMC. You save capital outlay on the number of sizes needed.

Extremely High Accuracy. These are high Q units, built with such precision that they may be used as secondary standards to calibrate all other laboratory cavities. Micrometer readings are plotted on a multi-page, high resolution calibration chart for maximum accuracy. DE MORNAY-BONARDI units are temperature compensated, and unaffected by changes in humidity or atmospheric pressure.

Sustained Accuracy. Sturdy, sealed construction, use of ball bearings, and inert gas pressurization assure permanence of calibration . . . Q values maintained for many years without service. Write for complete data.

SPECIFICATIONS

Temperature Range	−30°C. to +70°C.
Correction Factor	Temperature correction over range in the order of 10^{-6} f/deg.C.
Temperature Compensation	Bi-metallic mechanism
Constant Dielectric	Nitrogen – not affected by environment
Hermetic Waveguide Seal	Metal – glass – mica window
Tuning Plunger Seal	Bellows type
Spurious Mode Suppression	Thru use of Microllon absorbing material
High Resolution Micrometer	Resolves plunger travel into 0.0001".

REACTION* TYPE CAVITY WAVEMETERS

Calibrated Freq. Band KMC	Calibration Accuracy Min ± MC	Cat. No.
60-90	40	DBA-715-1
50-75	30	DBB-715-1
33-50	10	DBC-715-1
26.5-40	6	DBD-715-1
18-26.5	3	DBE-715-1
12.4-18	1.5	DBF-715-1
8.2-12.4	0.75	DBG-715-1
7.05-10	0.60	DBH-715-1
5.85-8.2	0.35	DBJ-715-1
3.95-5.85	0.15	DBK-715-1
2.6-3.95	0.075	DBL-715-1

**Note: Absorption and Transmission types also in stock*

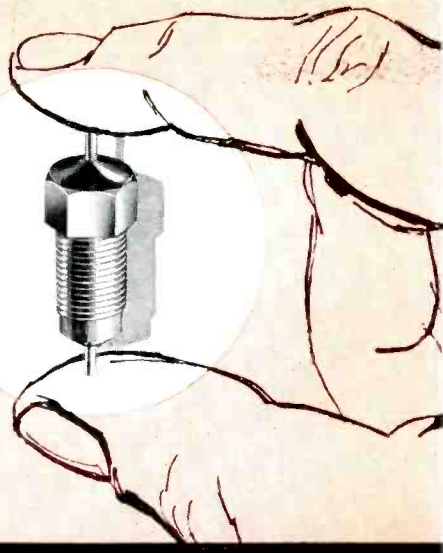
30-day deliveries on all sizes!

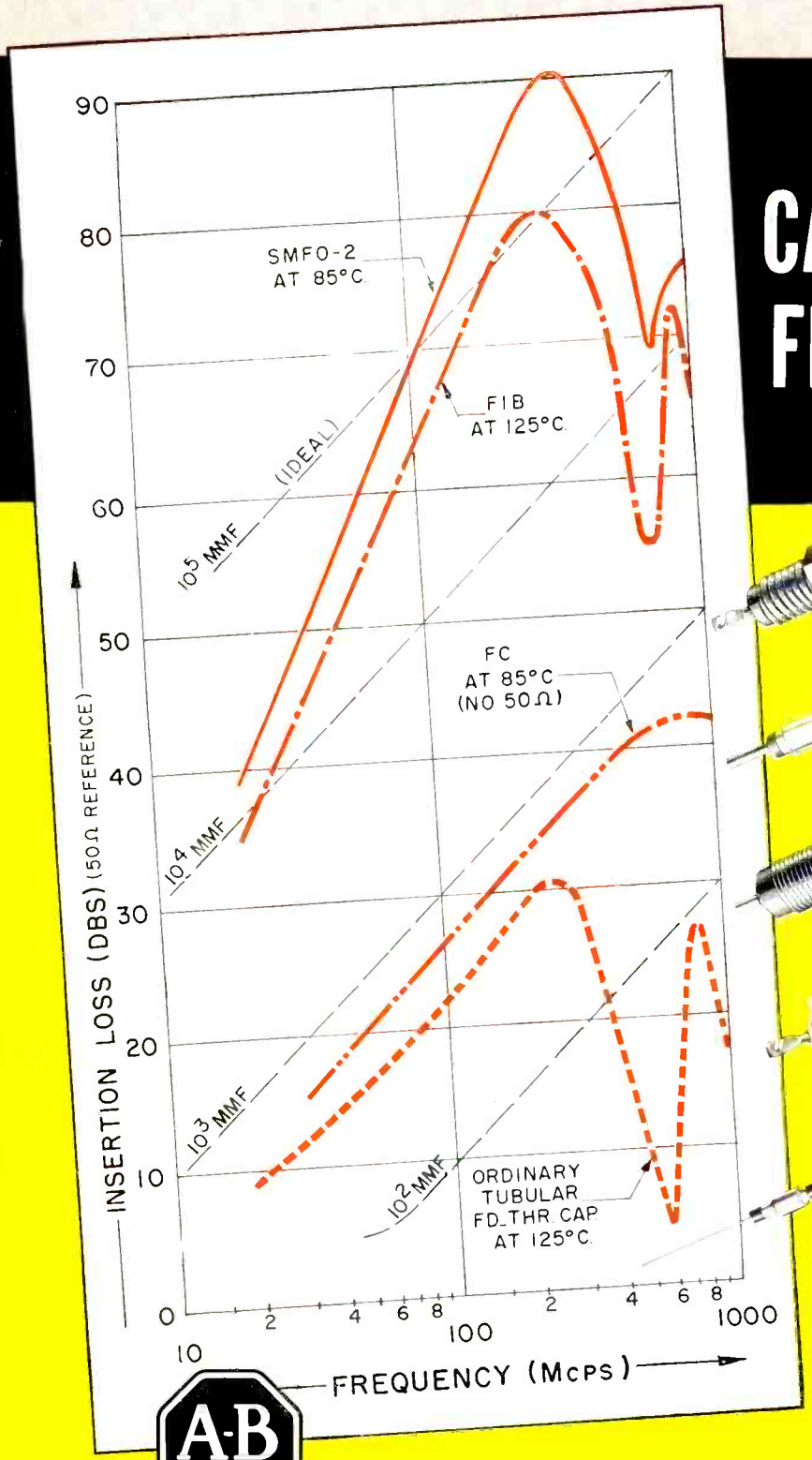
DE MORNAY BONARDI

DE MORNAY-BONARDI • 780 SOUTH ARROYO PARKWAY, PASADENA, CALIFORNIA

a new idea

in the elimination of high frequency radiation





ALLEN-BRADLEY

CASCADED CERAMIC FEED-THRU FILTERS

(PATENT PENDING)

TYPE **FIB**

TYPE **FIS**

TYPE **FCD**

TYPE **FC**

TYPE **SMFO**
(FULL SIZE)

NOW . . . out of the Allen-Bradley research laboratories comes a completely new and far more effective line of high frequency filter elements . . . especially designed to eliminate radiation from low power circuits operating in the frequency range from 50 mcs to 5000 mcs.

Employing an entirely different concept, these new filter elements have a phenomenal filtering efficiency . . . that actually *increases* tremendously with frequency, as illustrated in the graph at left.

These filter elements display none of the detrimental internal resonance characteristics of standard tubular capacitors . . . and cascading elements permit an increase in effective capacity far beyond that practical even with discoidal design.

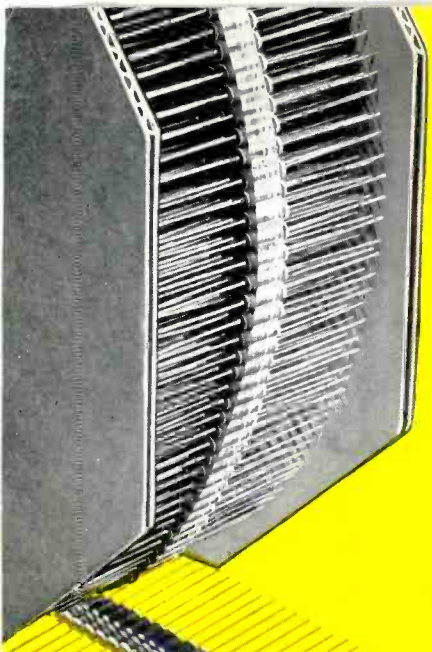
Filters are available in voltage ratings up to 500 v. DC at temperatures up to 125°C. Max. RF current is 0.25 amp. and max. DC or low frequency current is 5 amp.

Technical information available upon request.

ALLEN-BRADLEY
ELECTRONIC COMPONENTS

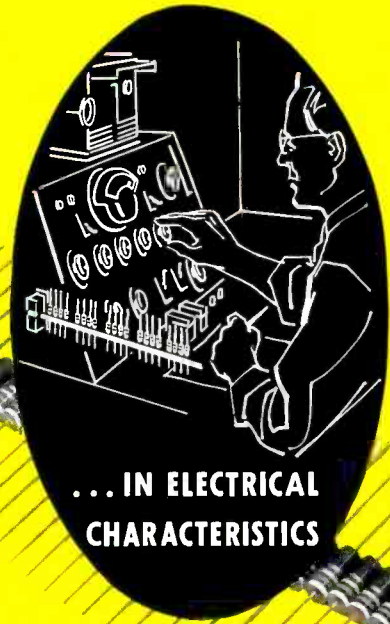
1-58-E

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

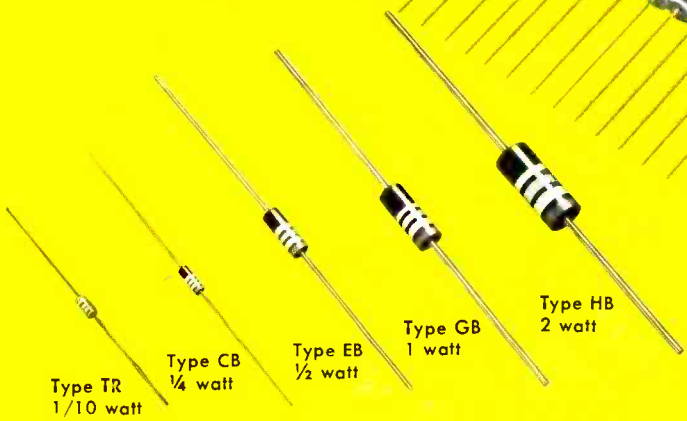


Allen-Bradley Hot Molded Composition Resistors—

INCREDIBLY UNIFORM!



Among electronic engineers, Allen-Bradley *hot* molded resistors have won a reputation for unequalled uniformity. That's why they are the "industry standard" wherever component uniformity . . . electrical and mechanical . . . is especially critical. Through continuous sampling and testing, consistent quality—Allen-Bradley *quality*—is maintained. Conservative ratings and stable properties assure reliable performance at *all* times. A-B resistors are free from catastrophic failure. When you buy Allen-Bradley quality components—fixed and variable composition resistors, ceramic capacitors, and ferrite parts, you assure yourself of fewer "rejections" on final test. These Allen-Bradley components are not always the lowest priced, but—they are *always* the best! Write for technical information, today.



ALLEN-BRADLEY

ELECTRONIC COMPONENTS

QUALITY

1-58 E

Allen-Bradley Co.
222 W. Greenfield Ave.
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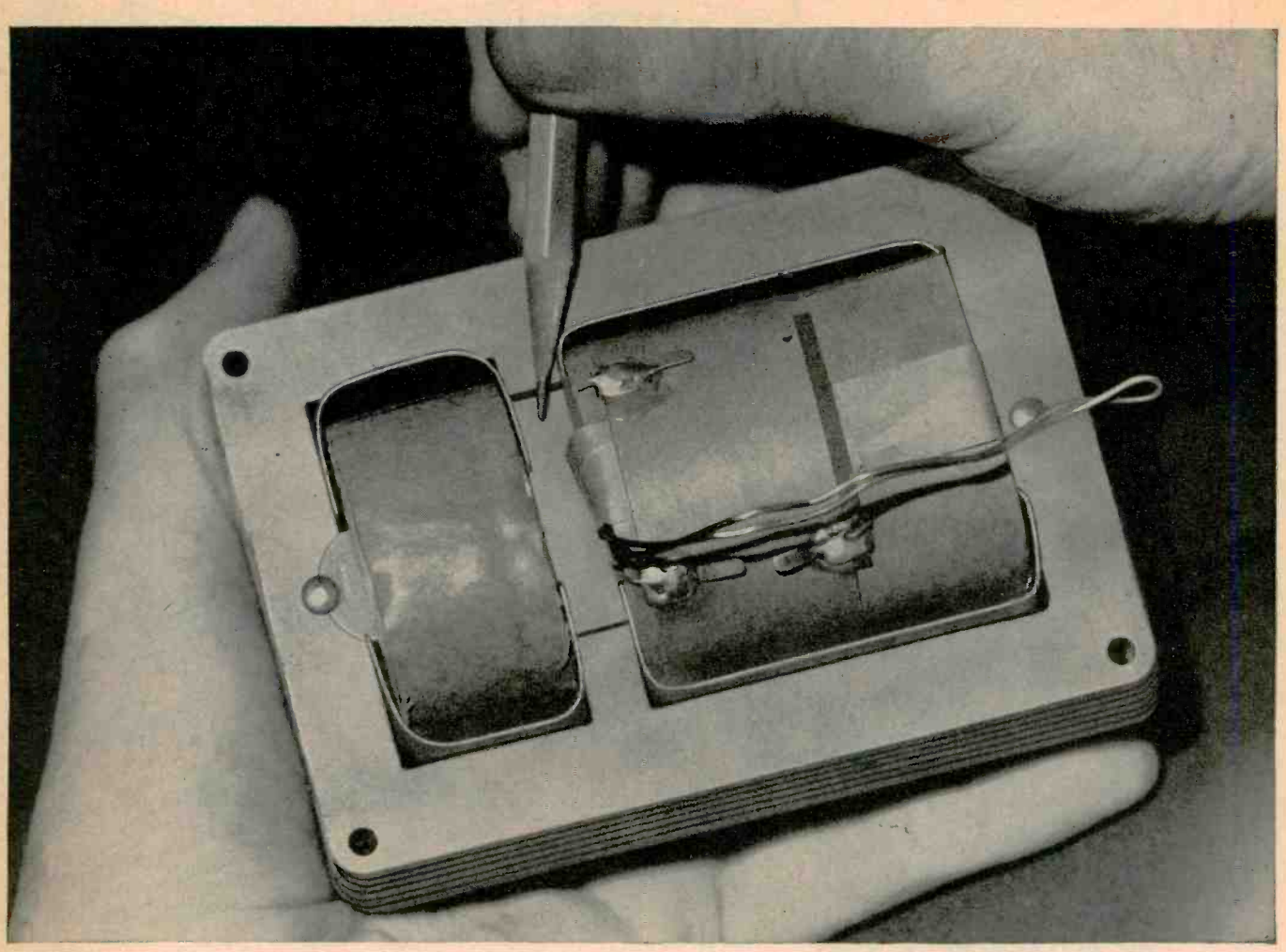


PHYSICAL ISOLATION OF INPUT AND OUTPUT CIRCUITS *of the Sola Constant Voltage Transformer is indicated in the core-and-coil assembly shown above. At pencil-point is one of two magnetic shunts which separate the input from the output sections of the windings.*

YOU GET VOLTAGE REGULATION AND MORE FROM A SOLA:

Isolation of Input and Output Circuits in Sola Constant Voltage Transformers Generally Eliminates Need for Static Shields

A fixed level of input voltage to today's complex electrical and electronic equipment is virtually essential for adequate performance. The Sola Constant Voltage Transformer, a static-magnetic stabilizer, combines automatic, instantaneous voltage regulation with other desirable electrical functions.

One of these functions is both electrical and physical isolation of the input circuit from the output circuit. In general, this isolation is sufficiently effective to eliminate the need for additional line filtering. Static shields, often required with regulators having a common connection between input and output circuits, are rarely necessary.

Sola Constant Voltage Transformers are available in stock models, or in custom designs to meet the exact requirements of many load devices or service conditions. Your Sola representative will be happy to provide you with information on your particular application.

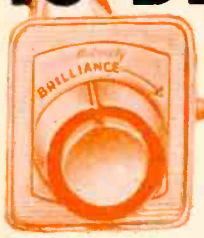
SOLA *Constant Voltage* **TRANSFORMERS**

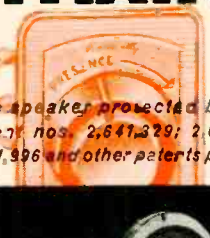
Write for Bulletin.. 7A-CV170D
SOLA ELECTRIC CO.
4633 W. 16th Street
Chicago 50, Illinois

CONSTANT VOLTAGE TRANSFORMERS • LIGHTING TRANSFORMERS • CONSTANT VOLTAGE DC POWER SUPPLIES
SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • BRANCH OFFICES: Boston, Mass.; Cleveland, Ohio; Kansas City, Mo.; Los Angeles, Calif.; New York, N. Y.; Philadelphia, Pa.; San Francisco, Calif.; Wallingford, Conn. • *Representatives in Other Principal Cities*
Sola Electric (Canada) Ltd., Toronto 17, Ontario: 102 Laird Drive, Mayfair 4554

Indisputably the Finest!

UNIVERSITY'S NEW 315-C 3-WAY 15" DIFFAXIAL

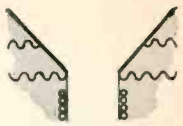




This speaker protected by U. S. Patent nos. 2,641,329; 2,690,231; 2,751,996 and other patents pending.

THESE ARE THE REASONS WHY

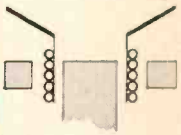
Exclusive self-stabilized woofer cone structure and dual spider construction ensure lifetime centering of moving system, for all extreme excursions.



University-controlled processing of imported cone pulps results in consistently uniform, distortion-free response.

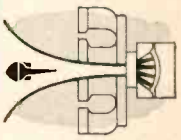
Exclusive, massive flux-contoured 6 pound Gold Dot Alnico 5 magnet provices efficient power drive for deepest low frequencies, free of transient distortion.

Extra-long voice coil ensures purity of maximum low frequency energy conversion during periods of extreme cone excursion.



Exclusive University-formulated long polymer lattice permeates rim suspension for effective acousto-mechanical rim damping.

True through-axial construction permits balanced tweeter, mid-range and woofer acoustic integration without design compromise.

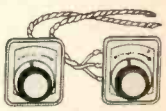


Exclusive hypersonic tweeter incorporating radial phasing equalizer automatically balances all high frequencies for smooth, realistic reproduction.

Exclusive "reciprocating-flare" horn now has wave front equalizer for more uniform wide-angle treble coverage.

Exclusive multi-sectional Diffusicone provides controlled diffraction for linear mid-range response and dispersion.

Continuously variable dual control network integrates and blends mid-range and tweeter for concert realism regardless of room acoustics.



Response: 25 cps to inaudibility; Power capacity: 50 watts, integrated program; Total magnet wt.: 6½ lbs. Alnico 5; Impedance: 8-16 ohms; Depth: 12"; User net: $156.00.

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Once upon a time, business moved at a slower pace, and people and things were sort of tidily pigeonholed. So many companies were wedded to a single product, a modest plant, simple processing, comfortable competition, family ownership and one-man rule.

Once upon a time, you could be a specialist in a particular part of a particular business, live within narrow walls, and everything was just dandy. No longer! Today, job isolation is stagnation. Companies, products, industries, have cross-bred like crazy. Anybody's business is everybody's business. Being "an expert" is always essential in depth, lacks much in breadth.

Look ahead, read ahead, get ahead. Open up this magazine, and start reading as you never have before. In the past, your eye instinctively has spotted the pages concerned with you and your job, and you've read this material and used it. Now, take the next big step. Read the stories involving other job functions, other men's brand of problems in your field. Get on speaking acquaintance with all the phases and facets of your business — what one McGraw-Hill publisher so aptly calls "Cross-Communication."

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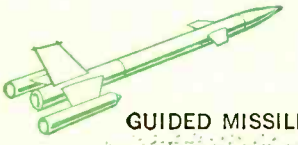
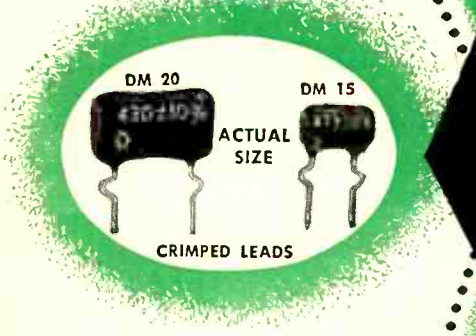
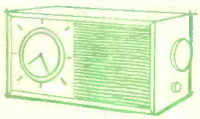
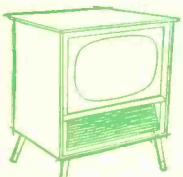


GUIDED MISSILES

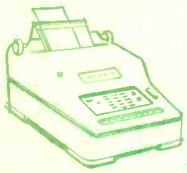




RADIO



TELEVISION



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Wherever your specifications call for long-lived *miniaturized reservoirs*, El-Menco Dur-Mica Capacitors offer **PRE-PROVEN LIFE EXPECTANCY OF UP TO 20 YEARS.** These mighty midgets carry mammoth loads for lasting peak performance . . . guarantee you confident, worry-free planning.

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Extra-rough phenolic casings prolong life, increase stability over wide temperature range.

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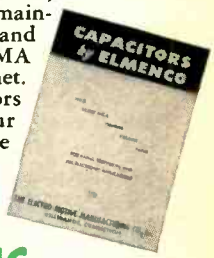
Simple 'hairpin' design facilitates use in tight spots in television, radio, computers, miniature printed circuits, guided missiles, hearing aids and countless civilian and military applications, with little or no replacement and maintenance cost. All environmental and electrical requirements of RETMA and MIL C-5 specs have been met. Test El-Menco Dur-Mica Capacitors for yourself with our help. Our engineering staff is at your service upon request.



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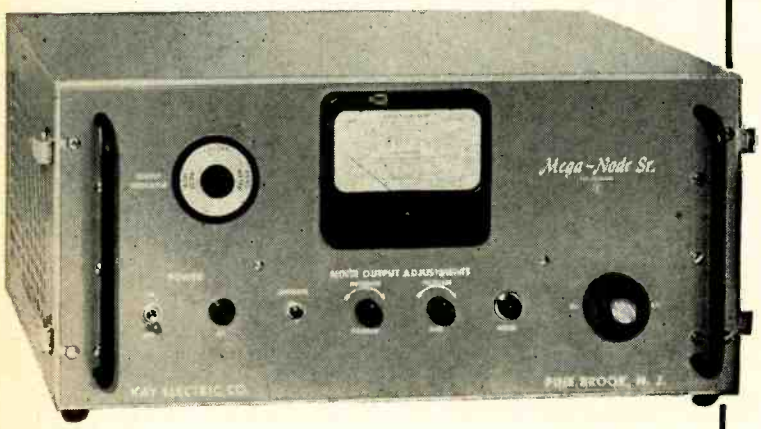
KAY

Noise Figure Measurement 10-3,000 mc



KAY *Mega-Node Sr.*

- **Absolutely no modulation on noise output**
- **Built-in stability**
- **Longer life on noise diode**
- **Ease of operation due to front panel design**
- **All power supplies regulated**

A calibrated random noise source providing an output from 10-3,000 mc, the Mega-Node Sr. may be used to measure noise figure and receiver gain and for the indirect calibration of standard signal sources.

At the lower end of the frequency, range noise figure may be obtained directly from the meter. For greater accuracy at higher frequencies, corrections for diode transit time and termination mismatch are available from charts supplied with each instrument.

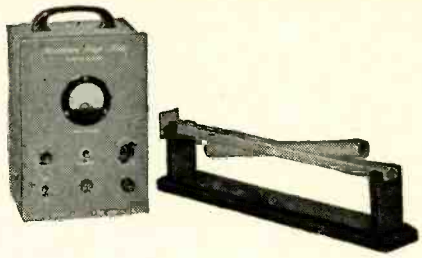
SPECIFICATIONS

Frequency Range: 10 mc to 3,000 mc.
Output Impedance: 50 ohms unbalanced into Type N Connector.
Noise Figure Range: 0 to 20 db.
Filament Voltage Supply: From regulated supply.
Meter Calibration: Logarithmic in db noise figure; linear in D.C.M.A.
Fuse Protection: One Type 3AG, 2 amps.
Tubes: 1 Eclipse Pioneer TT1 Diode.
Power Supply Source: 117 Volts ± 10% 60 cps a.c. Available for 50 cps on special order.
Power Consumption: 200 Watts.

Price: $790.00, f.o.b. factory.

Write for Kay Catalog

KAY ELECTRIC COMPANY
Maple Avenue Pine Brook, N. J.
Dept. E-1 *CAldwell 6-4000*



KAY *Microwave Mega-Nodes*

Calibrated random noise sources in the microwave range, used to measure noise figure, and receiver gain and calibrate standard signal sources in radar and other microwave systems. Available in following waveguide sizes to cover range of 1,120-26,500 mc.

‡RG-69/U	$595	RG-50/U	$195†
RG-69/U	$400	RG-51/U	$195†
‡RG-104/U	$495	RG-52/U	$195†
‡RG-112/U	$495	§RG-91/U	$250
RG-48/U	$195†	§RG-53/U	$250
RG-49/U	$195†		

Available with fluorescent or argon gas tubes. Noise output fluorescent tubes, 15.8 db ±0.25 db; argon tubes, 15.28 db ±0.1 db*.

Universal Power Supply for both fluorescent and argon gas tubes in all waveguide sizes: $100.

* Noise output of argon gas tubes independent of operating temperature.
‡ Fluorescent only § Argon only
† $167 per guide when 3 or more are ordered with $100 power supply

KAY *Mega-Node* 175-A

Noise Figure Range: 0-19 db; Frequency Range: 50-900 mc. Output Impedance: Balanced, 300 ohms; Price: $325.00, f.o.b. factory.

KAY *Mega-Node* 403-A

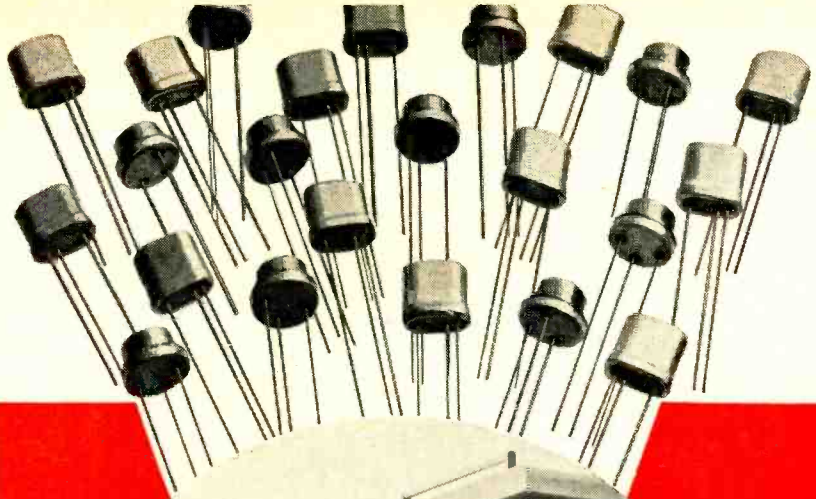
Noise Figure Range: 0-19 db; Frequency Range: 3-500 mc. Output Impedance: Unbalanced, 50 ohms into type N connector; Price: $325.00, f.o.b. factory.

KAY *Mega-Node* 240-A

Calibrated random noise source reading direct in db, for measurement of noise figure, receiver gain and for indirect calibration of standard signal sources. Frequency Range: 5 to 220 mc. Output Impedances: Unbalanced—50, 75, 150, 300, Infinity; balanced—100, 150, 300, 600, Infinity. Noise Figure Range: 0-16 db at 50 ohms; 0-23.8 db at 300 ohms. Price: $325.00, f.o.b. factory.

KAY *Rada-Node*

Complete radar noise figure measuring set for IF and RF, including attenuators, detector and noise sources. Complete with power supplies. Frequency Range: 5 to 26,500 mc. Noise Figure Range: Up to 23.8 db. in lower part of spectrum. Prices on request.



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"We use them by the bucketful" . . . these are the words of Remington Rand engineers at the Univac Division of Sperry Rand Corporation. They refer to the General Transistor products used in Univac® File-Computers. Three prime portions of the system are completely transistorized . . . the adapters for the 80-column and 90-column punching units and the General Storage for the Model O File-Computer . . . with GT transistors.

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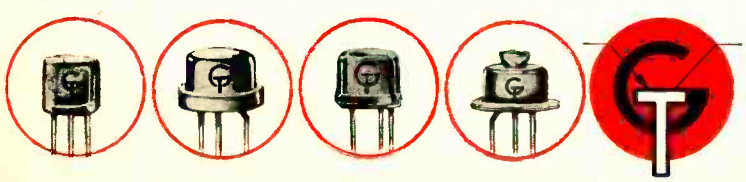
This is just one more example of why General Transistor is the fastest growing name in transistors.



For immediate delivery from stock, contact your nearest authorized General Transistor Distributor or General Transistor Distributing Corp., 95-27 Sutphin Blvd., Jamaica 35, New York

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GENERAL TRANSISTOR

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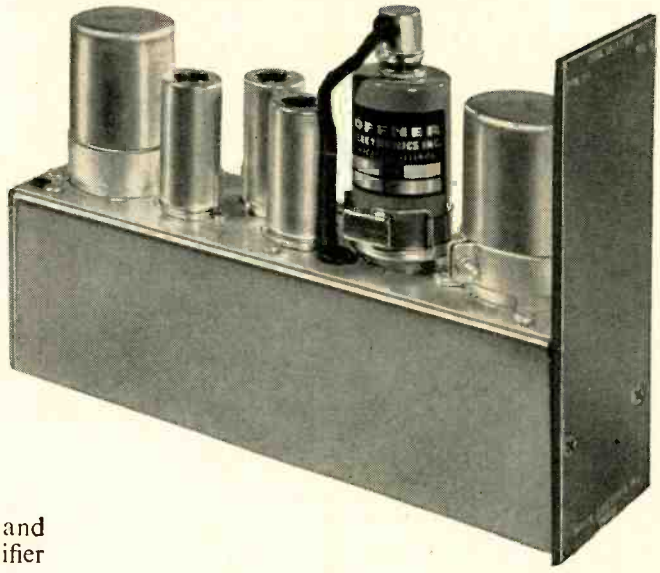
THE OFFNER TYPE 190

DIFFERENTIAL DATA AMPLIFIER



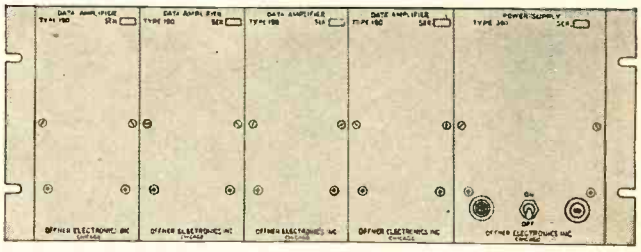
d-c Amplifier with zero drift and 1/100th percent gain stability

For amplification of thermocouple, strain gage, and similar low level signals the Type 190 Data Amplifier provides a combination of features available in no other amplifier:

- ☆ **Infinite rejection of common-mode d-c signals**
- ☆ **One microvolt input resolution**
- ☆ **Gain stability of 0.01%**
- ☆ **Rapid step input response**
- ☆ **Linearity of 0.05%**

The true differential response of the Type 190 provides increased accuracy and simplified installation for data reduction, control, and similar applications. With infinite rejection of common d-c signals, and a rejection ratio at 60 cps of the order of a half million, errors due to ground currents are completely eliminated, and pickup problems greatly diminished.

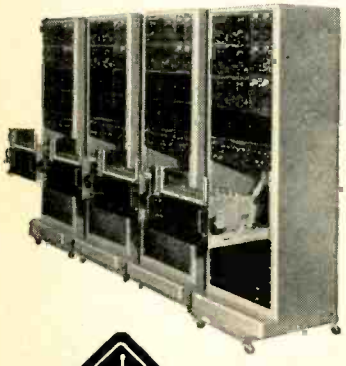
The Type 190 is designed for fixed-gain operation from low impedance sources, into high impedance load. Gain may be set at values ranging from 160 to 1200. Amplifier characteristics are unchanged at ambients from −67°F to +170°F.



Four Type 190 Amplifiers mounted in BM190 modular rack unit with Type 390 power supply.

Price of Type 190 Amplifier.....$325
Type 390 Power Supply, for up to four Type 190 Amplifiers.....$250
Type BM190 Rack Unit for four Type 190 Amplifiers and Type 390 Power Supply.....$140

Ask for bulletin No. 572 giving full technical information



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Zero-drift d-c recorder with microvolt sensitivity.
One amplifier type covers all requirements.
Models for one to 19 channels.
Rectilinear or curvilinear recording.

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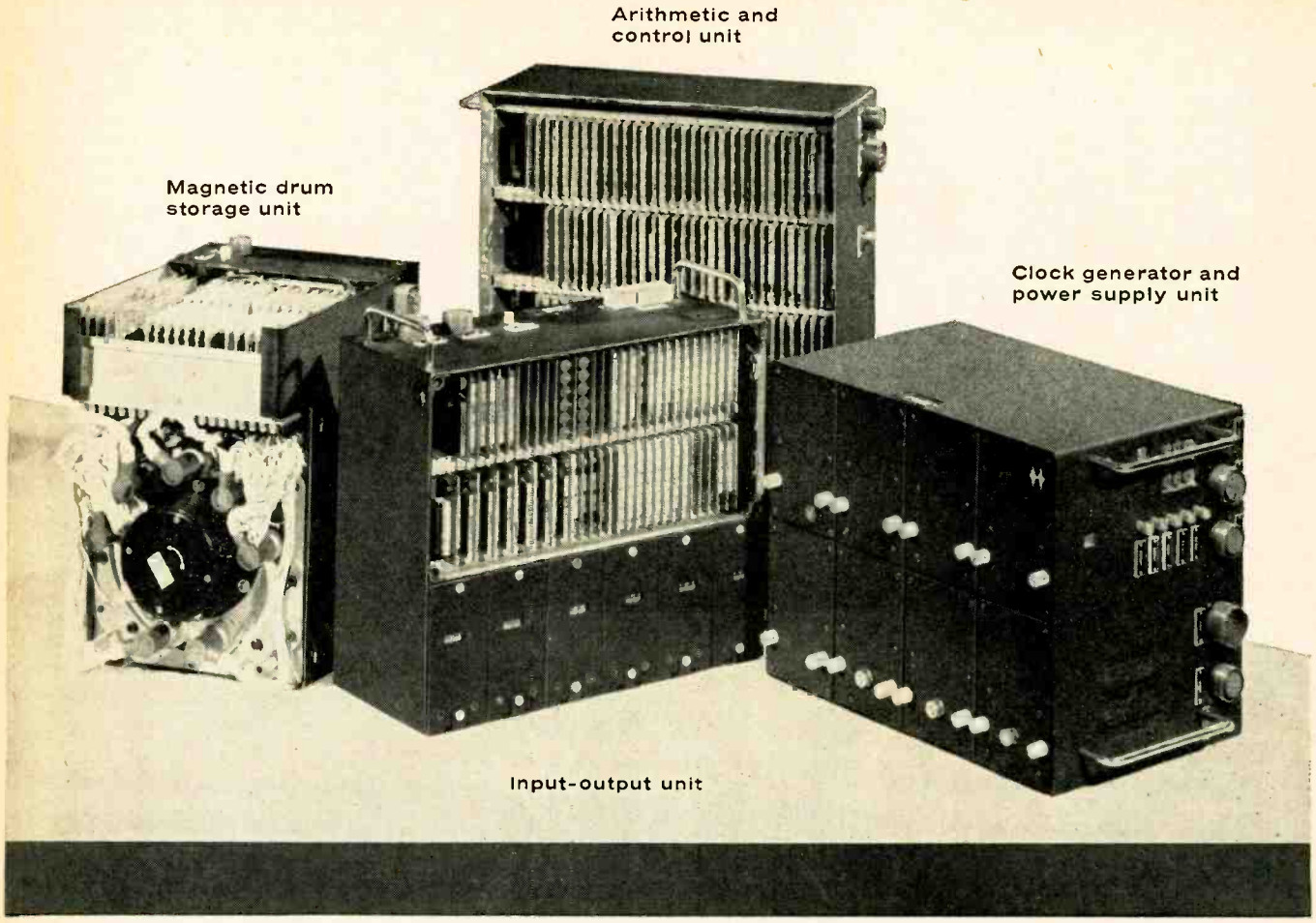

The Importance of **DIGITAL TECHNIQUES**

Digital techniques constitute one of the important developments which have made possible the recent advances in computers and related equipment for computation, data processing, and industrial and military electronic control.

Digital computers for scientific computation range from small specialized units costing a few thousand dollars, to large general-purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit is being installed early this year.

Electronic data processing for business and industry is rapidly growing based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. A closely related field is that of industrial process control. To meet the needs in this field, Ramo-Wooldridge has recently put on the market the RW-300 Digital Control Computer.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows the RW-30 Airborne Digital Computer.

The RW-30 is an example of what can be accomplished through the application of digital techniques in conjunction with modern semiconductor components. It performs complete mathematical operations, including multiplications, at the rate of 4000 per second (as fast as large scientific computers). Yet it occupies only 4.19 cubic feet, weighs 203 pounds and uses 400 watts power. It is packaged in four separate units to facilitate installation in aircraft. The magnetic drum memory has a capacity of 2607 21-bit words.

The versatility inherent in digital techniques makes it possible for the RW-30 to handle such varied military aircraft problems as navigation, armament control and bombing, and combinations of these problems, without changes in the RW-30 itself.

The RW-30 also serves to illustrate the balanced integration of systems analysis and product engineering which is a principal objective at Ramo-Wooldridge. Similar programs are in progress on other airborne and electronic control systems, communication and navigation systems, and electronic instrumentation and test equipment. Engineers and scientists are invited to explore openings in these fields at Ramo-Wooldridge.

The Ramo-Wooldridge Corporation

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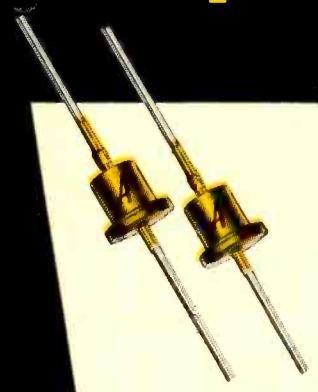
important news for AIR FORCE contractors...

AUTOMATIC silicon rectifiers designed to meet the NEW USAF specification MIL-E-1/1089



PIGTAIL TYPES*

1N538 (USAF)
1N540 (USAF)
1N547 (USAF)

* Do not confuse these USAF types with commercial types having the same numbers.

AVAILABLE FOR IMMEDIATE DELIVERY
IN LARGE SCALE PRODUCTION QUANTITIES

General Instrument's semiconductor manufacturing skill assures contractors fast delivery of these special new pigtail type silicon rectifiers now covered by this Air Force specification. AUTOMATIC's outstanding group of USAF type silicon rectifiers meets and often exceeds the rigorous MIL-E-1/1089 (USAF) specification – And expanded facilities permit us to deliver them in quantity at prices that reflect volume production.

AUTOMATIC MANUFACTURING DIVISION also offers the industry's most complete line of silicon rectifiers for an extensive range of applications including types for magnetic amplifiers, power supplies, D.C. blocking and germanium replacement, as well as types for general purpose use.

Would you like a set of our engineering data sheets? Please write us today!

Maximum Values for AUTOMATIC Military Type Silicon Rectifiers meeting MIL-E-1/1089 (USAF) Specification

Type No.	Peak Reverse Voltage (VDC)	DC Output Current @ 25° C. Ambient (MA)	DC Output Current @ 150° C. Ambient (MA)	Maximum Reverse Current* (MA)	Mounting	MIL-E-1 Technical Spec. Sheet No.
1N538 (USAF)	200	750	250	0.350	Pigtail	1089a
1N540 (USAF)	400	750	250	0.350	Pigtail	1089b
1N547 (USAF)	600	750	250	0.350	Pigtail	1089c

*Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current at 150° C. ambients.

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precision wave analyzers frequency-selective voltmeters

Sierra 121A Wave Analyzer

Sierra now offers exactly the instruments you need for wave analysis, wire carrier and microwave subcarrier applications.

Sierra 121A Wave Analyzer is a highly selective, double superheterodyne receiver covering frequencies from 15 KC to 500 KC and providing wave analysis data directly in voltage and dbm at 600 ohms. The instrument offers the selectivity required for use with new single sideband carrier systems.

Sierra 158A Wave Analyzer is similar but covers frequencies from 500 KC to 10 MC.

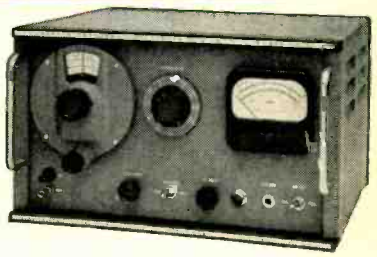
Both analyzers have high selectivity, accuracy of ± 2 db, spurious response at least 50 db down, and a signal-measurement range of 77.5 μv to 97.5 volts. The instruments are supplied in cabinet mountings which are readily adaptable to relay rack mounting.

SPECIFICATIONS — SIERRA VOLTMETERS

Model	Frequency Range—kc	Selectivity		Accuracy		Direct Reading in dbm	
		Down 3db	Down 45db	Frequency	Measuring	Balanced	Unbalanced
101C	20-500	± 550 cps	± 2900 cps	Note A	± 3 db	Note D	600 ohms
103B†	3- 40	± 400 cps	± 3000 cps	± 0.5 kc	± 3 db	Note D	600 ohms
104A	5-150	± 300 cps	± 1500 cps	± 1 kc	± 3 db	Note D	600 ohms
108B	15-500	± 550 cps	± 2900 cps	± 3 kc Note B	± 2 db Note C	135 ohms Note D	600 ohms
114A	100-800	± 550 cps	± 2900 cps	Note A	± 3 db	Note D	600 ohms

All Sierra Carrier Frequency Voltmeters feature built-in calibration oscillators and circuits for level calibration, have aural monitoring jacks, and (except 103B) are furnished with Sierra Model 149A Precision Spiral Scale Dials.

† Contains carrier re-insertion oscillator for monitoring suppressed carrier systems. Furnished with planetary drive dial. Note A. Ranges from ± 2 KC at low end of dial to ± 3 KC at upper end. Note B. ± 1 KC in the 48 KC to 256 KC region. Note C. ± 1 db for + 30 db to — 40 db attenuator steps on 135 ohm balanced measurements. Note D. All models may be converted for 135 and 600 ohm balanced line measurements by convenient plug-in bridging transformer, Model 130D.



Sierra 101C Carrier Frequency Voltmeter

For carrier system and other field or laboratory work between 3 kc and 800 kc, Sierra offers 5 accurate, stable, tuned vacuum tube voltmeters. All are direct reading in voltage and dbm at 600 ohms from —80 dbm to +42 dbm.

Line Bridging Transformer

Model 130D Dual Impedance Line Bridging Transformer converts VTVM and wave analyzer inputs from single-ended to balanced operation. Covers 3 kc to 500 kc, bridges both 135 and 600 ohm balanced lines.

Impedance Meter, Line Fault Analyzer

Sierra 166 Impedance Meter (at left) measures impedance on high noise circuits, 30 kc to 300 kc; measures on "hot" lines through coupling capacitor.

Sierra 124 Line Fault Analyzer pinpoints shorts, opens or grounds on open wire lines. Direct reading, range ½ to 200 miles, accuracy ¼ mile.

Data subject to change without notice.

sierra

4084

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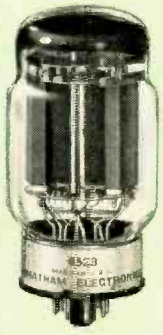
THYRATRONS—An extensive line of thyratrons for use as grid control rectifiers, relays and noise generators. Inverse voltage ranges from 100 to 5,000 volts. Sizes from subminiatures to ST 16 bulbs. Filamentary as well as hot and cold cathode types are available.

RECTIFIERS—Both vacuum and gas filled tubes with peak inverse voltage ratings from 200 to 15,000 volts. Included are tubes with special features such as fast warm-up, cold cathodes, clipper service ratings and rugged construction.

VOLTAGE REGULATOR AND REFERENCE TUBES—Gas filled tubes designed to specific voltages for regulating small currents. Also used to make available stable reference voltages for high current supplies. Sizes from subminiatures to bantams, including many reliable, ruggedized types.



TWIN POWER TRIODES—The most complete line of high current twin power triodes developed especially for regulated power supply usage. Current and power ranges up to 800 milliamperes and 60 watts respectively. Included are rugged types in both low and medium mu construction.

TELEPHONE TYPES — A highly specialized line of vacuum and gas filled types in both the 300 and 400 series.

Chatham research and development has produced many new tube types that have become industry standards. If you have a special purpose tube problem, Chatham experience can help you find the solution.

HYDROGEN THYRATRONS—Used primarily as switching tubes in line type radar modulators, these tubes permit accurate control of high energy pulses. Sizes from miniatures to the VC 1257. Peak pulse power ranges from 10 kilowatts to 33 megawatts.

CHATHAM ELECTRONICS Division of **TUNG-SOL ELECTRIC INC.**

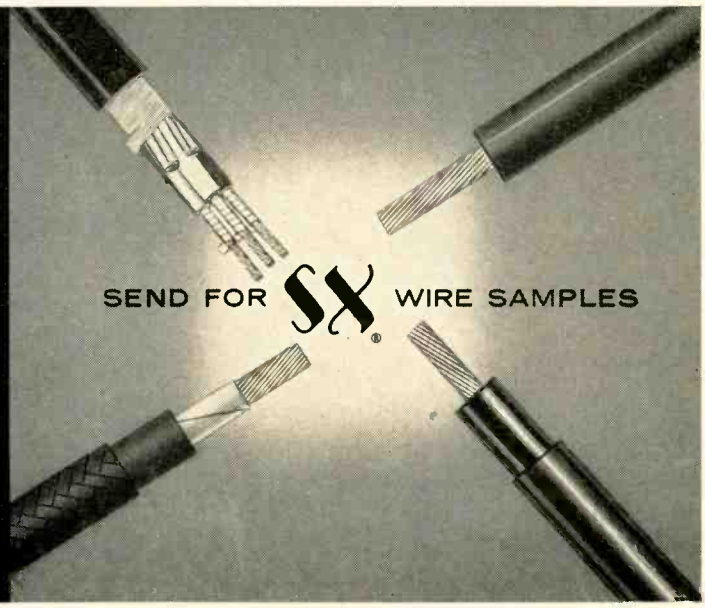
General Office and Plant: Livingston, New Jersey

SALES OFFICES: CHICAGO, DALLAS, LIVINGSTON, LOS ANGELES

ESSEX ENGINEERED

WIRE and CABLE

Motor Industry
Automotive
Appliances
Communications
Electronic
Radio & Television
Oil Burner
Neon Sign



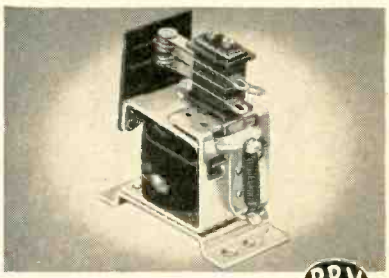
...laboratory-developed to meet the unique requirements of your specific application!

The Essex "Extra Test®" approach to the development of quality wire products has gained the confidence of engineers in every industry where electrical wire products are a factor! The full line of lead, appliance, automotive and refrigeration wires . . . plus submersible pump cable and 200° C. Sil-X® insulations are outstanding examples of the versatility of "Essex Engineering." Thorough engineering, from conductor to covering, has made available a wire of type and size with vital properties that assure you outstanding performance.

Unusual wire or cable specifications need not trouble today's engineer. By investigating the complete line of SX Wires and Cables, most wiring requirements can be quickly met by one or more of the Essex "Standards"; thus hastening delivery, affecting far greater economies, and guaranteeing an Essex Engineered "Industry Proven" product.

*EE

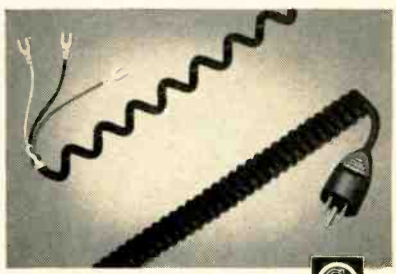
other outstanding
***ESSEX ENGINEERED**
production proven products



GENERAL PURPOSE RELAYS RBM®

A.C. or D.C. General Purpose Multipole relays. For circuit switching of electrical interlocking remote control devices. Features special cross-bar contacts for low-voltage, low current circuits or button type contacts for power switching circuits. Request Bulletin No. 1060.

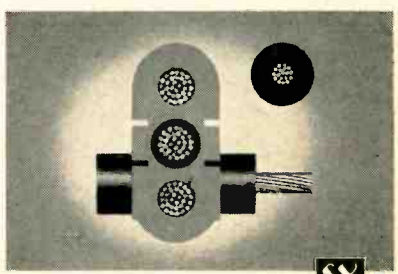
R-B-M "Control" Division
Logansport, Indiana



COILED CORDS ®

Coiled Cords automatically synchronize with moving components that are electrically powered. There are no looping, tangling cords in the way . . . because Coiled Cords extend and retract as needed. Complete line of cord sets and power supply cords. Write for new literature.

Cords Limited Division
DeKalb, Illinois



REFRIGERATION WIRES SX ®

The complete line of "Essex Engineered" internal, lighting circuit, heater and lead wire . . . plus flexible conduit, power supply cords and thermostat cables, are approved by UL and CSA.

Wire and Cable Division
Fort Wayne, Indiana

SX WIRE PRODUCTS ®

WIRE and CABLE DIVISION

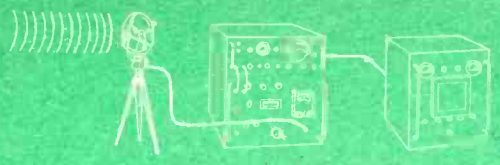
ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

SX ESSEX WIRE CORPORATION

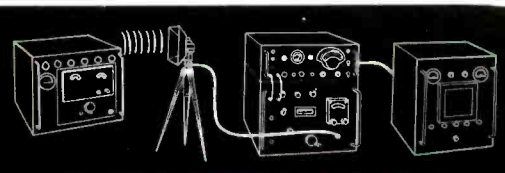
CIRCLE 40 READERS SERVICE CARD

CIRCLE 41 READERS SERVICE CARD →



FIELD INTENSITY MEASUREMENTS

Absolute measurements of field intensity are possible with the Model FIM field intensity receiver system. An incoming signal, received by the calibrated antenna, is matched against the signal of an internal calibration signal source to determine absolute power. The instrument is completely shielded to prevent stray signal pickup.

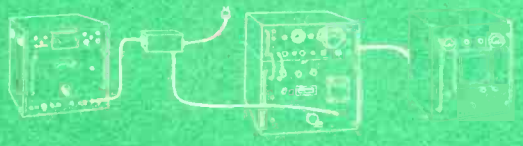


RADIATED INTERFERENCE MEASUREMENTS

Over the frequency range 1000 to 10,000 mc, interference radiated from any electronic equipment can be determined and examined to meet the requirements of commercial or military specifications.

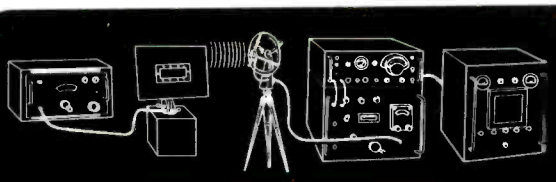
Broadband Measurement—Direct indication by peak reading slide-back V.T.V.M. and by quasi-peak meter function.

CW Measurement—Average indication of unmodulated carrier; average or peak indication of modulated carrier.



CONDUCTED INTERFERENCE MEASUREMENT

The Model FIM receiver system can be used to determine radio interference voltages operating on external power conductors, or other external system connections, by connecting the monitor unit to a line stabilization network. Both broadband and CW interference signal levels may be measured as described in "Radiated Interference Measurements" (above).



ANTENNA PATTERN MEASUREMENTS

Because of the sensitivity of the FIM receiver system, transmitter and receiver antennas can be separated by distances great enough to avoid phase errors. Minor lobes can be carefully investigated. The automatic frequency control allows the use of a relatively unstable signal source. Preselection eliminates errors that may be caused by the presence of harmonics of the signal or spurious signals.

SENSITIVE R-F VOLTMETER AND POWER METER

The Model FIM receiver system will measure carrier levels from 10 micro-microwatts to 2 watts. A multi-position coaxial step attenuator is provided to switch ranges quickly, and the effective noise bandwidth is constant for the full r-f range of the instrument. UNI-DIAL single knob tuning permits quick frequency scanning.

CALIBRATED MICROWAVE FIELD INTENSITY RECEIVER SYSTEM

absolute measurements— radiation, interference and leakage 1,000 to 10,000 mc

The new Polarad Model FIM is the only instrument approved Class A MIL SPEC. MIL-I-006181C for performing radiation leakage measurements in the range 1,000 to 10,000 mc. It is a complete system including a monitor unit, 4 interchangeable tuning units covering the range 1,000 to 10,000 mc, a separate power supply, a series of antennas to match the frequency range of each tuning unit and one broadband omnidirectional antenna. The monitor unit provides meter, video, audio and recorder outputs. The power supply provides regulation of plate and filament voltages.

MODEL FIM SYSTEM
BASIC MONITOR UNIT—FIM-B
POWER UNIT—FIM-P
TUNING UNITS (interchangeable)

*FIM-L	1,000 to 2,240 mc
*FIM-S	2,140 to 4,340 mc
*FIM-M	4,200 to 7,740 mc
*FIM-X	7,360 to 10,000 mc

*U. S. PATENT NO. 2,774,243

Contact Polarad or your nearest Polarad representative for complete details.

POLARAD ELECTRONICS CORPORATION

43-20 34th Street, Long Island City 1, N. Y.

REPRESENTATIVES: Abington, Albany, Atlanta, Baltimore, Boeing Field, Chicago, Cleveland, Dayton, Denver, Detroit, Englewood, Fort Worth, Kansas City, Los Angeles, Orlando, Portland, Rochester, St. Louis, Stamford, Sunnyvale, Syracuse, Washington, D.C., Westbury, Westwood, Wichita, Winston-Salem, Canada: Arnprior, Ontario. Resident Representatives in Principal Foreign Cities.

ULTRA-BROADBAND

MICROWAVE SIGNAL GENERATOR

MSG-34

one continuous control frequency

4,200-11,000 mc

Replaces 2 or more present day signal generators normally required to cover C and X bands

The new Polarad MSG-34 outperforms all existing signal generators both in frequency coverage and ease of operation. In all respects, it is the most efficient and economical instrument to generate frequencies between 4,200 and 11,000 mc at a high power level.

By means of a unique design utilizing Polarad's exclusive UNI-DIAL control, Ultra-Broadband Frequency Coverage has been achieved in one completely integrated unit. Attenuator index is automatically set throughout the entire band after calibration, thus avoiding possible error when making accurate measurements rapidly. Frequency is read directly from a 4 foot linear dial that is easy to read.

Some unusual features:

Calibrated output: 1 milliwatt

Internal pulse modulations

.2 to 10 u sec. pulse width
10 to 10,000 prf
2 to 2,000 u sec. delay

Pulse rise and decay time 0.1 u sec.

Attenuator index independent of power set

Long life non-contacting choke in oscillator

Provision for external modulation, sine wave, pulse or multiple pulse.

POLARAD
PROVEN RELIABILITY

SPECIFICATIONS:

Frequency Range:
4,200 mc to 11,000 mc

Frequency Accuracy: ± 1%

Power Output:
1 milliwatt (0 dbm) calibrated

Attenuator Output Range:
0 dbm to—127 dbm, 0.223 volts to 0.1 microvolt, (directly calibrated).

Attenuator Output Accuracy: ± 2 db from 0 to — 127 dbm

Output Impedance:
50 ohms nominal.

Output VSWR: 2:1 maximum

Internal Pulse Modulation:
Width: 0.2 to 10 microseconds.
Repetition Rate: 10 to 10,000 pps
Delay: 2 to 2,000 microseconds.
Sync: internal, external-pulse or sine wave.
Rise Time: 0.1 microsecond as measured between 10% and 90% of maximum amplitude of the initial rise.
Decay Time: 0.1 microsecond as measured between 10% and 90% of maximum amplitude of the final decay.

Internal Square Wave:
Rate: 10 to 10,000 pps.
Symmetry: ± 5%
Sync: Internal

Internal FM:
Type: Linear sawtooth.
Frequency Deviation: 5 mc minimum.
Rate: 10 to 10,000 cps.
Synchronization: Internal or external, pulse or sine wave.

External Pulse Modulation:
Polarity: Positive or negative.
Rate: 10 to 10,000 pps.
Pulse Width: 0.2 to 100 microseconds.
Amplitude: 10 to 40 volts peak.

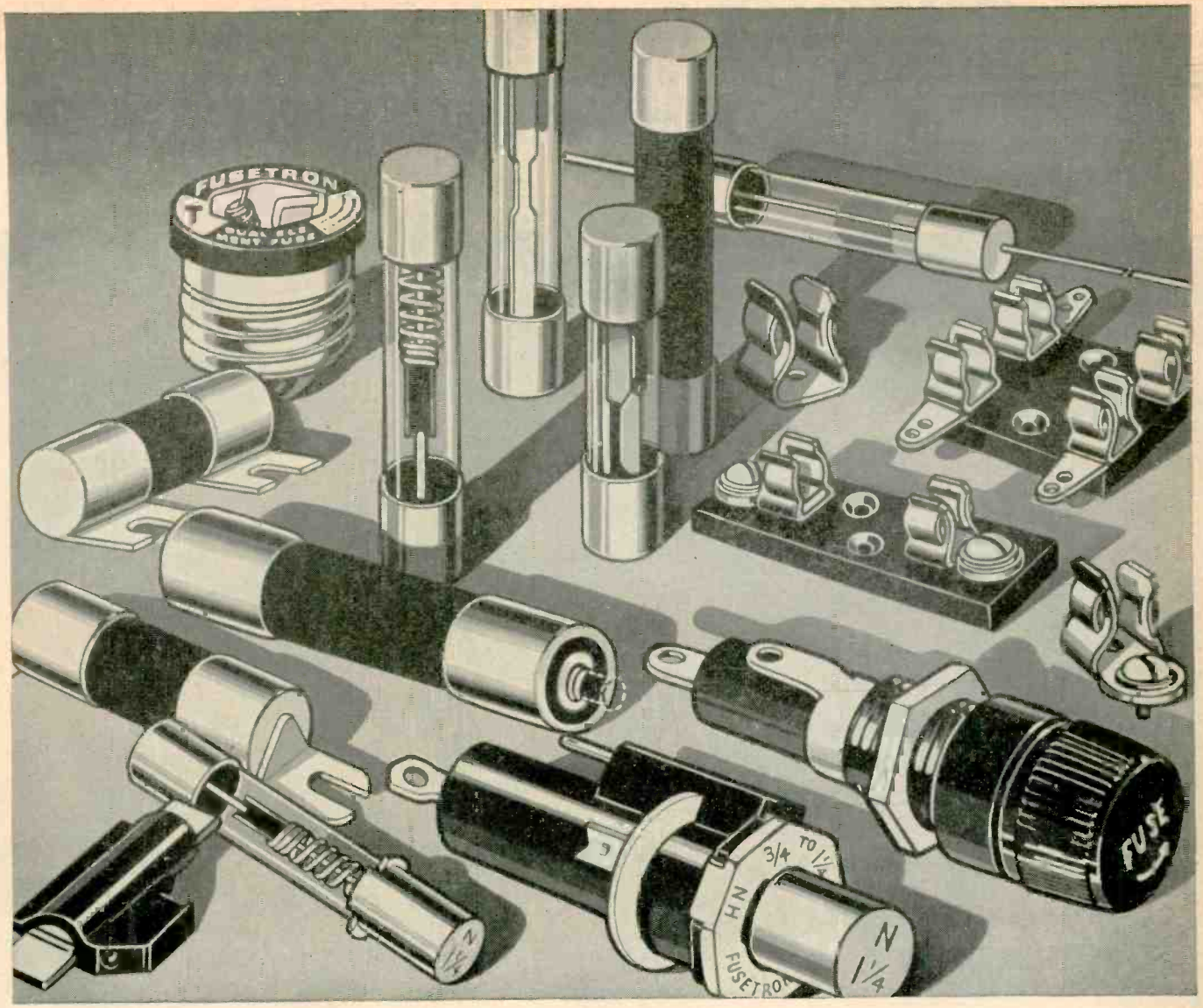
Output Synchronization Pulses:
Polarity: Positive, delayed and undelayed
Rate: 10 to 10,000 pps.
Amplitude: 15 volts peak minimum.
Rise Time: Less than 0.25 microsecond.

External Sync:
Type of Input: Positive, negative, or sine wave.
Amplitude: Pulse: 5 to 50 volts peak;
Sine wave: 5 to 40 volts rms.

POLARAD ELECTRONICS CORPORATION

43-20 34th Street, Long Island City 1, N. Y.

REPRESENTATIVES: Abington, Albany, Atlanta, Baltimore, Boeing Field, Chicago, Cleveland, Dayton, Denver, Detroit, Englewood, Fort Worth, Kansas City, Los Angeles, Portland, Rochester, St. Louis, Stamford, Sunnyvale, Syracuse, Washington, D. C., Westbury, Westwood, Wichita, Winston-Salem, Canada: Arnprior, Ontario. Resident Representatives in Principal Foreign Cities.



You can rely on BUSS FUSES to operate as intended.

Here's why— With BUSS fuses, dependable electrical protection isn't left to chance. BUSS fuses are tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

The result,—BUSS fuses provide maximum protection against damage due to electrical faults. And just as important, they eliminate useless shutdowns caused by faulty fuses blowing needlessly.

With a complete line of fuses available, it is just good business to standardize on BUSS. The "trouble-free" operation of BUSS fuses helps to assure that your product will operate as intended . . . thus, BUSS fuses help to maintain the reputation of your product for quality and service.

If you have an unusual or difficult protection problem, let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse already available in local wholesalers' stocks, so that your device can be easily serviced.

For more information on BUSS and Fusetron small dimension fuses and fuseholders . . . Write for Bulletin SFB, Bussman Mfg. Division, McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect – not to blow, needlessly

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

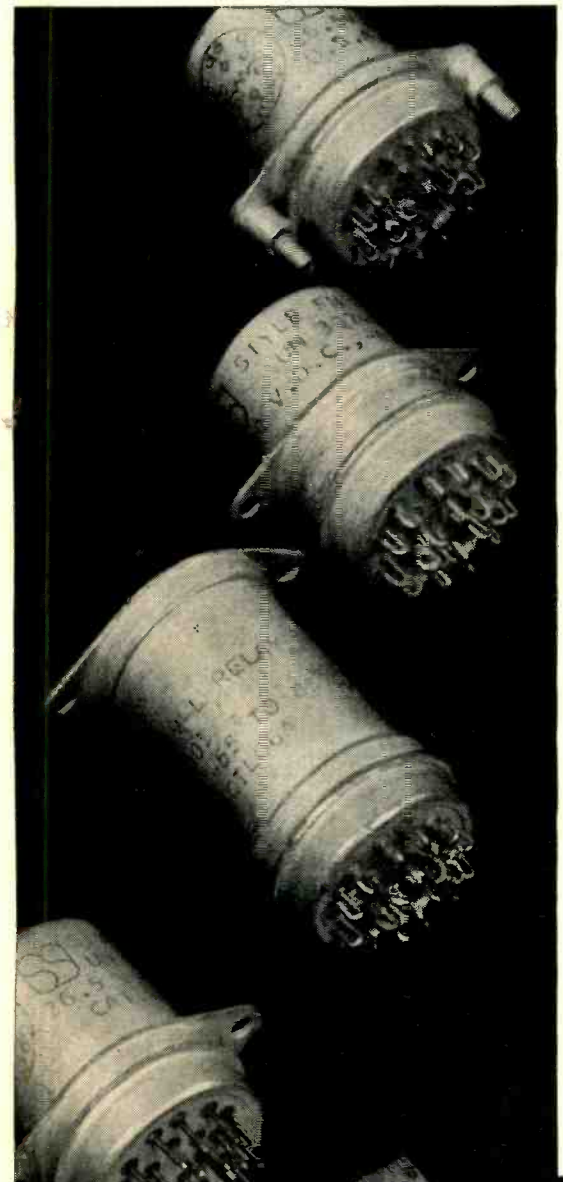
Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

158

UNION family of high-quality for dependable performance

Typical group of UNION High-Quality Miniature Relays. Special manufacturing techniques are used to provide quality relays in large quantities. Ultrasonic and jet abrasive cleaning provide clean material. Unique baking and evacuation processes guard against gassing in the relay.

Miniature Relays is designed in guided missile environments



Do YOU NEED A RELAY to operate with unusual reliability under severe conditions of temperature, shock, and vibration? Or one that functions on extremely low "dry-circuitry" loads? For AC or DC circuits? Or special applications? You can find almost any miniature relay you need in the UNION line.

UNION Miniature Relays were originally developed for use in airborne and guided missile electronic equipment and meet or exceed the requirements of MIL-R-25018, MIL-R-6106C and MIL-R-5757C. Their reliability and small size have led to their use in many industrial applications such as traffic control systems, computers, resistance welders and other electronic equipment.

Look over the many types of UNION Miniature Relays available, as shown here, and write for our Bulletin 1012 containing complete information.

Outstanding Features

1. Superior Contacts Standard HI-LO contacts permit high loads and low loads to be handled at the same time in one relay. Dry-circuit contacts are available when utmost reliability is desired for low-level, dry-circuit loads.

2. Coil Resistances Available in standard case from .9 to 8750 ohms and in long case from 1.6 to 13,600 ohms.

3. Temperature Rating Class "A" —55°C to +85°C; Class "B" —65°C to +125°C.

4. AC or DC Models Nominal operating voltages from 1.5 to 160 volts DC; 115 volts, 60 to 400 C.P.S., AC. AC relays incorporate built-in rectifiers and have same reliability as DC relays.

5. Types and Mountings All relays available in 6PDT or 4PDT models, plug-in or solder-lug connections, and all the usual mountings.

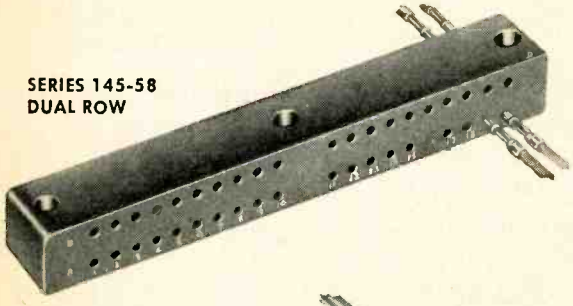
6. Special Relays *Slow-acting relays* for applications requiring a differential between operate time of various relays; *Plate-circuit relays* which operate on less than 8 milliamperes; *Double-coil relays* with each coil enabling operation of the relay . . . available on special order.

UNION SWITCH & SIGNAL

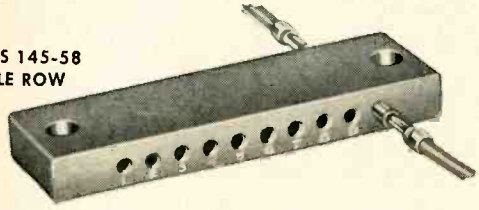
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

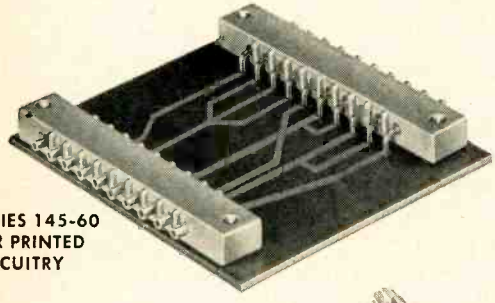
Continental Connector
TAPER PIN TERMINAL BLOCKS



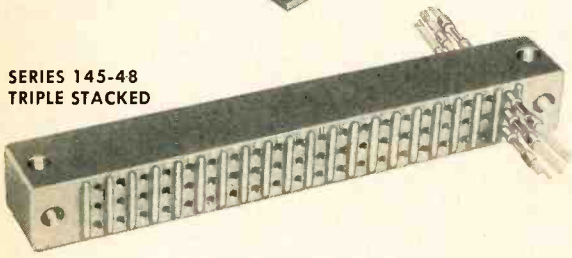
SERIES 145-58
DUAL ROW



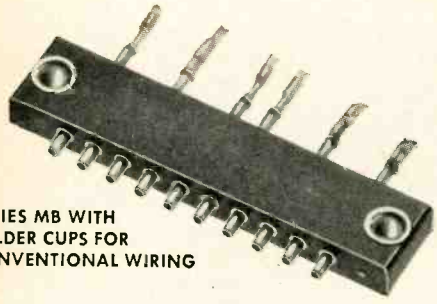
SERIES 145-58
SINGLE ROW



SERIES 145-60
FOR PRINTED
CIRCUITRY



SERIES 145-48
TRIPLE STACKED



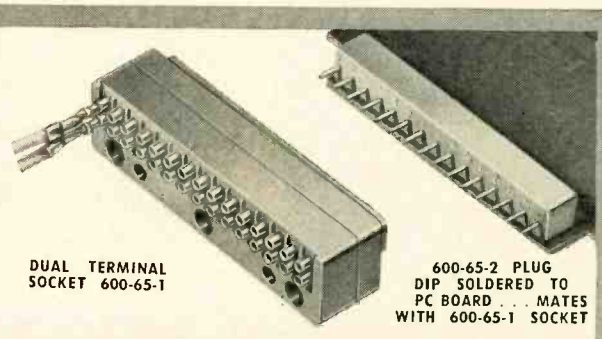
SERIES MB WITH
SOLDER CUPS FOR
CONVENTIONAL WIRING

for computer applications

MACHINE TAPERED FOR PRECISION ... MOLDED IN FOR RUGGEDNESS

Here is an improved terminal block design with permanently molded-in and precision reamed taper pin receptacles for maximum durability. These receptacles maintain secure electrical and physical contact with AMP Series "53" solderless taper pin. The body is molded of high impact, glass reinforced Alkyd 446 (MIL-P-14E, Type MA160). Other molding materials on request. Taper receptacles are brass, gold plated over silver for low contact resistance.

Continental Connector can supply all types of taper pin blocks and connectors for conventional wiring and printed circuitry in any combination of feed-through shorting or non-shorting terminals. Our engineering department is prepared to cooperate in solving your connector application problems. Write today for technical information.



DUAL TERMINAL SOCKET 600-65-1

600-65-2 PLUG DIP SOLDERED TO PC BOARD . . . MATES WITH 600-65-1 SOCKET

DUAL TERMINAL CONNECTOR FOR SOLDERLESS WIRING 15 contact . . . series 600-65

Developed primarily for COMPUTER APPLICATIONS requiring dual solderless wiring leads for each single contact. The right angle plug is dip soldered to the printed circuit board and mated with the dual terminal socket. Socket terminals are precision machine tapered for AMP "53" solderless wiring. Contact rating 20 millivolt drop maximum at 7.5 amps. Connector rating 500 volts RMS.

Manufactured by Continental Connector Corporation, Woodside 77, N. Y.

You're always sure with **DeJUR** electronic components

Exclusive Sales Agent
DeJUR-Amsco Corporation
45-01 Northern Boulevard
Long Island City 1, N. Y.

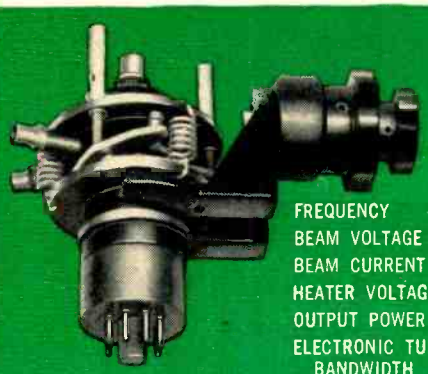
CIRCLE 45 READERS SERVICE CARD

CIRCLE 46 READERS SERVICE CARD

SPERRY 2K SERIES KLYSTRONS COVER

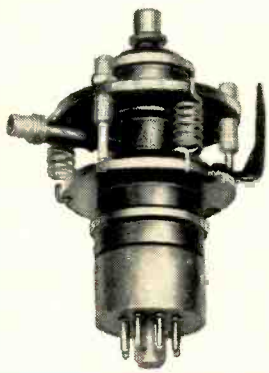
Continuous frequency range from 2660 to 10,300 mc

In wide use in the laboratory and on the production line



2K41 OPERATING SPECIFICATIONS

FREQUENCY	2,660 to 3,310 mc
BEAM VOLTAGE	300 to 1,250 v
BEAM CURRENT	15 to 60 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	0.02 to 2.75 w
ELECTRONIC TUNING BANDWIDTH	5 to 17 mc

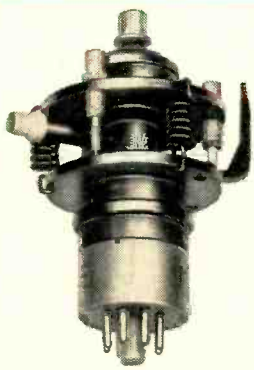


2K42 OPERATING SPECIFICATIONS

FREQUENCY	3,300 to 4,200 mc
BEAM VOLTAGE	300 to 1,250 v
BEAM CURRENT	6 to 50 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	30 to 1,450 mw
ELECTRONIC TUNING BANDWIDTH	15 to 30 mc

2K43 OPERATING SPECIFICATIONS

FREQUENCY	4,200 to 5,700 mc
BEAM VOLTAGE	500 to 1,250 v
BEAM CURRENT	12 to 50 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	0.25 to 1.25 w
ELECTRONIC TUNING BANDWIDTH	25 to 50 mc



2K44 OPERATING SPECIFICATIONS

FREQUENCY	5,700 to 7,500 mc
BEAM VOLTAGE	500 to 1,250 v
BEAM CURRENT	14 to 54 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	50 to 1,025 mw
ELECTRONIC TUNING BANDWIDTH	10 to 70 mc

2K39 OPERATING SPECIFICATIONS

FREQUENCY	7,500 to 10,300 mc
BEAM VOLTAGE	500 to 1,250 v
BEAM CURRENT	12 to 35 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	0.25 to 1 w
ELECTRONIC TUNING BANDWIDTH	20 to 40 mc

2K25 OPERATING SPECIFICATIONS

FREQUENCY	8,500 to 9,660 mc
BEAM VOLTAGE	300 v
BEAM CURRENT	32 ma
HEATER VOLTAGE	6.3 v
OUTPUT POWER	3 to 20 mw
ELECTRONIC TUNING BANDWIDTH	25 to 115 mc

Sperry is currently producing, for immediate delivery, a wide range of Series 2K Reflex Oscillator Klystron Tubes.

Especially suited for use in laboratory test equipment, as signal generators and bench oscillators, the 2K tubes are also used in production line testing and in radar equipment. Design features include integral cavity and tuner, convenient modulation, simple single-screw tuning and extra-rugged construction for long service life.

• Write or phone the nearest Sperry district office for more details on these and other Sperry Klystrons.

ELECTRONIC TUBE DIVISION

SPERRY GYROSCOPE COMPANY

Great Neck, New York

DIVISION OF SPERRY RAND CORPORATION

BROOKLYN · CLEVELAND · NEW ORLEANS · LOS ANGELES
SAN FRANCISCO · SEATTLE · IN CANADA: SPERRY GYROSCOPE COMPANY OF CANADA, LTD., MONTREAL, QUEBEC.

ESSEX® *has all the* MAGNET WIRE TYPES!

ENAMEL . . . Class A 105° C

An oleo-resinous enamel, used primarily in ignition coils, relays, small transformers, radio and electronic coils and similar applications.

FORMVAR . . . Class A 105° C

A film composed of polyvinyl formal resins with good electrical and chemical qualities and exceptional adhesion, flexibility, toughness and abrasion resistance properties.

Self-Bonding FORMVAR . . . Class A 105° C BONDEX

A Formvar insulation with a "bonding" film added. All the desirable Formvar characteristics are retained plus the "self-bonding" of the coil wound wires.

NYLON . . . Class A 105° C

Comparable with Formvar, this polyamide insulation features self-fluxing properties; has an extremely smooth finish, and good electrical, chemical, and physical properties.

FORMVAR-NYLON Combinations . . . Class A 105° C NYFORM®

A Nylon film applied over a Formvar insulation gives these wires outstanding physical properties and is well suited to applications where pre-heating before dipping and baking is not practical.

SOLDERABLE FILMS . . . Class A 105° C SODEREX

These smooth red insulations with a modified isocyanate or polyurethane base have outstanding physical, chemical and electrical characteristics plus self-fluxing properties which permit hot solder connections without prior stripping.

ENAMEL . . . Class B 130° C (Isonel) THERMALEX

Constructed with a polyester, this insulation has a very long thermal age life and compares with Formvar in physical, chemical and electrical characteristics.

SILICONE . . . Class H 180° C

This insulation, constructed with a silicone base material and accommodating extreme temperature requirements, is modified with other materials, insuring its physical, chemical and electrical properties.

HERMETIC FILMS . . . Class B 125° C ACRYLEX

Based on acrylic resins, these insulations are excellent for hermetic applications. Their non-crazing, high cut-through, long heat age life and excellent solvent resistance indicate a bright future for hermetic applications.

TEXTILE INSULATIONS . . . Class A, Class B, Class H

Cotton, paper, fiber glass, nylon, silk or combinations of them, are applied over bare or film insulated magnet wires for various physical, chemical and electrical requirements.

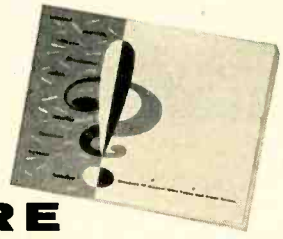
ROUND, SQUARE, RECTANGULAR

All types of the above wire, both bare, film insulated, and textile covered are available from Essex.

"Extra Test®" Insulations for every application!

Whatever your winding requirements, for prompt delivery of the exact wire and insulation . . . look to Essex! Essex "Extra Test" Magnet Wire is available in metal, fiber container (MAGNA-PAK)®, commercial reel or spool putups.

WRITE TODAY . . .
for new "Directory of Magnet Wire Types and Trade Names."



EXTRA TEST®

ESSEX MAGNET WIRE

DIVISION ESSEX WIRE CORPORATION, Fort Wayne 6, Indiana

MANUFACTURING PLANTS — Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Detroit, Michigan; Hillsdale, Michigan.

SALES OFFICES AND WAREHOUSES*

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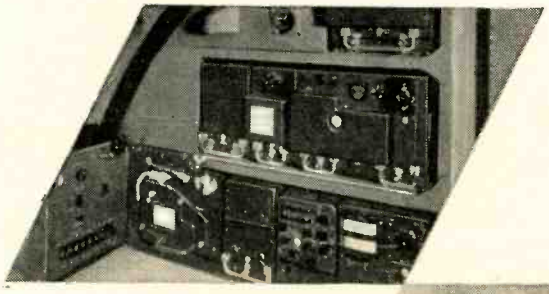

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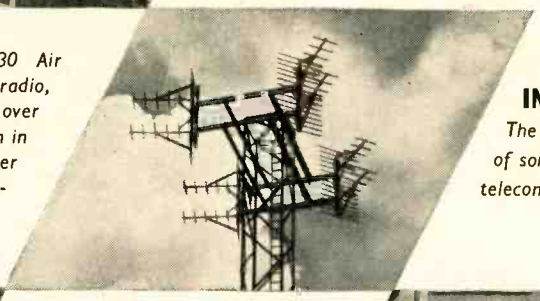

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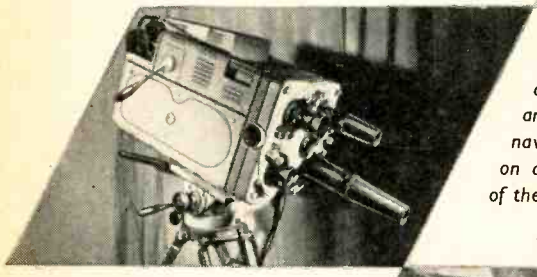

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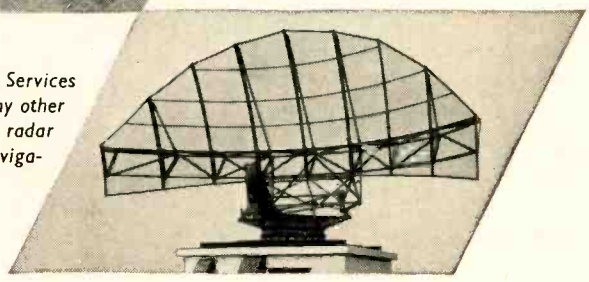

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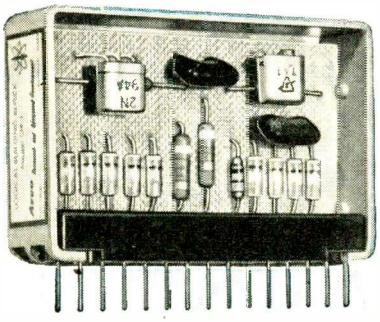

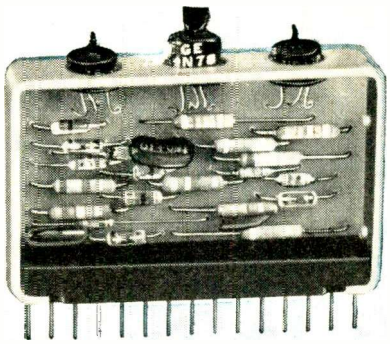

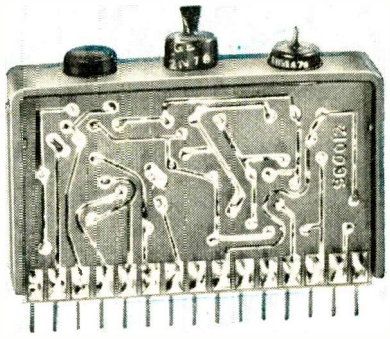

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- Gated Amplifier Element
- Complementer Amplifier Element
- Monostable Element
- And Gate Package
- Or Gate Package
- Emitter Follower Package
- And-Or Gate Package

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Silicon Unijunction Transistor

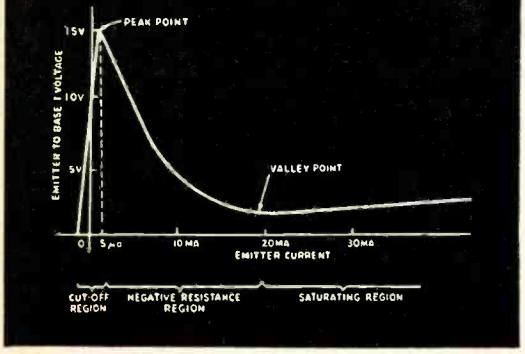
SPECIFICATIONS OF THE SIX SILICON UNIJUNCTION TYPES

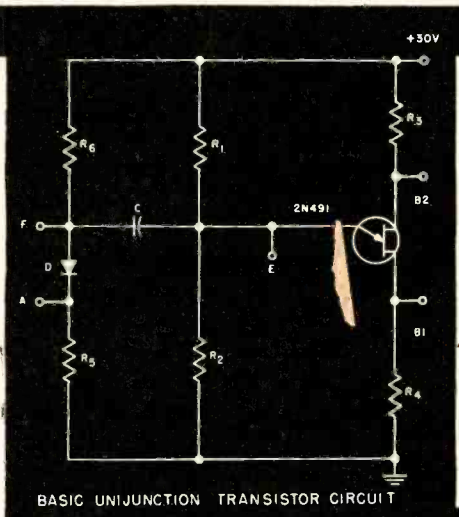
Absolute maximum ratings (25°C)

RMS power dissipation—stabilized	350 mw
RMS emitter current	50 ma
Peak emitter current	2 amps
Emitter reverse voltage	60 volts
Operating temperature range	—65°C to 150°C

Major electrical characteristics (nominal)

	2N489	490	491	492	493	494	
Interbase resistance at 25°C junction temp.	5.6	7.5	5.6	7.5	5.6	7.5	kΩ
Intrinsic standoff ratio.	.56	.56	.62	.62	.68	.68	
Modulated interbase current	12	12	12	12	12.	12	ma
Emitter reverse current							
(T_j=25°C)	.07	.07	.07	.07	.07	.07	μa
(T_j=150°C)	28	28	28	28	28	28	μa





BASIC UNIJUNCTION TRANSISTOR CIRCUIT

Circuit function	Components removed from basic circuit
Pulse generator	D, R2, R5, R6
Pulse amplifier	D, R4, R6
Multivibrator	R2, R4
One-shot multivibrator	R4
Flip-flop	C, D, R4, R5, R6
Sawtooth generator	D, R2, R4, R5, R6
Triangular wave generator	R2, R3, R4
Pulse rate modulator (1)	D, R1, R2, R4, R5, R6
Pulse rate modulator (2)	R2, R4, R5, R6
Time delay circuit	D, R2, R5, R6
Sensitive current detector	D, R1, R2, R4, R5, R6
Temperature indicator	D, R2, R4, R5, R6
Peak voltage detector	D, R1, R2, R5, R6

Unijunction transistor takes advantage of negative resistance to spark circuit savings

The new unijunction transistor has the useful property of negative resistance. Briefly, the current rises with the voltage input as usual, but only up to a certain peak, past which the current keeps on increasing though the voltage starts going down. This principle gives the unijunction two stable states—one "off" and the other "on"—so that it can be used to take the place of two conventional transistors (minus much other circuitry) in many switching and oscillator applications. A few of these applications making use of the unijunction's high peak current capabilities combined with high temperature rating and stability are shown above.

To put the unijunction to work for you, you'll want all the specs, plus application data with sample circuits. Please write for information. As you'll see, the unijunction is actually a new type of semiconductor, the first since the conventional transistor itself to reach commercial success.

G-E High-voltage Silicon Triodes

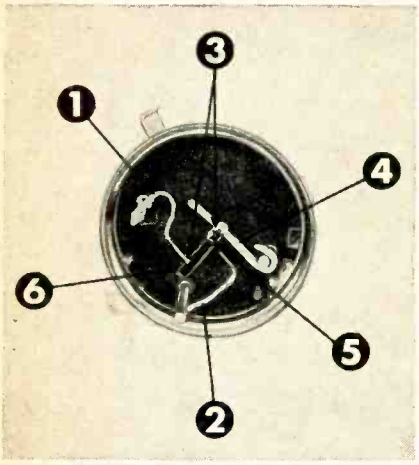


Photo shows top view of G-E silicon high-voltage transistor, with cap removed. 1. Gold emitter ribbon. 2. Aluminum base-lead ribbon. 3. Gold-silicon alloy. 4. Collector tab. 5. Base region. 6. NPN diffused meltback silicon bar. Cantilever design for shock resistance. Silicon bar is alloyed firmly to tab; ribbons are flexible to minimize constraints.

General Electric can now supply your needs for popular, industry-accepted high-voltage silicon transistors—types 2N332, 2N333 and 2N335. Every unit is aged at 200°C for more than 500 hours, and takes a drop test considered more rugged than the standard military 500 G shock test. That's why you can depend on ratings and performance characteristics shown. Rated at 45 volts (collector to base), these transistors are designed for amplifier use, both audio and RF, and general purpose switching. Among its many features are low output capacity, high cutoff frequency and low leakage. Full specs are available from your Semiconductor Sales representative or from the factory.

SPECIFICATIONS, Types 2N332, 2N333, 2N335

Absolute maximum ratings

Storage temperature	200°C
Operating temperature	—55°C to 175°C
Collector to base voltage	45 volts
Emitter to base voltage	1 volt
Collector current	25 ma
Power	
Collector dissipation (25°C)	150 mw
Collector dissipation (100°C)	100 mw
Collector dissipation (150°C)	50 mw

A section of the test area in G.E.'s Buffalo transistor plant. In the foreground is a humidity control box in which transistors are inspected prior to encapsulation.

Transistor Reliability

enhanced by spotless factory, stringent controls

The production section of G.E.'s Buffalo semiconductor plant resembles a medical research laboratory. Production workers are dressed in white; white walls and ceilings predominate. The entire plant is air conditioned and slightly pressurized so any dust will flow out instead of in when doors are opened. Water is super-purified and tested electronically, for chemical testing is not accurate enough. Alcohol used to dry transistors has to be so pure that a single drop of water in a barrel of it would ruin it.

These are just three of the manufacturing techniques that have their pay-off in reliability. They are supported by special quality control techniques using over $500,000 worth of test equipment, to help assure G-E transistors do not fail or permanently change parameters.

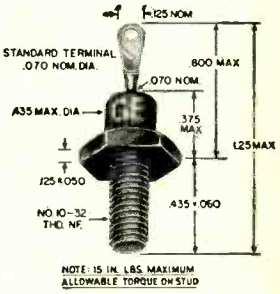
Military specifications call for dozens of rugged tests. But commercial and industrial transistors undergo most of them also, plus a few of their own. Here are some examples: Shock test: a transistor is mounted on a heavy metal block and dropped as much as 4 feet to a metal base. 20,000 G centrifuge test: transistors are spun about 36,000 rpm in various positions, then checked both mechanically and electrically. 15 minute temperature cycling test: transistors are frozen at −65°C and then immediately placed in an oven set at maximum temperature (up to 250°C). Vibration test: transistors are rattled at 40 to 100 cps for 96 hours. Salt spray test: corrosion and hermetic sealing properties are tested for periods ranging up to 12 days.

G-E Silicon Stud-mounted Rectifiers

If you're looking for greater current at higher temperatures, with no sacrifice of chassis space . . . this is just one of several advantages offered in G-E silicon low-current stud-mounted rectifiers. Other features include: • Ratings up to 170°C ambient • Low forward drop • Forward current up to 1.5 Amperes • Low leakage at high temperatures • Operating reliability assured under all conditions • May be mounted directly to heat sink using a tapped hole or a nut and lockwasher, or electrically insulated with mounting kit which is supplied with each unit.

RATINGS AND SPECIFICATIONS

	1N1115	1N1116	1N1117	1N1118	
60 cps, resistive or inductive					
Peak inverse voltage	100	200	300	400	v
RMS voltage	70	140	210	280	v
Cont. Reverse DC V	100	200	300	400	v
DC Output C (150°C Case Temp.)	600	600	600	600	ma
DC Output C (85°C Case Temp.)	1.5	1.5	1.5	1.5	amps
Full load forward voltage drop (Full-cycle ave at 150°C)	.65	.65	.65	.65	v
Leakage current (Full-cycle ave at 150°C)	0.4	0.3	0.3	0.3	ma
Max. operating freq.	100	100	100	100	kc
Ambient operating temp.	170 −65	170 −65	170 −65	170°C max. −65°C min.	
Storage temp.	175 −65	175 −65	175 −65	175°C max. −65°C min.	



Need a few semiconductors in a hurry?

Check your local G-E distributor

For fast delivery of transistors and rectifiers, see your local G-E distributor first. Just check and see, for yourself, if his service facilities and prices don't work out to your great advantage.

Florida engineers, for example, can call on Thurow Distributors. Thurow recently put in the most complete line of semiconductors available (G.E. of course) to better serve the greatly expanding electronic and aircraft industries throughout Florida. Shown at left are Thurow and General Electric executives looking at part of their initial shipment of G-E semiconductors.

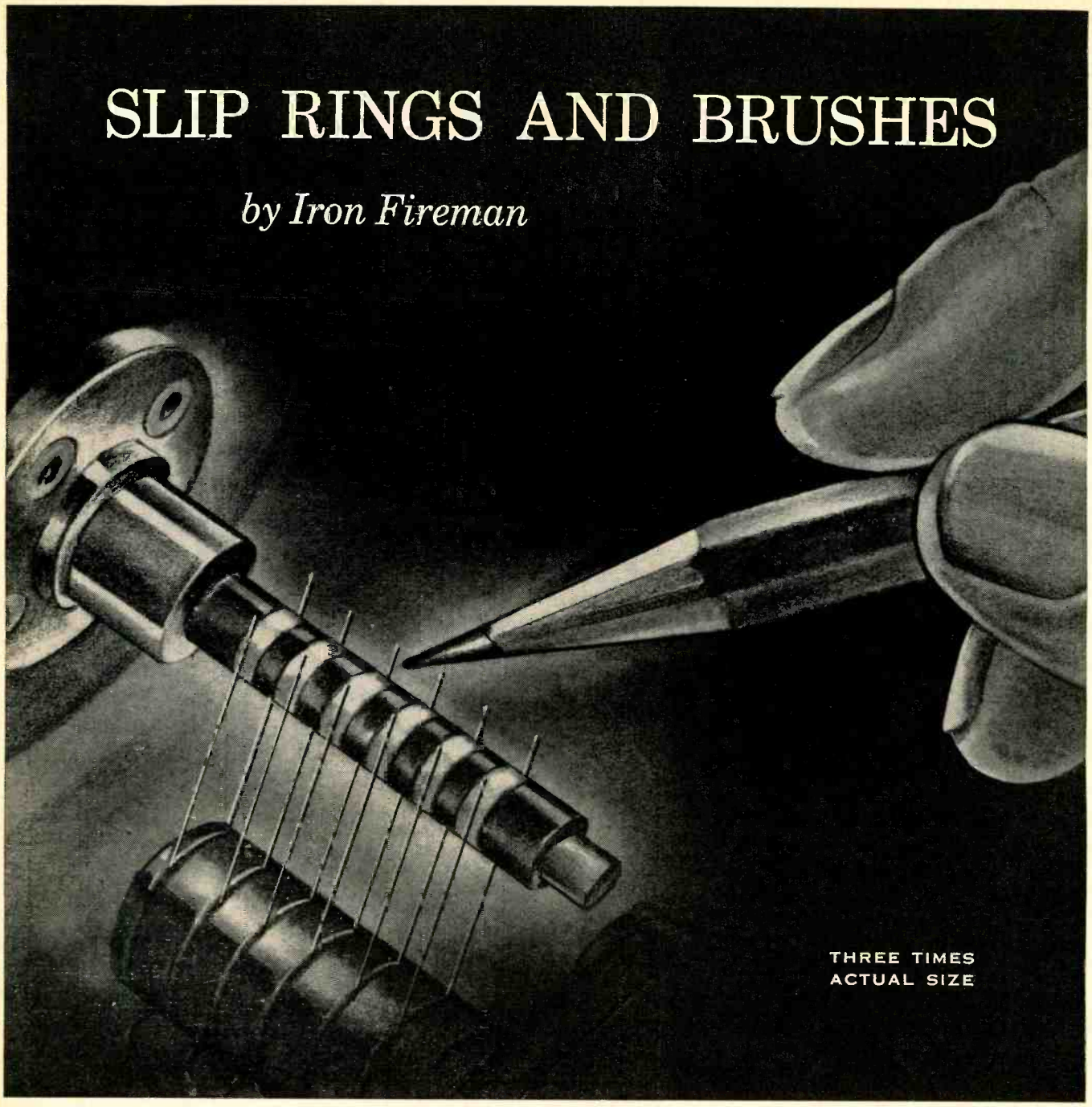
Quick-reference transistor manual—This famous pocket-size reference is now in its enlarged second edition. Gives you all the facts—basic semiconductor theory, parameter symbols, specifications of G-E transistor types, circuit diagrams, applications, registered types of all manufacturers, and other data frequently needed. 112 pages. Available at your local G-E Tube distributor, or enclose 50 cents (no stamps, please).

YOUR G-E SEMICONDUCTOR SALES REPRESENTATIVE will be glad to give you further information and specifications on General Electric transistors and rectifiers. Manual, bulletins, and other data can also be obtained by writing Section S25158, Semiconductor Products Dept., General Electric Company, Electronics Park, Syracuse, New York.

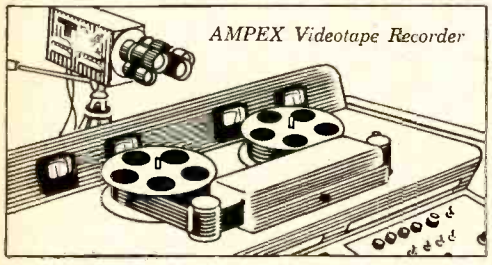
GENERAL ELECTRIC

SLIP RINGS AND BRUSHES

by Iron Fireman



More than just a product



Iron Fireman skill in developing slip rings and brushes for special applications is well illustrated in the Ampex Videotape Recorder. Ampex required a slip ring of exceptionally high standards and with unusual characteristics. Iron Fireman perfected a design to meet this specific need.

If you have a precision slip ring application Iron Fireman can be of service to you, too. Write to the address below for detailed information.

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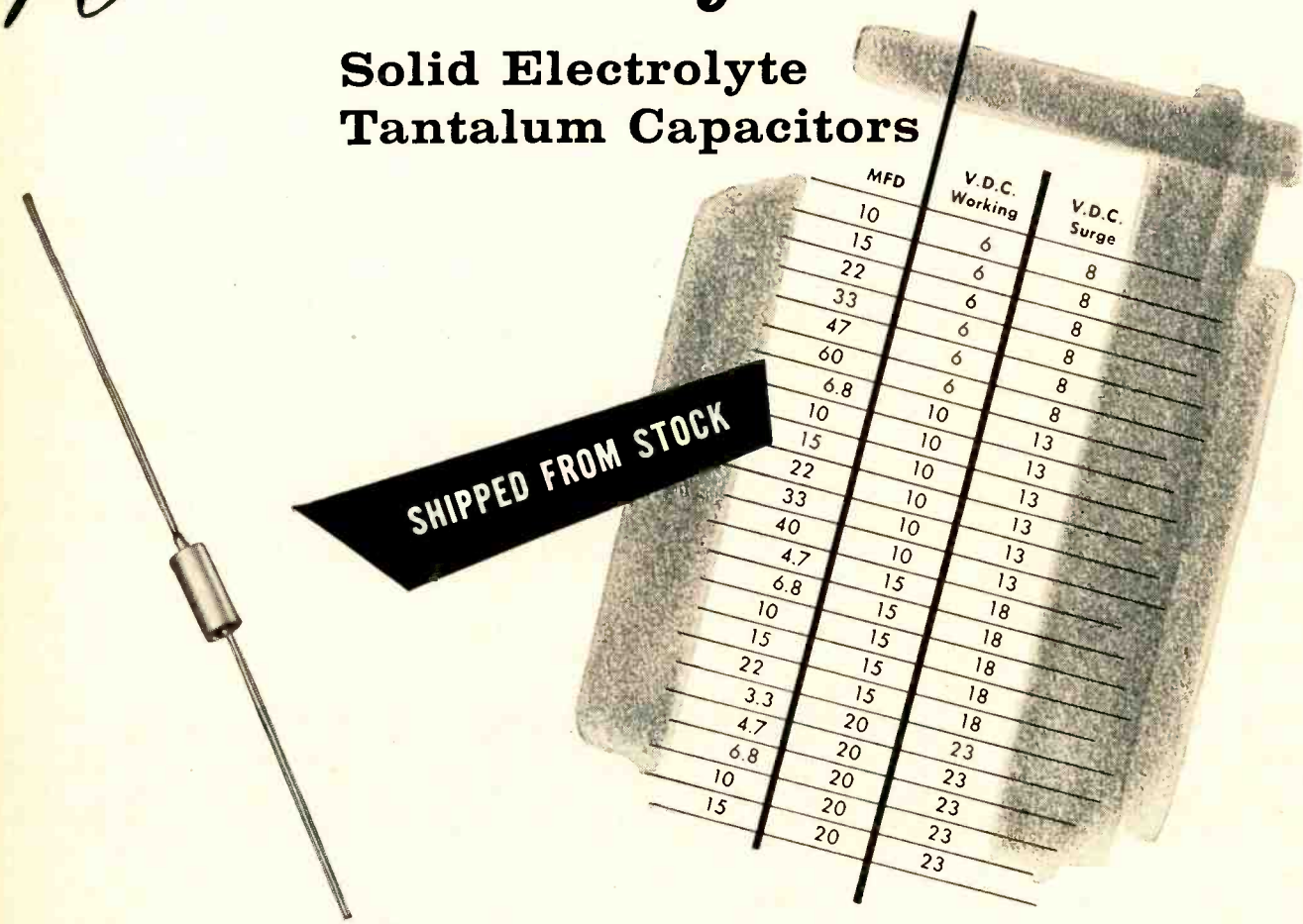

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The electrolyte used in Mallory "Tan-Sol" capacitors is a solid semi-conducting material that is not subject to corrosion. The design enables the use of these capacitors in severe environmental operating conditions including those specified for military applications. Shelf life is indefinite.

This new series adds to the complete Mallory line of tantalum capacitors which includes subminiature types TNT and STNT, and the XT and XTM types for 175°C operation. Mallory "Tan-Sol" type TAS capacitors have exceptionally stable capacity and dissipation factor over the range from −80 to +85°C—are particularly good at the low temperature end.

Mechanical construction features include axial leads with hermetic glass-to-metal end seals. Tinned nickel lead wires are 1½-inch long .020 wire, and are completely free of external welds.

Standard capacity values, in EIA ratings, are available for shipment from stock. Prototypes of special designs can be shipped in less than three weeks. Write for complete technical information on the Mallory "Tan-Sol" type TAS—solid electrolyte tantalum capacitors.

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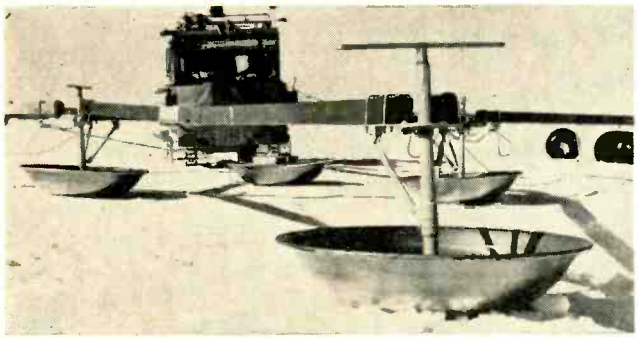


Crevasse detector has made it possible to explore many hundreds of miles of ice and snow in the Arctic and Antarctic and has never failed to detect a crevasse (see cover)

FIG. 1—Sketch shows the electrical field set up by sled electrodes in contact with glacier surface. A three dimensional pattern flows through the ice. Crevasse is detected by electrodes

Crevasse Detector Blazes Glacial Trails

SUMMARY —— Sled Electrodes, in contact with ice-snow surface, set up an electrical field in ice pack and pick up constant readings when ice is solid and safe for travel. As tractor approaches a crevasse, bridged with snow, the flow of electrical current is disrupted and an alarm warns operator of hidden chasm. Transistorized system uses the crevasse walls to simulate capacitor

By H. P. Van ECKHARDT Project Engineer, Pathfinding Section, Mine Detection Branch, Research and Development Laboratories, U. S. Army Corps of Engineers, Fort Belvoir, Virginia

CREVASSES, hidden pitfalls often wide and deep enough to swallow men and equipment, have haunted Arctic explorers for many years. Bridged over slightly with snow, these chasms in the ice are particularly dangerous, in summer Arctic white outs and snow storms.

Detecting Methods

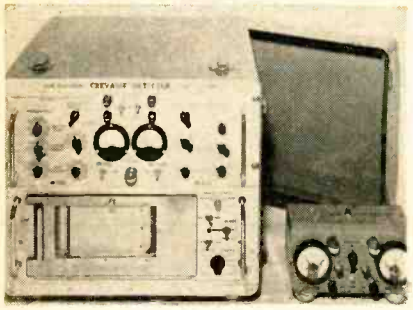
Until recent years, the only methods used for detecting crevasses were aerial photography and hand-probing with long rods. Aerial observation proved effective only under highly favorable weather conditions and hand-probing was extremely tiring, tedious and slow.

A research program resulted in the development of electronic techniques employing surface-electrodes for the effective detection of crevasses.

The detector employs a double-system of electrodes. A wide system detects crevasses in a path around and in front of a vehicle. A long system detects crevasses with extra thick snow roofs missed by the wide system, and distinguishes between large crevasses and narrow cracks.

System Details

Each system consists of four large dish-pan-shaped sled electrodes in contact with the ice-snow surface. The wide-system electrodes are pushed in front of the vehicle in a fan-wise arrangement on wooden booms. Two pans act as current electrodes which set up an



Recorder chassis and alarm box at right. The frequency selector switch provides for reception on four different bands, corresponding to those of the transmitter, plus one for the 60-cps vibrator supply used in an emergency

electrical field in the surrounding ice pack. The remaining two signal electrodes pick up readings from this electrical field. When the ice is solid and safe for travel, the signal is comparatively constant. As the vehicle approaches a crevasse, the flow of the electrical field is disrupted and an alarm signals danger.

The long system operates simultaneously with the wide, but on a separate frequency. Its electrodes are arranged differently. One electrode is pushed ahead by the vehicle, which also acts as an electrode, and the other two are towed behind at 20-ft intervals.

Alarm

As the vehicle travels over the glacial surfaces the detector reports its findings by a two-channel recorder, mounted in the vehicle. An alarm box containing a pair of special relay meters, a red light and a buzzer warns the driver of crevasses. Audio warning is also available through earphones. A light and a buzzer signify component failure in the detector.

Electrode Pattern

The sled electrodes are in contact with the glacier surface. As seen in Fig. 1, a source of alternating current, I, is connected between two current electrodes I_1 and I_2 and a three-dimensional pattern of current flows through the ice. Since ice is a nonconductor, this is displacement current, like that flowing through the dielectric of a capacitor connected to an a-c source.

A potential-difference measuring device is connected between the signal electrodes e_1 and e_2. Any marked distortion of current pattern by an obstruction, such as a crevasse near the electrodes, will cause a change in the voltage reading, e.

Ice Coupling

The electrodes are large enough to provide good coupling to the ice. Since the assembly moves over the surface to determine safe trails, the electrodes' effectiveness in contact with snow and ice is bound to vary. The resulting variations in the electrode-voltage drops should not be allowed to affect either the input current or the output voltage reading appreciably.

Spacings and arrangement of the electrodes determine the ice-sampling depth. In general, the smallest practical spacing between any pair of the four electrodes should exceed the depth of the thickest snow bridge anticipated. Also, the spacing should be several times the dimensions of the electrodes themselves so that the variations in snow contact will not appreciably alter the effective electrode spacings.

Symmetrical electrode patterns are avoided as they place the electrodes on a common equipotential in the current field and would fail to indicate crevasses oriented parallel to that equipotential plane. The most suitable arrangement found is shown in Fig. 2.

A block diagram of the crevasse detector is shown in Fig. 3. The system is operated from a 24-v system that can be readily changed for use entirely from the 12-v vehicle storage battery.

Transmitter

The main transmitter consists of a bridge-T oscillator and a power amplifier. These two assemblies are bolted within the transmitter chassis which is provided with three front-panel controls.

The oscillator, Fig. 4A incorporates heavy degenerative feedback in which a small incandescent lamp is used as a nonlinear compensating resistance. The oscillator provides constant output frequency and voltage for any supply between 12 and 32 volts at temperatures as low as −20 F. Oscillation frequency is governed by capacitors C, in Fig. 4A. Various values of these ca-

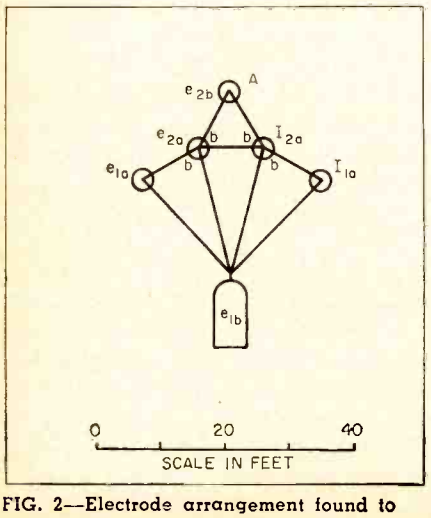


FIG. 2—Electrode arrangement found to produce the best detection results

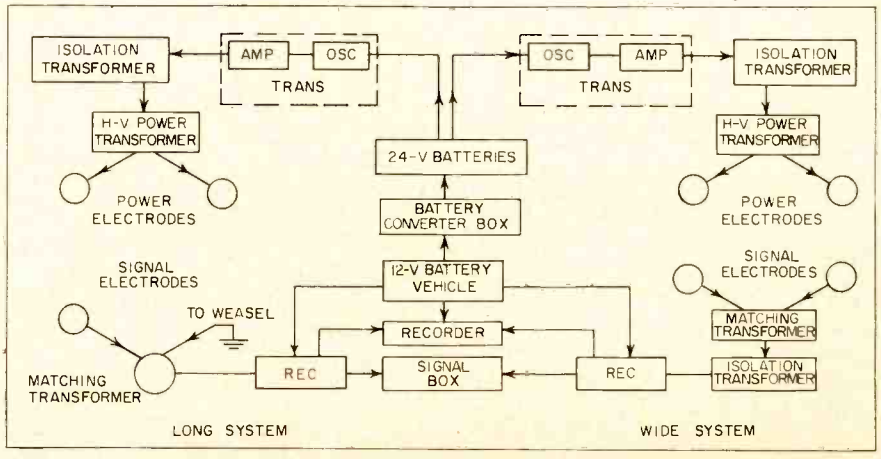


FIG. 3—Block diagram of crevasse detector showing the double-electrode system that distinguishes between large crevasses and narrow cracks The detector operates from a 24-v source that can be converted to operation from the 12-v vehicle storage battery

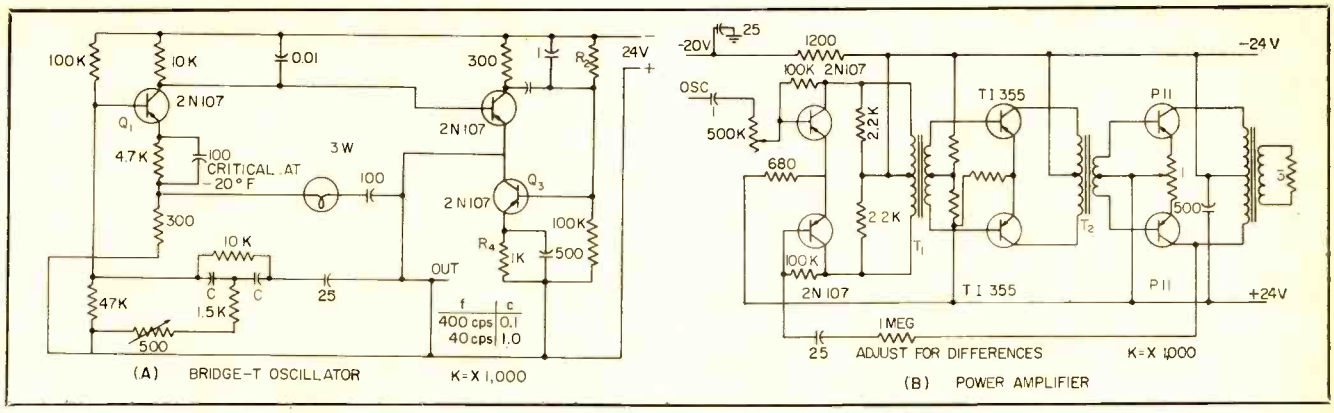


FIG. 4—The main transmitter consists of two distinct parts, a bridge-T oscillator (A) and a power amplifier (B)

pacitors provide frequencies of 100, 150, 230 and 350 cps. These frequencies are adjusted by the 500-ohm trimmer control which varies a shunt resistance in the tuning circuit. The oscillator fine-frequency trimmer is adjusted slowly since there is a frequency-change lag in the nonlinear feedback stabilizing system.

Audio Output

Oscillator a-f output is fed to the power amplifier shown in Fig. 4B, consisting of a phase-inverter and two push-pull stages. The input amplifier and phase-inverter employ two 2N107 transistors, coupled through transformer T_1 to the intermediate stage employing two TI 355 *pnp* transistors which are operating class AB. These, in turn, apply driving power to the low-resistance interstage transformer T_2, manufactured to order.

The interstage transformer, which drives the final power stage, employs a pair of P11 transistors operating Class B. Types XH-25 or XH-10 may be substituted for these transistors which are no longer manufactured.

Receivers

The receiver input signal, Fig. 5, from the electrodes and isolating or matching transformers is attenuated to a suitable level at a constant impedance of 1,000 ohms by the T-pad and passed to the preamplifier. The supply voltage of the 2N107 preamplifier is stabilized at 5.8 volts by a reversed TI 620 silicon diode shunt, operating at the Zener point. Signal voltage then passes through a band-pass L-C filter employing a 10-henry inductor, is further amplified and applied to the driver circuit employing two 2N185 transistors in push-pull.

The signal is applied to the final output amplifier which uses a 355 transistor operating class A and to one of the large voltage step-up driver transformers mounted on a separate chassis. The signal power is rectified in push-pull and applied to the recorder pen motor and to the relay-meter. The frequency-selector switch shown in Fig. 5 provides for reception on four different bands corresponding to those of the transmitter plus one for the 60-cps emergency vibrator supply.

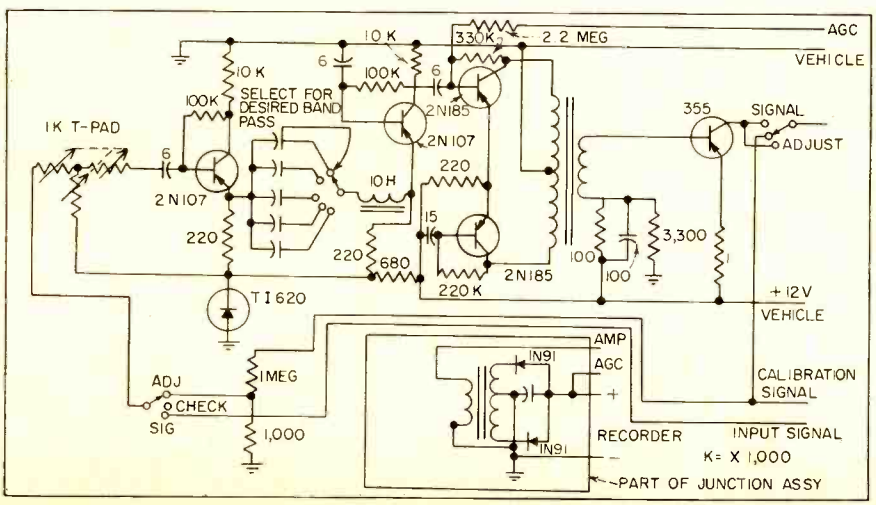


FIG. 5—Receiver of the crevasse detector showing the driver circuit for one recorder channel along with checking and adjusting circuitry

Test Results

In tests covering a 200-mile unexplored trail in Greenland, the unit never failed to detect a crevasse. The U. S. Navy has also enjoyed complete success with the use of the detector in its Antarctic operations.

Exhaustive tests have shown that: operating frequencies of 200 cps or lower give the largest crevasse indications relative to background fluctuations. The background signal fluctuations are sometimes so complex that crevasse anomalies may be disguised. However, proper electrode spacings and visible recording of the signal over the distance travelled assist in distinguishing the crevasse anomalies.

In addition to crevasses, buried buildings, other large objects are readily detected. Small portable outfits towed by a man are fairly successful, providing adequate electrode spacings are used.

The crevasse detector works best at low temperatures when near surface melt moisture is absent. However, frictional electric noise generated by motion of the potential electrodes is bad at low temperatures.

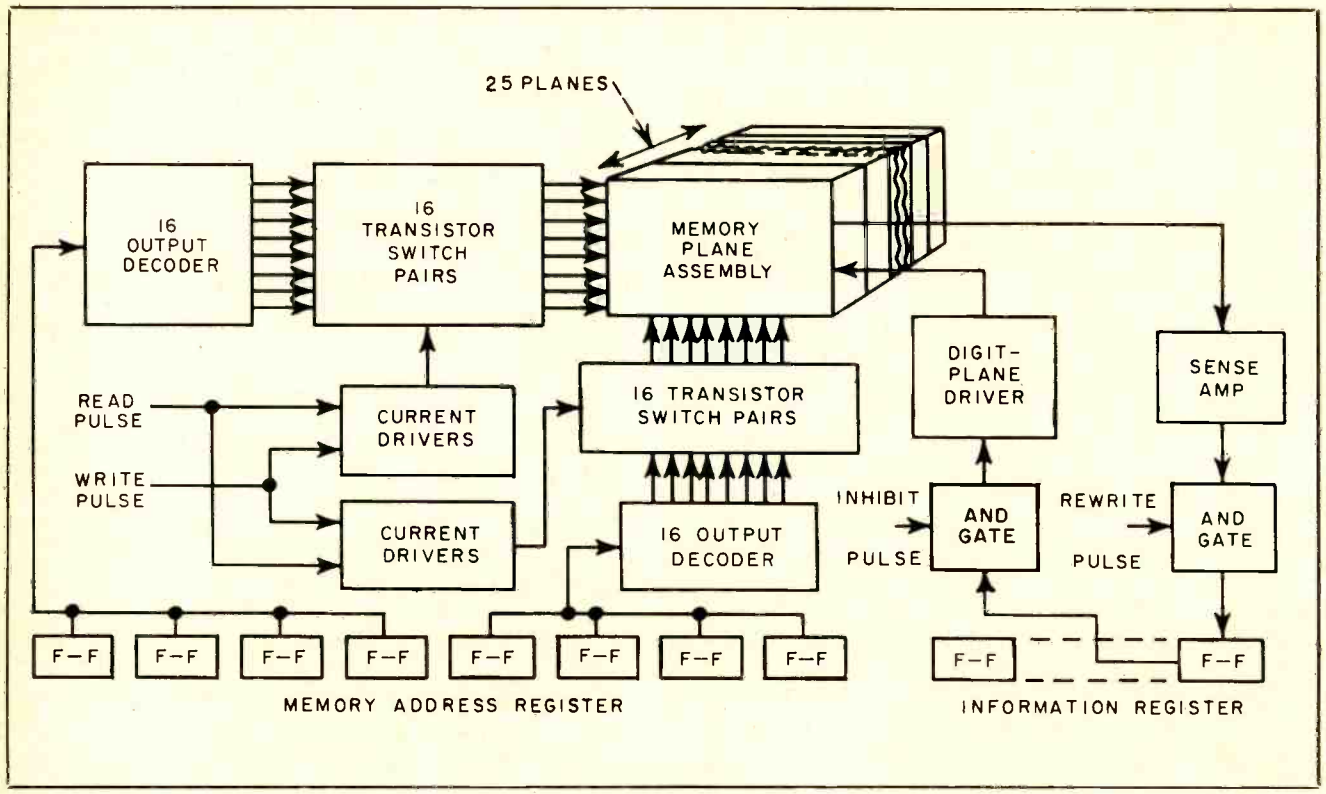


FIG. 1—Block diagram of linearizer memory shows basic relationships between one magnetic-core memory plane and transistorized input and output circuits. Each of the other 24 planes have identical arrangements to provide a total capacity of 6,400 volts. Driving and sense circuits are completely transistorized

Transistorized Memory

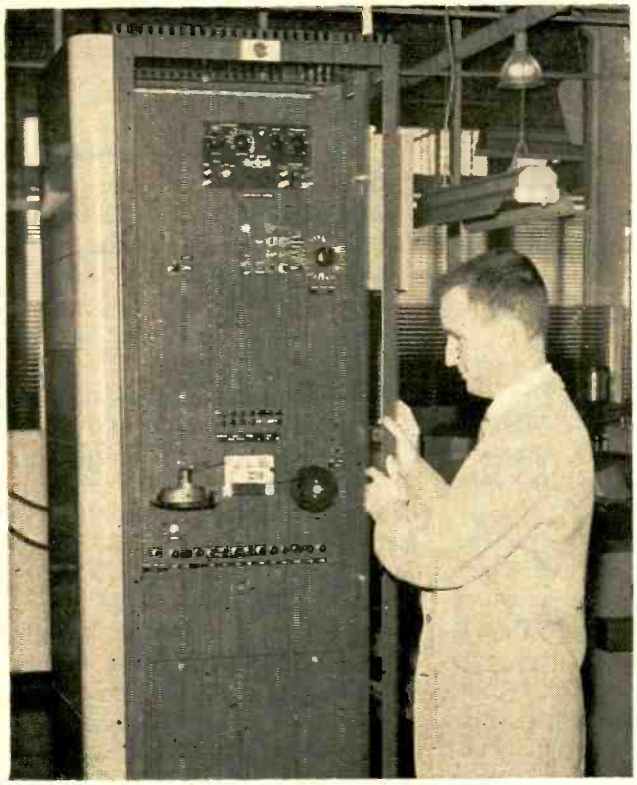
SUMMARY —— Telemetered data from U.S. earth satellite will be decoded by transistor-operated magnetic-core memory. Circuits required to numerically translate input information and present modified output information use alloy-junction transistors as current drivers, gated-pulse amplifiers, voltage amplifiers, high-speed switches and flip-flops. Memory storage capacity is 6,400 bits arranged as 256 characters of 25 bits each

By C. S. WARREN, W. G. RUMBLE and W. A. HELBIG

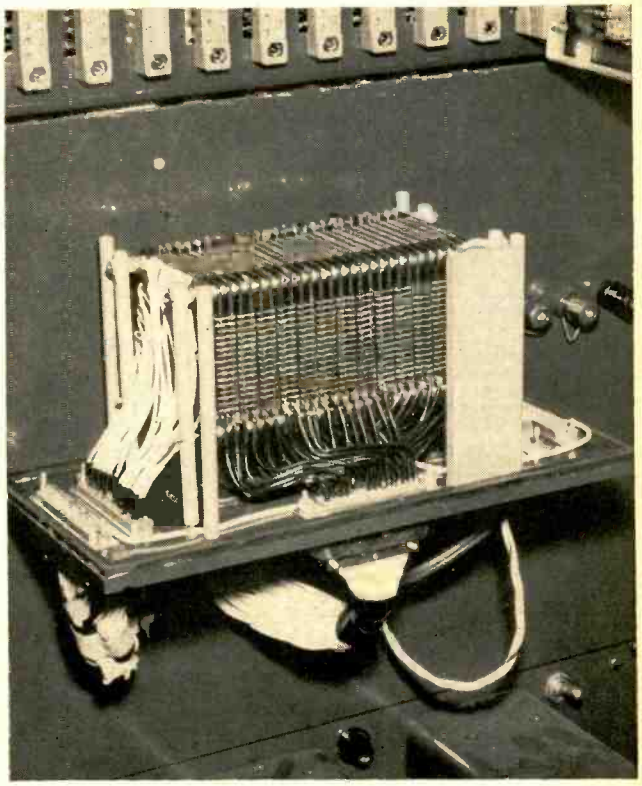
Defense Electronic Products, Radio Corporation of America, Camden, New Jersey

ONE OF THE FIRST transistor-operated magnetic-core memories used in the field for the U.S. earth satellite program *Vanguard* uses a unit, known as a linearizer memory. This memory is essentially a data converter which operates on input information according to a predetermined numerical transformation and presents it in modified form as an output. Input data is used to address the memory and the desired output data is stored in corresponding memory locations. Provision is also made for monitoring the outcoming data with an automatic plotter or similar device.

Data telemetered from the earth satellite to a receiving unit may be coded in any desired manner since



Paper tape reader preloads linearizer memory with calibration information. Coded input signals telemetered from the earth satellite are digitally converted by the calibrated memory



Memory plane assembly, shown with cover removed, has thermostatic control to provide stabilized temperature for ferrite cores. Transistorized circuits facilitate high-speed random access

Monitors Earth Satellite

the linearizer memory can be precalibrated to decode the signals. For example, if the information received originated from a temperature sensing instrument in the satellite, the linearizer memory can convert the coded telemetered data into a directly usable output which is fed into other types of computers. The entire data from a satellite can be recorded on magnetic tape and read into the linearizer at a later time.

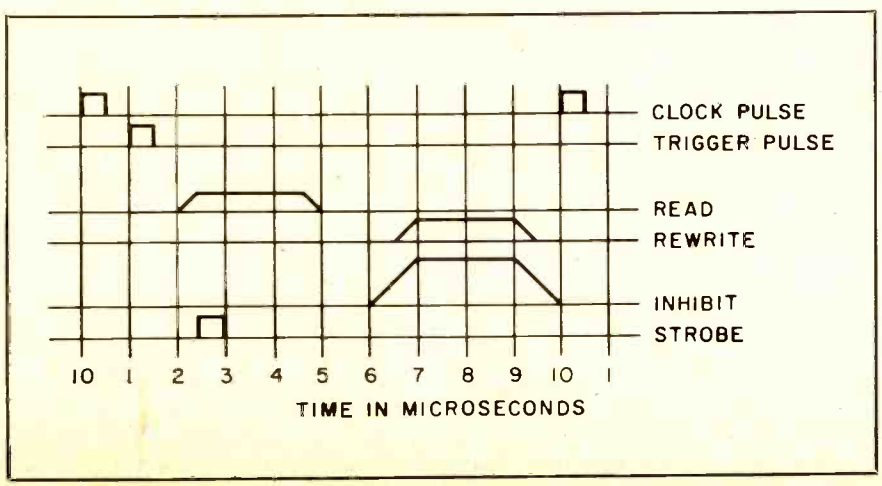


FIG. 2—Timing diagram shows sequence of pulses controlling memory cycle

Storage Capacity

The memory system, shown in the block diagram in Fig. 1 uses 25 memory planes, each having 256 memory cores, which provide a 6,400-bit storage capacity. Each memory matrix is square and has 16 cores along each axis. Since the X-axis planes are connected in series as are the Y-axis planes, an excitation voltage applied to one X winding and one Y winding selects 25 cores which are identically placed in each of the memory planes. Information stored, therefore, is arranged into 256 characters of 25 bits each. Each plane has inhibit and sense windings.

At the start of the memory cycle,

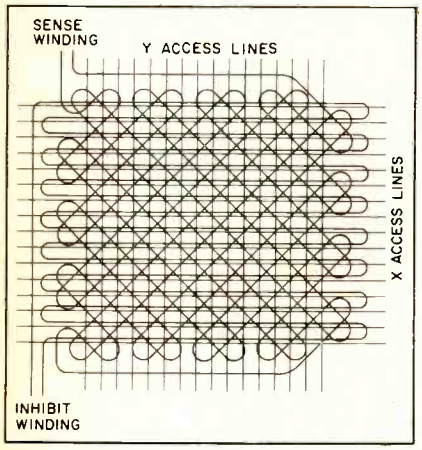


FIG. 3—Simplified diagram of one memory plane matrix. Sixteen access lines on both the X and Y axes provide 256-bit storage in each plane

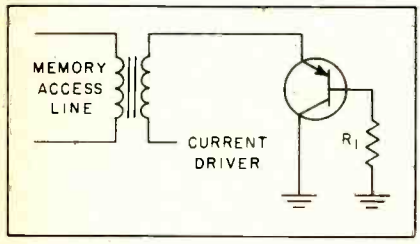


FIG. 4—Simplified basic transistor switch used in access driver circuits

the memory location to be interrogated is set into an address register by the 0.5-μsec trigger pulse shown on the timing diagram in Fig. 2. The address register consists of eight flip-flops; four address the X axis and four address the Y axis.

Outputs from the two groups of transistor switch pairs feed the access windings along the X and Y coordinates of the memory matrices. Current drivers associated with each group of switches supply the current pulses which excite the memory. Each driver consists of two pulse amplifiers; one for read polarity and one for rewrite polarity. These circuits control amplitude and rise time of the driving pulses.

Read Pulse

When the address flip-flop and decoder settle out, a read pulse of the proper polarity to drive the selected memory core to the ZERO state is applied. A voltage then appears on the sensing wire output if on ONE was previously stored.

Following the read pulse, a rewrite pulse is applied, driving the selected core to the ONE state. To allow writing of a ONE, each of the 25 planes is provided with an inhibit winding and driver. These apply a half excitation-current pulse having the same polarity as the read pulse to all the cores in a plane when ZERO is to be stored or regenerated.

Regeneration

Regeneration circuits consist of two parts: the sensing amplifier with its associated output gate and the digit-plane driver with its associated input gate. Sense windings series-link the cores in each plane and connect to amplifiers which rectify and amplify all signals above a predetermined threshold value. The sense amplifier output sets an information register flip-flop. The information output is obtained from the sense output gate 3 μsec after the start of the cycle.

During interrogation of the memory, the sense amplifier output is gated into the information register by the digit-plane drive. When new information is to be stored the sensing output gate is blocked and information from the computer is supplied to the register.

Memory Plane

Memory plane construction and winding arrangements are shown in Fig. 3. Equal numbers of cores along any one access line are linked in opposite senses to cancel a large percentage of noise resulting from half-excited cores in the memory.

Three characteristics were considered in selecting the memory core: switching time, drive current and noise voltage. Since the switching time of the core is inversely related to the current and voltage drive requirements, it was considered desirable to select a memory core having a long switching time which is consistent with reasonable access time.

To allow the core itself to participate in the switching required for its selection, the hysteresis loop generated by the drive current must be square. Although good rectangularity improves the signal-to-noise ratio, noise voltage is reflected back to the drivers when the induced voltage peaks. This is caused by half excitation of the memory cores and appears as reverse bias across the transistor driver.

Memory cores selected for application in this memory have an outside diameter of 0.08 in. and a full excitation drive current of 500 ma. With a 0.5 μsec rise time for the driving current pulse, the core requires 2 μsec (measured from the 10 percent point of the drive pulse) to reverse its state of magnetization. The maximum voltage readout for half excitation is 10 mv; the voltage output for full excitation of a core storing a ONE is approximately 100 mv.

Temperature Effects

Since the ferrite cores are the most temperature sensitive elements in the memory, stabilization

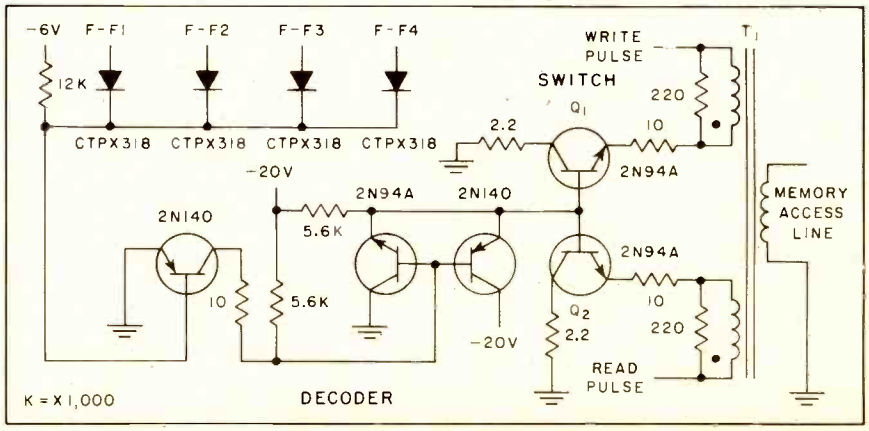


FIG. 5—Decoder and switch circuits. In circuit used with linearizer memory, switches Q_1 and Q_2 each are made up of two parallel connected transistors

of operating temperatures is reqired to assure that the signal and disturb or noise outputs of the memory do not vary. Present memories maintain an adequate signal-to-noise ratio over a limited temperature range of 10C. The range can be extended by the following methods: selecting improved ferrite material; providing automatic temperature compensation in sensing circuits; providing automatic temperature compensation in drive circuits: or maintaining the memory core matrices at the maximum required operational temperature.

Only the last method was found both feasible and presently attainable. Using this technique, the memory core matrices are maintained at 45 C ± 5 C. Stable operation was accomplished by enclosing each core in an insulated box and thermostatically controlling the temperature.

Access Drivers and Switch

A fast, efficient switch capable of handling large current pulses is required between the single source input and the appropriate line of the memory matrix. Transistors are ideally suited for this because their low saturation impedance permits relatively large currents to pass with low power dissipation. Since current gain and speed are also desirable, the transistor must not be operated too far into saturation. Operation at the knee of the grounded-base collector characteristic curve assures low storage and low dissipation at full current gain.

A circuit which operates at this point without the use of an additional collector voltage supply is shown in Fig. 4. If a low-value resistor is used for R_1 the transistor will present a low input impedance.[1] In the switching circuit described here, base resistor R_1 is replaced with an emitter-follower which provides extra current gain and low base resistance.

Drive Pulses

The 250-ma read and rewrite current pulses that drive the memory cores are generated by a constant-current pulse driver and directed into the proper access line by the voltage-selected transistor switch. Figure 5 shows the switch circuit for a single line of the matrix. Two switch transistors are used for each memory access line through the plane; one for the read pulse and the other for the rewrite pulse.

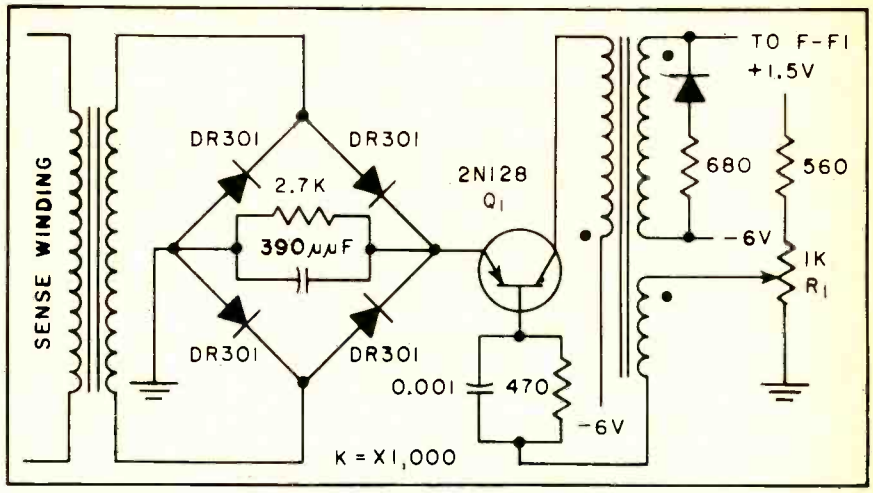


FIG. 6—Sense amplifier. Reverse bias on base of transistor amplifier Q_1 prevents false triggering

Recovery Time

Since the switch transistors are operated in saturation, a symmetrical emitter follower is required to insure fast recovery between memory cycles. During each memory cycle, emitter circuits of all read and rewrite transistors are pulsed from the read constant-current drive. By transformer-coupling the current pulses to the memory plane with T_1, only one access wire is required for both the read and rewrite pulses.

To prevent additional reverse voltages from appearing across the emitter-base diode of the switch transistor, the output pulse transformer is specially designed to give low leakage inductance. By using a toroidal core made from high-permeability ferrite wound with trifilar windings having a one-to-one turns ratio the low leakage inductance is obtained.

Decoder

The decoder consists of a 64-diode matrix having 16 outputs, each of which feeds one transistor amplifier. The circuit for one decoder output is shown in Fig. 5.

Each decoder output feeds the base of an emitter follower associated with the address switch.

Input current requirements of the decoder are low enough that amplifiers are not required between the address register and the decoding matrix. Decoding is accomplished in less than 1.5 μsec after the arrival of the information pulse at the address register.

Sensing Amplifier

The sensing amplifier shown in Fig. 6 contains a blocking-oscillator type transistor amplifier which is triggered by the output from a diode bridge network. Since the memory sensing wire exhibits a low output impedance, sufficient amplification of the readout signal input is obtained by transformer coupling.

To assure that readout voltages of both polarities are sensed, the signal is rectified by the diode bridge network. Because semiconductor rectifiers respond nonlinearly to voltage signals, small signals are greatly attenuated relative to large signals. This factor increases the s/n ratio at the rectifier output to about twenty to one.

Complete elimination of spurious signals and the standardization of all readout signals from the memory is accomplished with transistor amplifier Q_1. All signals below a specified level are pre-

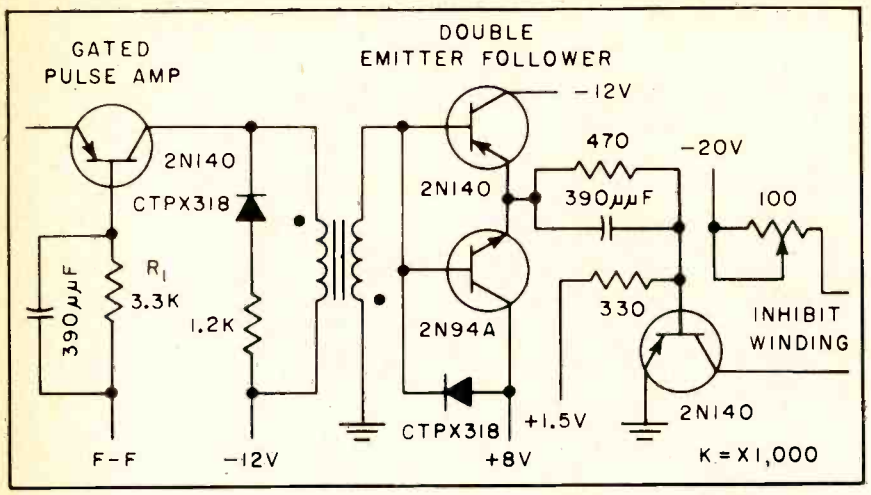


FIG. 7—Digit-plane driver. Sensing amplifier output is gated through information register during interrogation but is blocked out during storage of new information. Double emitter follower reduces input requirements of circuit that drives inhibit winding

vented from triggering the amplifier by a small adjustable reverse bias applied to the emitter-base of Q_1 by potentiometer R_1. A signal of at least 12 mv above the controlled threshold level is required to obtain a full output from the sense amplifier. Since the noise impulses appearing on the sense wires are relatively few, a minimum s/n ratio of ten to one is obtained, therefore, the problem of false triggering is eliminated.

Digit Plane Driver

The digit plane driver shown in Fig. 7 contains a high-current pulse amplifier capable of supplying half excitation-current pulses to all of the cores within a given plane. Voltage and current drive requirements are dictated by the size of the memory matrix.

A conventional grounded-emitter amplifier with the memory load in the collector circuit makes up the output stage of the amplifier. The transistor is operated in saturation; therefore, the collector-current amplitude is a function only of the collector voltage and the 100-ohm variable resistance.

When a high-frequency transistor is used, the rise time of the current pulse is controlled by the time constant L/R of the collector circuit. In this instance, L represents the inductance of the memory matrix plus a small added inductance. To reduce the input requirements, an emitter follower drives the output stage.

Gate requirements for the inhibit function are provided by a gated pulse amplifier. The gating function of the circuit is accomplished in the base-emitter diode of the transistor. When the control level from the information register flip-flop is at ground, the emitter diode remains reverse biased under the maximum excursion of the positive 3-v input pulse. However, when the control level is at a negative six volts, the pulse forward biases the emitter-base diode and an output pulse results. Thus the inhibit pulse is gated through only if there is no readout from the sense wire.

A power gain of approximately ten is obtained from this circuit using currently available *pnp* transistors. The inhibit-pulse gate can be designed to handle pulses having a 5-μsec duration.

Logic Circuits

Flip-flops throughout the memory use a complementary symmetry circuit with two *pnp* and two *npn* transistors.[2] At any one time, one *pnp* and one *npn* are conducting in saturation while the other two are held in the cutoff region. Address register flip-flops are conservatively designed to supply a maximum current of 10 ma with a voltage drop of 6 v.

Because of their many applications and variations, both *pnp* and *npn* transistor gated pulse-amplifier circuits are used in the logic associated with the memory.[3] A basic circuit of this type is part of the inhibit gate shown in Fig. 7.

Future Memories

Transistor operated memories are an answer to the need for high-speed random-access storage in cases where power requirements, size and weight must be minimized. Application of transistor circuits is not limited to the size and type of memory described here. With the exception of the sensing amplifier and decoder, these circuits could be extended to a 64 by 64 memory plane without much change.

In extrapolating the above circuits as building blocks for larger memories, three problems have arisen. First, increased voltage is required for driving and switching circuits. Second, better discrimination in the sensing amplifier is necessary to overcome the decreasing signal-to-noise ratio. Third, larger address decoders are needed to retain speed of operation and output current requirements.

Solutions

The first problem results from larger inductive loads presented by larger memory planes. Its solution is a function of the availability of transistors with high inverse voltage breakdown characteristics.

Since the s/n ratio of the read-out from a 64 by 64 plane is low, the sensing amplifier must incorporate an additional stage of amplification. A strobe gate would be required at first output to discriminate between the read-out signal and the noise generated from half-excited cores.

A 64-output decoder using 80 transistors and 180 diodes is now being tested. It is expected that decoding will be accomplished in less than 1 μsec with a maximum output current of 10 ma with this unit.

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(3) G. W. Booth and T. P. Bothwell, Logic Circuits for a Transistor Digital Computer, to be published in *Proc PGEC*.

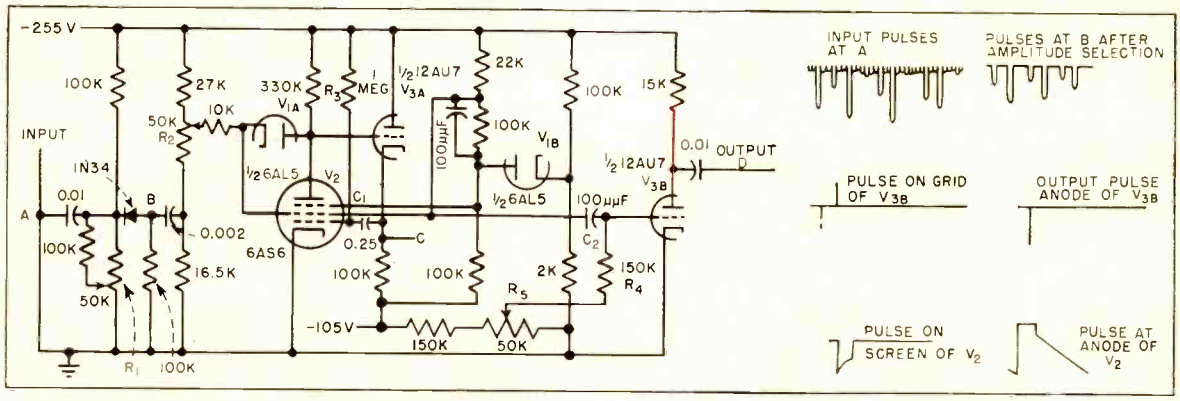

FIG. 1—Self-setting gate circuit, showing typical waveforms at designated test points

Self-Setting Servo Gate

SUMMARY —— Simple circuit, used in ionospheric pulse experiments, picks out pulses transmitted at a fixed repetition frequency in the presence of random noise and improves reliability of synchronizing link by factor of 50

By E. R. SCHMERLING
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In ionospheric pulse experiments, a synchronizing link triggers time-bases at a receiving site about five miles from the main transmitter. The main transmitter emits 150 μsec pulses at 75 kc with a prf of 12 pps. Receivers record these pulses, together with pulses returned from the ionosphere. A 27-mc transmitter, emitting 20 μsec pulses, in advance of the main transmitter pulse, provides synchronization that is relatively free from atmospherics.

However, frequent false triggering due to man-made interference, occurs during the 1/12 sec interval between pulses. The simple self-gating circuit described reduces this interference by a factor of 50.

The circuit is shown in Fig. 1. Input before and after amplitude selection is monitored at test points *A* and *B*. A monostable screen-coupled Phantastron V_2 is triggered at the anode via diode V_{1A}. After triggering, the circuit is reset just before the expected arrival of the next pulse. For maximum efficiency, cathode follower V_{3A} speeds up fly-back by providing a low impedance recharging path for C_1. With the values selected for R_2 and C_1, sweep time is adjusted to 1/12 sec by R_2.

Flyback

The screen pulse is differentiated by C_2 and R_4 where the negative pulse corresponds to the commencement of fly-back, and the positive pulse to the start of the sweep. Pulses are applied to the grid of V_{3B}, biased to cut-off by R_5. The positive pulse produces a negative output and the negative pulse is ineffective. The outgoing negative pulse, coincident with the leading edge of the incoming pulse, is used to trigger recording equipment.

The amplitude of the incoming pulse is adjusted for triggering at R_1, in this instance to 12 v. The anode waveform is then checked at point *C*. The top pedestal is adjusted at R_2 and is made as narrow as possible, consistent with stability. Pedestal width, representing the sensitive interval during which triggering is possible, can be made as small as 1/50 of the pulse interval, reducing the possibility of triggering from random pulses by the same fraction. Output pulse is monitored at *D* and R_5 adjusted for a negative pulse. Amplitude of the output pulse is 200 v, with a 1 μsec width.

The research program leading to this development was sponsored by the Geophysics Research Directorate of the Air Force Cambridge Research Center, ARDC, under Contract AF19(604)-1304.

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Highlight Equalizer

SUMMARY — Equalization of only the gray-to-white highlight region in the video signal provides better signal-to-noise ratio and improved definition over conventional aperture equalizers covering the full brightness range. Since most image-orthicon noise is in the lowlight region, the improvement stems from a division of the signal into two parts with only the relatively quiet highlight portion equalized for better tonal reproduction

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PRESENT APERTURE equalization of television signals has the severe limitation that high-frequency noise is increased with high-frequency picture signal information.

Noise Limitations

The amount that the high-frequency fine detail can be increased is therefore limited by the undesired noise. The highlight aperture equalizer provides more equalization without increasing the noise in the same proportion. This feature is obtained by dividing the video signal into two parts with respect to amplitude and equalizing the portion that is relatively free of noise. The circuit has been successfully tested in both monochrome and color television.

Distortion Compensation

Aperture equalization is a well known television technique. It is required to compensate for the distortion introduced by the finite size of the scanning aperture.

The cross-sectional area of the scanning beam suppresses the signal amplitude at high frequencies. As a result, the fine definition in reproduced images is impaired. The loss in resolution contributed by the beam cross section can be compared to the loss obtained when attempting to copy a fine drawing with a blunt pencil. It also occurs in kinescopes during picture reproduction, for here too the beam has a finite size.

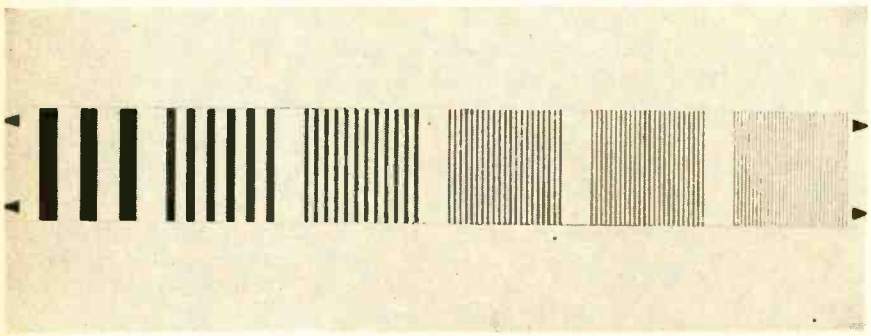


FIG. 1—Test pattern covering 0.5 to 5 mc

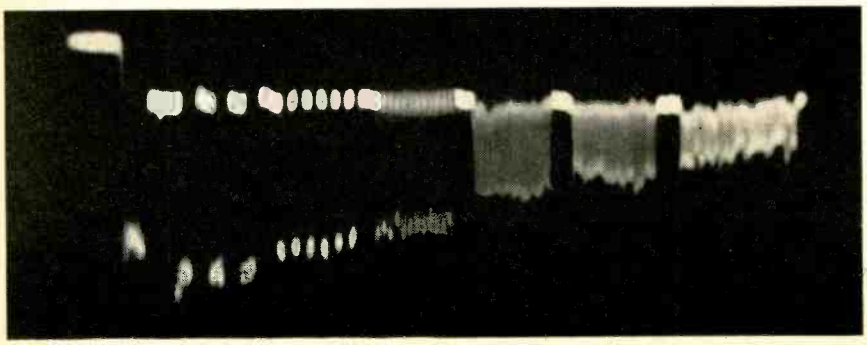


FIG. 2—Common waveform from scan of Fig. 1

High-Frequency Losses

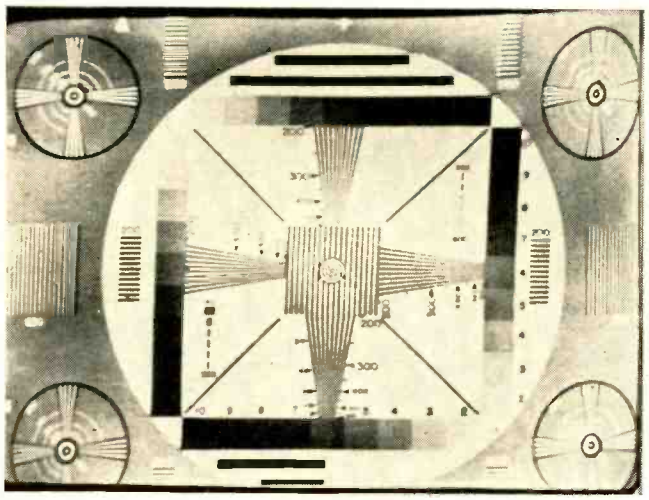
The loss at high frequencies is clearly illustrated by Figs. 1 and 2. Figure 1 is a black and white pattern comprising six groups of vertical lines representing video frequencies of 0.5, 1, 2, 3, 4 and 5 mc.

Figure 2 shows the video signal waveform, at line rate, obtained when this pattern is scanned by a good-quality flying-spot scanner and shows that upper frequencies are down in amplitude. Aperture distortion is free of phase shift, however, provided the scanning beam is symmetrical with respect to cross-sectional area.

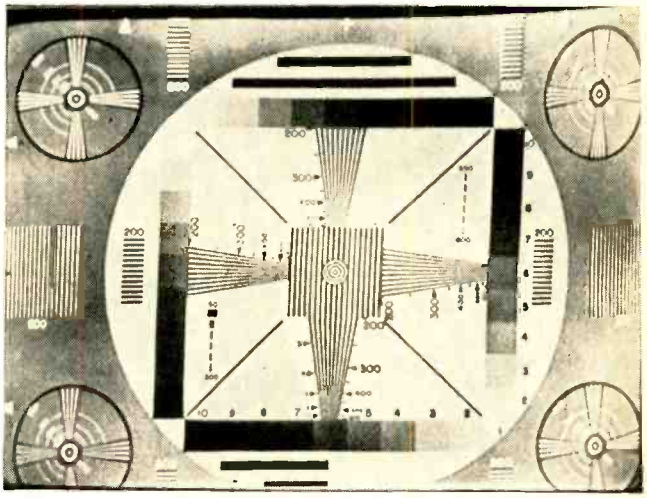
Conventional Equalization

To equalize for aperture distortion an amplitude boost to the high frequencies of the video signal is required. Linear phase (constant delay) at all frequencies must be preserved to prevent phase distortion. This compensation restores the high frequencies to their proper

Sharpens Tv Pictures



Test pattern reproduction using transversal-filter aperture equalizer



Improved test pattern definition achieved by highlight equalizer

amplitude to reproduce a high-definition image on the picture tube.

Of a number of equalizer designs, one popular circuit that has considerable flexibility of adjustment is the transversal type of filter, in which video voltages are tapped at various points along a delay line. The tapped voltages are properly summed together to form the equalizer.

Flat Frequency Response

An inherent characteristic of this filter is that it is free of phase shift. Two front panel controls are usually available to determine how the voltages at tapped points are weighted and they can be set to give a flat response or a rise with frequency.

Although the present aperture-equalizing circuits increase the sharpness of television pictures, the disadvantage is that the high-frequency noise present in the video signal is also increased.

It is quite often necessary in practice to effect a compromise whereby the fine picture detail is improved to a point where further equalization will introduce more than a tolerable amount of noise.

Minimizing Noise

The highlight aperture equalizer to be described operates without excessive increase of noise. As its name implies, it equalizes the picture highlight portion only, that is, the gray-to-white region. This is effective when the video signal is generated by a camera that uses an image orthicon, for such a signal has most of the noise concentrated in the lowlight levels.

Beam Discharge

The electron beam of an image orthicon camera tube discharges the target and it is the return beam to the multiplier that conveys the video information. This return beam is minimum at scene highlights and maximum at lowlights. The noise in the output of an image orthicon is proportional to the square root of the return beam current. Thus the noise is greatest in the lowlights where the return beam is maximum.

The human eye is most sensitive to fine detail in the highlights and less sensitive to details in the shadows.

Therefore by aperture equalizing just the highlights of the video signal the sharpness of the picture is increased where the eye is most sensitive and the noise increase resulting from equalization is far below that obtained when the entire signal is equalized.

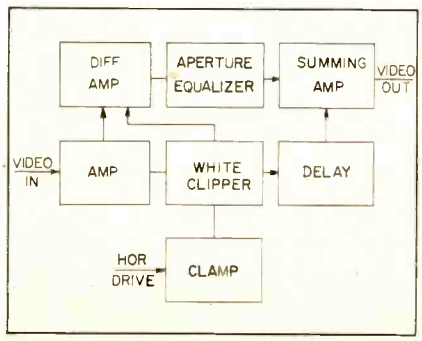


FIG. 3—Functions of highlight equalizer

Equalizer Functions

A block diagram of the highlight equalizing circuit is shown in Fig. 3. The complete video signal is amplified and applied to two different stages, a white clipper and a difference amplifier. Horizontal drive is also applied to the clamp portion of the circuit. The video signal is clamped at the white clipper where the highlights are clipped from the signal. From the clipper stage the signal is applied to the difference amplifier and also to the delay block.

Highlight Extraction

The inputs to the difference amplifier are the full video signal and the clipped signal. The clipped signal is subtracted from the full signal and the remainder is the same portion of the highlights which was cut off in the clipper stage.

From the difference amplifier the highlight portion is applied to the

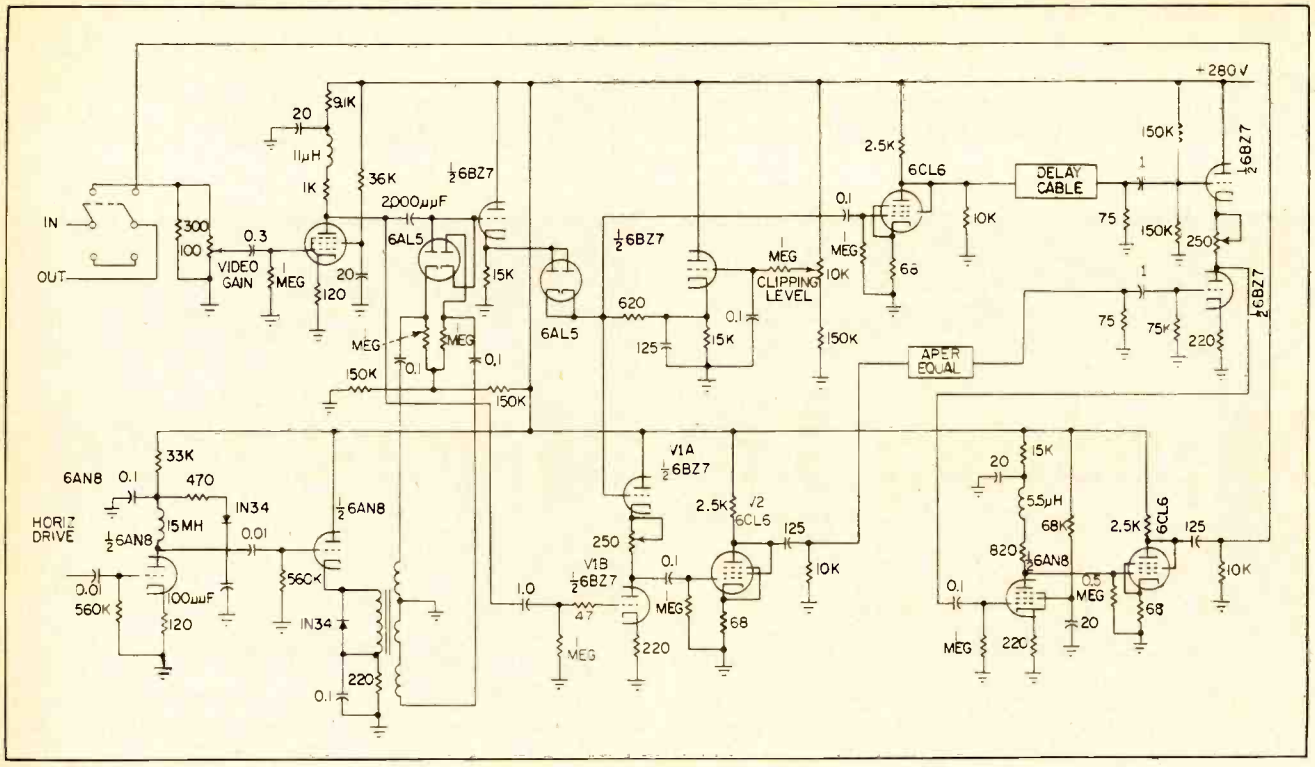


FIG. 4—Overall schematic of experimental equalizer. Conventional video chains can easily be modified to incorporate this circuitry

equalizing circuit. This circuit boosts the high-frequency components present in the highlight portion of the signal. Since the aperture equalizer is the transversal-filter type, the highlight portion of the signal is delayed approximately 0.2 μsec. An equal amount of delay must be introduced in the path of the unequalized lowlight portion of the signal.

Combined Signals

The signals from both paths are applied to a summing amplifier where they are combined to form the full video output signal. The clipping level is adjustable. With nothing clipped from the signal there is complete cancellation in the difference amplifier and nothing is equalized.

On the other hand note that if the entire signal is clipped, there is no subtraction in the difference amplifier and the entire signal is equalized. Thus the clipping level determines what portion of the signal highlights is to be equalized.

The difference amplifier portion of the circuit comprises V_1 and V_2 of Fig. 4. The subtraction takes place in the double-triode section. The full video signal is applied to the lower control grid and the same signal with the whites clipped off is applied to the upper control grid. The difference, which is the scene whites or highlights, is applied to the next stage.

Subtraction

The double-triode stage can be analyzed briefly by considering both of the cathode resistors to be shorted. The plate of the lower section works into the cathode of the upper section which presents an impedance equal to $1/G_m$. Thus the gain of the lower section is approximately unity.

In operation the upper section can be thought of as a cathode follower also having a gain of approximately unity. Subtraction takes place when the signal of the lower section goes through a polarity reversal while the signal of the cathode-follower section does not.

Summing

With the resistors in the circuit the potentiometer is adjusted to equalize the gains which are less than unity. The 6CL6 stage drives the standard aperture equalizer having 75 ohms input impedance. For the summing amplifier the same circuit as that shown for the difference amplifier is used, except that the polarities of the two inputs are arranged to provide summation rather than subtraction.

System Performance

The highlight aperture equalizer was laboratory tested using a black-and-white image-orthicon chain and performed as expected. The fine detail was enhanced in the highlights without an objectionable increase of noise. When the clipping control was adjusted to equalize the entire signal with the same equalizing setting the noise became objectionable.

The highlight unit has also been used with an NTSC color system by placing it in the Y path of a color encoder.

When placed in this position the luminance portion of the signal is aperture equalized and it sharpens the picture without an objectionable amount of noise characteristic of a standard equalizer.

Noticeable improvements in picture resolution can be obtained by equalizing only the top 10 to 15 percent of the hightlights, but initial experience with the circuit indicates that most desirable results are obtained when the top 25 to 50 percent of the signal is equalized.

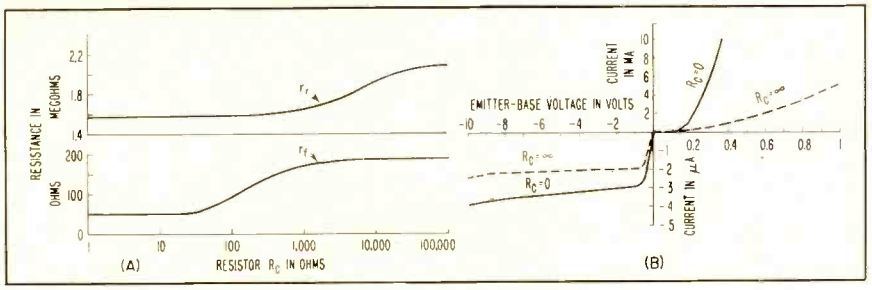


FIG. 1—Forward and reverse resistances of transistor-diode are plotted as functions of variable resistor R_e (A). Varying R_e rotates characteristics about origin (B)

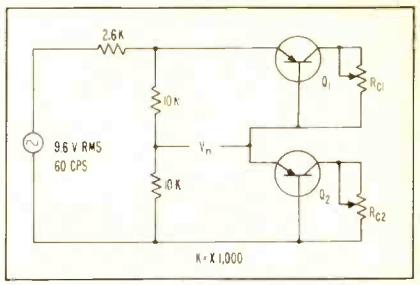


FIG. 2—Matched transistor-diodes have R_c between collector and base

Matching Transistor-Diodes

SUMMARY —— Emitter-to-base circuit of transistor has characteristics comparable to ordinary diode. Variable resistor connected between collector and base alters characteristics to achieve matching

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MISMATCH between a pair of diodes in a modulator or demodulator sets a lower limit to sensitivity and linearity.

Difficulties normally encountered with ordinary diodes are overcome by employing emitter diodes of transistors. Matching is accomplished by varying a resistor connected between the collector and base of the transistor. Since active elements are not involved, most rejected transistors can serve as transistorized diodes.

Control

The diode in the emitter-base circuit of a transistor has characteristics comparable to those of an ordinary diode of similar size and material. Forward and reverse resistances of a transistorized diode are lower when the collector is shorted to the base than when the collector is open circuited.

Experimental investigations with 2N131 a-f germanium transistors showed that a certain amount of control can be exercised over the diode characteristics with a variable resistor R_c connected between the collector and the base.

Varying R_c between zero and infinity increases the forward resistance r_f by a factor of 2.6 and the reverse resistance r_r by a factor of 1.5.

Resistance Change

Most of the change in r_f occurs when R_c is varied between 50 and 500 ohms and most of the change in r_r occurs when R_c is varied between 1 to 50,000 ohms. Consequently, adjusting r_f leaves r_r virtually intact and vice versa. Varying R_c rotates the entire diode characteristics about the origin of the V-I field.

A graph of r_f, at $I = 5$ ma and r_r at $V = -6$ v as functions of R_c for a 2N131 transistor is shown in Fig. 1A. The volt-ampere characteristics of a similar transistorized diode with R_c equal to zero and infinity are shown above in Fig. 1B.

Performance

The circut used to evaluate the matching conditions between transistorized diodes is shown in Fig. 2. Since the 10,000-ohm resistors were precision components, the null voltage V_n was taken as a measure of the mismatch between the two diodes. Source voltage and impedance were chosen for a peak forward current of about 5 ma through the diodes and a peak reverse voltage of about 12 v across them.

Components

A pair of 2N131 transistors, Q_1 and Q_2, were found to have the following characteristics: $40 < r_{f1} < 110$ ohms, $1.6 < r_{r1} < 2.2$ megohms, $44 < r_{f2} < 120$ ohms and $1.8 < r_{r2} < 3$ megohms. Matching by adjusting r_{r1} and r_{f2} was accomplished by using 50,000-ohm and 500-ohm potentiometers for R_{c1} and R_{c2} respectively.

With $R_{c1} = R_{c2} = \infty$, V_n was 1.1 v p-p. With $R_{c1} = R_{c2} = 0$, V_n was 1 v p-p. With $R_{c1} = 10{,}000$ ohms and $R_{c2} = 300$ ohms, the minimum null voltage of 0.1 v p-p was obtained. Balance condition was thus improved by a factor of ten.

Where the initial mismatch in characteristics is more pronounced, the improvement using this matching method is greater.

SUMMARY —— Test instrument measures hysteresis properties of small magnetic toroids used in coincident-current memories and high-speed magnetic amplifiers. Flux, drive current, remanent flux to maximum flux ratio, squareness ratio and ratio of coercive force to maximum magnetizing force are read directly from window potentiometers as B-H loop is presented on crt. Performance of single-turn, 60-cps hysteresis loop equipment is accurate to within one percent on measurements of the B-H coordinates of any point on the loop of samples with a saturation flux linkage of one maxwell-turn

By **T. H. BONN, R. D. TORREY** Remington Rand Univac, Division of Sperry Rand Corp., Philadelphia, Pa.
and F. BERNSTEIN Fischer and Porter Co., Hatboro, Pa.

B-H Tester Measures

PRODUCTION of small, high-speed magnetic amplifiers and ferrite memory cores for use in digital computers required the development of a suitable instrument for measuring magnetic parameters of small toroids. Standard methods do not provide accurate and sensitive measurement of cores with a flux of about one maxwell. The ballistic galvanometer and Cioffi fluxmeter lack required sensitivity. Conventional crt techniques also do not provide sufficiently accurate and sensitive core measurement.

The single-turn, 60-cycle hysteresis loop tester described here is about 200 times more sensitive than previously described fluxmeters. Measurements with the tester can be performed with an accuracy within one percent on magnetic parameters of a core whose saturation flux is one maxwell. Since the tester is a single-turn device and no multiturn windings are necessary, operation is rapid and simple.

The entire tester is contained in a 6-ft relay type rack. Main elements of the tester are within easy reach of the operator. Rack also contains the oscilloscope, power supplies, battery charger and standardizing meters.

All parameters are measured by a null or coincidence method, using a crt as the indicator. Measurements are independent of scope linearity. The instrument provides a coordinate display of flux as a function of magnetizing force. From 10-turn, three-window linear potentiometers, direct readings may be taken of flux, drive current, the ratio of remanent flux to maximum flux B_r/B_m, squareness ratio, and the ratio of coercive force to maximum magnetizing force H_c/H_m. Squareness ratio is important in evaluating rectangular-loop memory-core performance. Quantities B_r/B_m and H_c/H_m are important for evaluating rectangular-loop cores in both memory and magnetic amplifier applications. The tester can be easily adapted to measure directly other points on the hysteresis loop.

Block Diagram

Block diagram of the hysteresis loop tester is shown in Fig. 1. A 60-cps drive current $I(t)$ is produced by an adjustable current source. This magnetizes the core which generates a core flux, $\phi(t)$. The flux links the pickup winding of the core to produce a voltage dependent on the time rate-of-change of flux. The signal is then integrated to produce an output voltage directly proportional to $\phi(t)$ and is presented on the Y-axis of the oscilloscope.

Output of the integrator may be sampled and measured with the

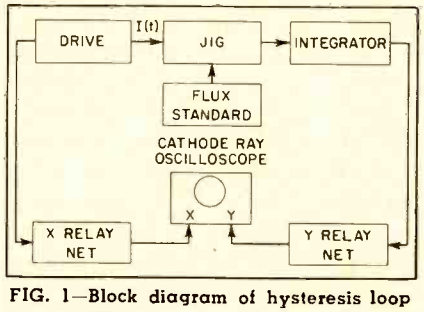

FIG. 1—Block diagram of hysteresis loop tester. Flux standard is conventional mutual inductor of 1.198 μH used to generate artifical ideal loop. Drive circuits magnetize core in test jig. Core generates flux that links pickup winding of core to produce a voltage which is integrated and presented on Y-axis of scope. The X-axis signal produced is proportional to drive current for proper display

Test jig is used for mounting unwound magnetic core. Jig consists of coaxial single-turn drive wire and pickup tube

Operator performs measurements on ferrite memory core used in digital computers. Hysteresis loop of core is displayed on scope. Tester consists of long time-constant transformer, integrator, various measuring circuits and a jig which is at right on table platform

Memory Core Parameters

scope as the indicator. The X-axis signal voltage is proportional to the drive current and, hence, to magnetizing force. X-axis signals may be modified or switched synchronously with the Y-axis signals to provide the display desired. The oscilloscope serves also as an indicator for X-axis measurements.

Drive and Pickup Circuits

Drive and pickup circuits are shown in Fig. 2. Drive current is determined by a variable 60-cps voltage source E in conjunction with a bank of five resistors whose values are known to within one percent.

The test jig which consists of a coaxial single-turn drive wire and pickup tube called core rod, holds the core to be tested. The front cover plate has been removed. The bottom part of the jig has contact tabs that are glued in each of four vertical slots under the core rod. Connections are made from these tabs to a pickup transformer, located beneath the jig. Insulated spring fingers, mounted on the hinged top of the jig, press on the core rod to ensure good contact between the tabs and the various sections of the core rod. Two phenolic blocks on the core rod are for positioning.

The pickup tube is divided into two insulated sections so that an air flux cancellation loop, having the same area and position with respect to the drive wire as the pickup loop, can be used. The cancellation loop rejects any signal in the pickup loop because of drive current in the absence of the core. This permits the insertion of the core to produce an output as a result of core flux only. Tube and contact tabs are gold-plated to minimize contact resistance.

The entire jig, including contact tabs, pickup loop and air flux cancellation loop, is extremely rigid. A narrow slot automatically positions the core rod in a repeatable manner whenever the jig is closed. Careful measures to ensure rigidity are necessary to maintain constant air flux compensation and to keep contact resistance to the core rod at a low value.

Made of a supermalloy core with a 15-turn primary and a 15,000-turn secondary, the transformer has a voltage gain of 1,000 and must pass a wide frequency spectrum. Analysis shows that for an $H_m \geq 5H_c$ the upper 3 db point required for a one percent error in H_c is 20 kc. The lower 3 db point for production of B_r/B_m to an accuracy of one-quarter percent is less than one cps. A long time-constant primary is necessary to ensure undistorted 60-cps components. The time constant is limited because primary resistance must be at least 100 times the contact resistance variation of the jig to avoid significant errors as a result of changes in contact resistance.

Since the transformer has a small time constant, 0.08 second, the overall system must be compensated with a bass-boost circuit. Compensation requires that the hysteresis loop of an ideal material be reproduced with fidelity. This hysteresis-loop tester reproduces an ideal B-H loop, one which has a B_r/B_m of unity, to within one quarter of one percent.

Another transformer design consideration is that the equivalent primary impedance be sufficiently large to avoid loading the core be-

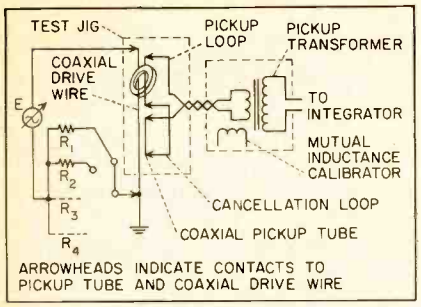

FIG. 2—Schematic of drive and pickup circuits. Voltage source *E* consists of variac and 6-v, 20-a filament transformer enabling precise control over drive current during test

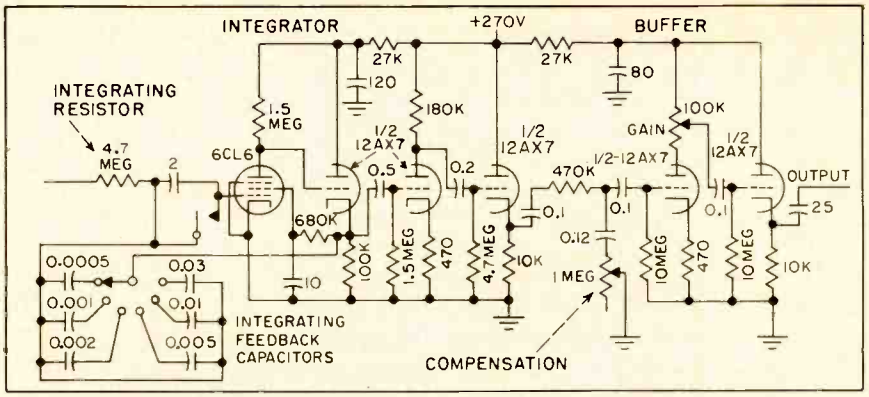

FIG. 3—Schematic of integrator and buffer amplifier. Integrator generates output voltage directly proportional to $\phi(t)$ for eventual display on crt

ing tested. Loading impedance is the open-circuit primary inductance in parallel with the reflected value of the integrating resistor. The transformer, in conjunction with an integrating resistor of 4.7 megohms, permits better than one percent reproduction of coercive force as small as 0.1 oersted and a mean diameter as small as 0.1 inch. Cores may be driven with a maximum magnetizing force five times the coercive force and still maintain one-percent accuracy in H_c. For larger cores, a transformer with a higher primary inductance and a lower turns ratio is required.

Integrator and Buffer

Integrator circuitry and buffer amplifiers are shown in Fig. 3. Overall system compensator located in the buffer amplifier chassis is also shown. The integrator consists of a 6CL6 starved-pentode Miller feedback amplifier, d-c coupled to a 12AX7 cathode follower. This follower supplies low-impedance coupling to the signal grid of the 6CL6 for the integrating-feedback capacitor. The 12AX7 is also coupled to the 6CL6 screen to improve stability. Forward gain of the integrating amplifier is 600. Both the integrator and buffer use battery supplies for hum-free operation.

The integrator must be capable of producing a square wave from an impulse whose repetition rate is 60 cps, such as the output of a rectangular-loop core under high drive conditions. Response of the integrator to a unit impulse is $\epsilon^{-1/RC}$ One percent droop over a period of 8.3 milliseconds (one-half of a 60-cps period) requires an R-C time constant of 0.83 second. A time-constant of about 1.25 seconds is used in this tester to compensate for tube aging.

Flicker-effect noise is a major limitation of the sensitivity of the amplifiers. At low frequencies, it may greatly exceed shot noise. This is because flicker-effect power for each cycle varies inversely with frequency while shot-noise power is invariant. Furthermore, because of its gain characteristic at low frequencies, a 60-cps integrator enhances flicker-effect noise. For example, with an integrator time-constant of 0.83 second, the gain at 0.6 cps is about 70 times the gain at 60 cps.

Other disturbances considered are microphonics and normal tube noises such as shot noise and induced grid noise. Shock mounting of the integrator minimizes microphonics. Low-frequency components of the other tube noises are trivial compared to flicker effect. High frequency components are integrated and cause no disturbance.

Maximum Magnetizing Force

Main core parameters to be determined are the maximum magnetizing force H_m, coercive force H_c, maximum flux density B_m, various ratios such as remanent flux density to maximum flux density B_r/B_m and squareness ratio.

To determine H_m, peak drive current of the core being tested must be known. This is found by measuring the voltage across the accurately known, current-limiting drive resistors. The quantity H_m is related to the current by the physical dimensions of the core and may be determined with a nomograph.

The crt display during this measurement is a simultaneous presentation of part of a hysteresis loop and a vertical line. Displacement of the vertical line from the X-axis is determined by a variable d-c

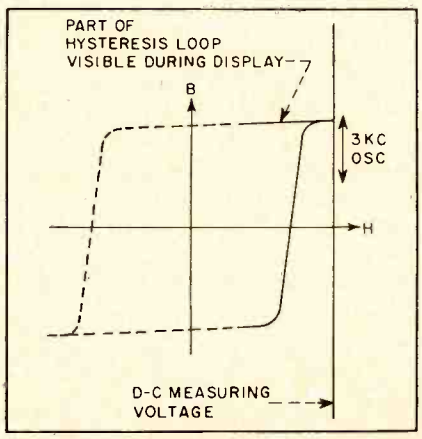

FIG. 4—Example of hysteresis loop being measured for drive current as generated by two synchronized relays

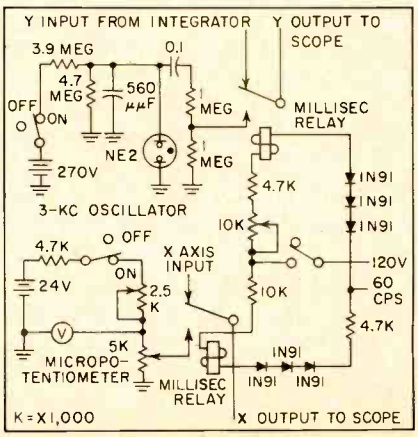

FIG. 5—*H* calibrator circuit provides accurate reading of instantaneous value of *H* occurring at any point on loop

voltage. This voltage is taken from the adjustable arm of a direct, window-reading potentiometer.

The scope presentation may be expanded several times to determine precisely the coincidence of the loop tip and the vertical line. A typical example of a hysteresis loop being measured for drive current is shown in Fig. 4. This display is generated with two synchronized relays. The X-axis oscilloscope input is chopped between the signal normally present with a hysteresis loop display, the 60-cps voltage across the current-limiting drive resistors, and the d-c measuring voltage.

Switching

The Y-axis input is chopped between the input normally present with a hysteresis loop display and a circuit used to produce the vertical line. The circuit producing the vertical line or Y-axis is a neon-bulb sawtooth oscillator operating at a frequency of approximately 3 kc. See Fig. 5, *H* calibrator. Relay timing permits the neon-bulb oscillator and the d-c calibrating voltage to be presented simultaneously. The relays display the hysteresis loop in such a way that approximately half of the loop is shown, usually the right half, together with a vertical line. The *H* calibrator measures the value of *H* of the intersection of vertical line and the hysteresis loop. The Y deflection of vertical line is obtained from precision d-c sources. The circuit is adjusted so that the micropotentiometer always has 10 v d-c across it.

Quantity B_m is evaluated by the formula $B_m = \phi_m/A$. Cross-sectional area A of the core being tested can be measured directly. The technique for measuring maximum flux is to subtract an accurately known artificial, ideal hysteresis loop from the loop under test. The artificial ideal loop is generated by driving an accurately known mutual inductor (flux standard) located in the primary side of the pickup transformer, with a square-wave current as shown in Fig. 2. This introduces a voltage impulse into the primary of the pickup transformer which is equivalent to the output of an ideal rectangular-loop core. The mutual inductor output is 180 degrees out of phase with respect to the output of the core and, therefore, subtracts from it.

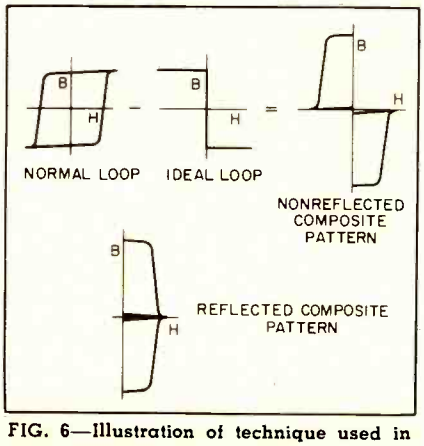

FIG. 6—Illustration of technique used in flux measurement. To obtain maximum flux, size of artificial loop is adjusted until the tips of reflected composite pattern are on same horizontal line

The inductor consists of a phenolic toroid with a multiturn primary and a single-turn secondary, electrostatically shielded. The single-turn secondary is in series with the primary of the pickup transformer. The phenolic mutual inductor and pickup transformer are potted together in a mu-metal shield can.

Technique used in flux measurement is illustrated in Fig. 6. To measure maximum flux, the square wave current amplitude, hence the size of the artificial loop, is adjusted until the tips of the composite scope pattern are on the same horizontal line. This is most accurately done by reflecting the composite pattern about its vertical axis making tips coincident.

Square-Wave Source

Square-wave current is generated by a relay chopper in series with a storage battery and current-limiting potentiometers. A precise monitoring resistor in series with the mutual inductor establishes a voltage directly proportional to the square-wave current peak value.

After the loop tips have been made coincident, the chopper relay is kept closed. A second relay compares the d-c voltage across the monitoring resistor with an accurately-known voltage read directly from a window-reading potentiometer previously adjusted to a full scale value of, for example, 10 maxwells. The crt is used to determine the equality of the d-c voltages. By referring to the fundamental relationship for the air-core mutual inductor the window-reading linear potentiometer is adjusted for direct reading. This relationship is represented by

$$MI = 2N\phi \times 10^{-8}$$

where M is the value of mutual inductance; I is the peak value of square-wave current; ϕ is the value of flux of core under test; and N is the number of pickup turns.

Considering this relationship for a single-turn device, the basic measurement is

$$\text{Flux} = MI\ 10^8/2$$

Making the oscilloscope pattern tips coincident requires cancelling peak-to-peak flux and gives rise to the factor of 2. To set the full-scale reading of the ϕ_m potentiometer,

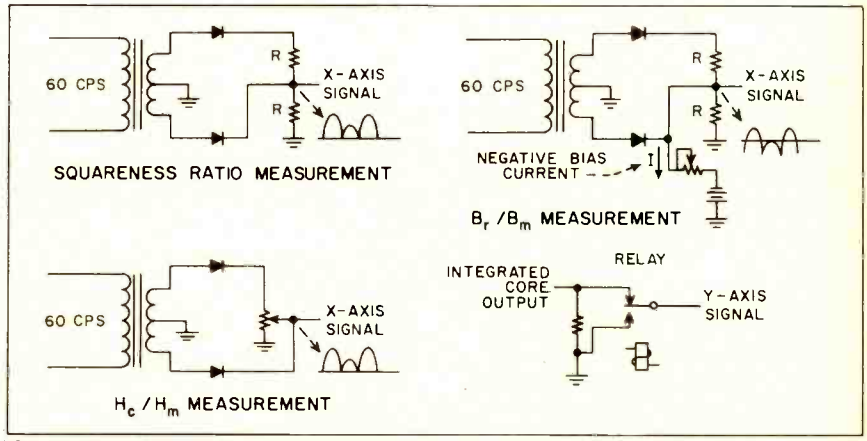

FIG. 7—Networks for measuring squareness ratio. B_r/B_m and H_c/H_m

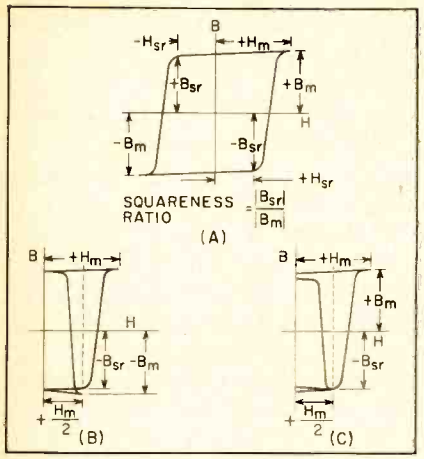

FIG. 8—Illustration of definition of squareness ratio as found by tester

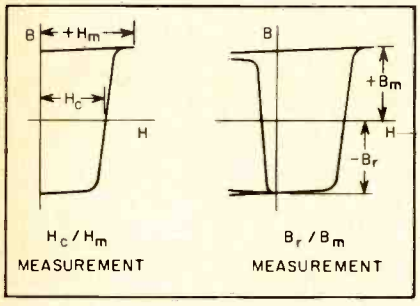

FIG. 9—Displays for measurement of ratio of coercive force to maximum magnetizing force and ratio of remanent flux to maximum flux as produced by tester

an accurately known d-c corresponding to, for example, 10 maxwells, is passed through the precisely known monitoring resistor. Then the full-scale voltage of the window-reading potentiometer is adjusted until it is exactly equal to the voltage of the monitoring resistor.

Ratio Measurements

Ratio measurements useful in evaluating magnetic materials are B_r/B_m, H_c/H_m, and squareness ratio. Circuits used in these measurements are illustrated in Fig. 7.

In general, the Y-axis oscilloscope input in all the displays is obtained by sampling either the full or an adjustable portion of the integrator signal with a relay. The X-axis input is either the full amplitude or an adjustable part of a full-wave rectified 60-cps sine wave which is in phase with the drive current. The 60-cps sine wave is not varied as the drive is varied.

The principle can be shown by explaining the determination of squareness ratio. Squareness ratio is useful in evaluating signal-to-noise performance of cores in digital-computer coincident-current memory applications. Its definition is illustrated in Fig. 8A. Symmetry of the B-H loop permits a knowledge of a $\pm B_{sr}$ and a $\pm B_m$ to determine the squareness ratio.

The quality H_{sr} is one-half of H_m. The $-H$ side of the hysteresis loop is reflected about the vertical axis and the H attenuated by one-half. This is accomplished by substituting the waveform shown for the normal sinusoidal X-axis signal. The output of one of the two diode rectifiers is attenuated by one-half with a resistor divider. This locates the $-B_m$ tip at ± 0.5 H_m, hence along the same vertical reference line as $-B_{sr}$, in Fig. 8B.

While the X-axis input is being presented, a relay in series with Y-axis input switches alternately between the full-amplitude integrated signal and a specific part of it. The integrated signal is impressed across a linear window-reading potentiometer.

The Y-axis relay chops between the top of the potentiometer and the adjustable arm. Timing of the relay permits the full rectified X-axis signal and the full-amplitude Y-axis signal to be presented together. The half-amplitude rectified X-axis signal and the adjustable reflected Y-axis signal are formed with the coordinates during the next half cycle. Then, the reflected $-B_m$ is adjusted with the potentiometer until it is coincident with the hysteresis loop in Fig. 8C.

Oscilloscope gain can be increased by a large factor for closer inspection of the coincidence. Direct reading from the window dial of the potentiometer gives a quick and precise determination of squareness ratio.

An optimum squareness ratio is the largest possible with a given core. The independent variable is the exciting current. Maximum squareness ratio can be readily determined by observing the coincidence on the scope while slowly varying the drive current Variac and readjusting the squareness ratio potentiometer until the highest reading is obtained.

Determining B_r/B_m and H_c/H_m

Displays for B_r/B_m and H_c/H_m evaluations are shown in Fig. 9. Determination of B_r/B_m is similar to the technique for finding squareness ratio, except that the adjustable $-B_m$ tip is arranged to occur exactly at the point of zero magnetizing force. The X-axis voltage is obtained by inserting a negative current at the resistor divider junction and adjusting its value to position the $-B_m$ tip correctly. This adjustment is independent of the peak drive since the X-axis voltage is fixed, although the drive is variable.

The H_c/H_m ratio differs from the squareness ratio in that the Y-axis signal relay chops between the full integrated signal and zero signal. This chopping forms a horizontal line which lies on the H-axis of the hysteresis loop. The X-axis display is changed so the output of one of the diodes can be adjusted with a linear window-reading potentiometer. This potentiometer is adjusted until the horizontal line is coincident with the side of the loop. The dial shows H_c/H_m directly.

A hysteresis loop display for a single core is shown in Fig. 10.

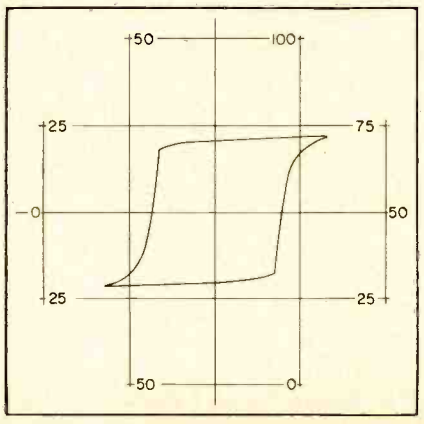

FIG. 10—Hysteresis loop of a single ferrite memory core used in computers

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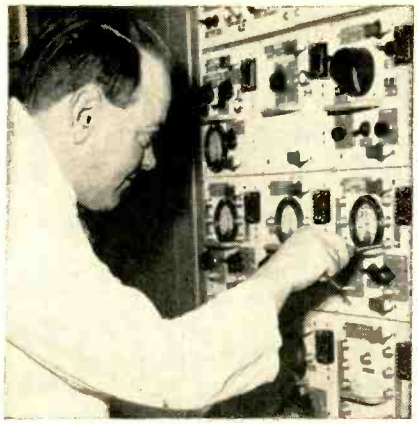
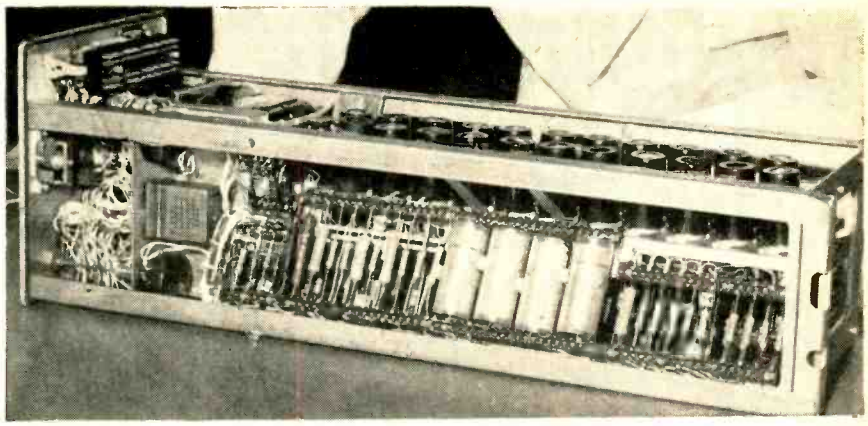


Zero-balance is set at front panel



Rack-mounted unit contains two 4-way electronic selector switches

Electronic Switch Doubles as Cathode Follower

SUMMARY — Basic two-way electronic switch may be expanded to multi-way unit by adding input selector circuits, or may be used as a precision cathode follower by eliminating the selector. Circuit has near-infinite input impedance and near-zero output impedance. Comparator compensation permits accuracy of 0.1 percent over ±100 volts

By **R. BENJAMIN** Senior Principal Scientific Officer, Royal Naval Scientific Service, Admiralty Signal and Radar Establishment, Portsmouth, Hants, England

MANY ELECTRONIC SYSTEMS require a device to sample two or more voltage sources and present the instantaneous values of the input functions to other units in the system. The sources being sampled may consist of steady voltages, pulse trains or complex waveforms. The simpler electronic switches such as the conventional diode type, are not sufficiently accurate for many purposes, while the additional requirements of high input impedance and low output impedance frequently arise.

The switch described here is designed to reproduce input voltages of ±100 v with an accuracy of 0.1 percent. The inputs to be sampled are selected by appropriate switching pulses. The input impedance of the switch is virtually infinite while the output impedance is extremely low. By omitting the selector portions of the circuit the unit can be used as a precision cathode follower.

Basic Switch

The general form of a switch for sampling two voltage sources is shown in Fig. 1. Comparator circuit C_1 compares one of the input voltages with the output. Any difference between these voltages causes a change in the output of the comparator and this error is fed to amplifier A, bringing the output signal into alignment with the input. Similarly C_2 compares the second input voltage with the output. At any particular instant only one of the comparators is operative, their conduction determined by the switching pulses S_1 and S_2. Any number of sources may be sampled by this means if more comparators and suitably-timed switching pulses are provided.

In an ideal comparator circuit the output voltage should depend only on the difference between the two input voltages and be independent of the actual levels. This condition can be achieved by the arrangement shown in Fig. 2, in which identical comparator tubes are supplied from a constant-current source.

If equal voltages are applied to the two grids the constant current will divide equally between the tubes and the output of each will

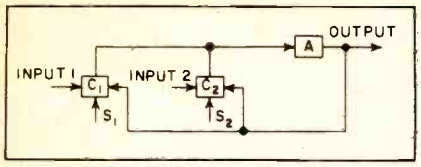


FIG. 1—Basic 2-way switch with feedback

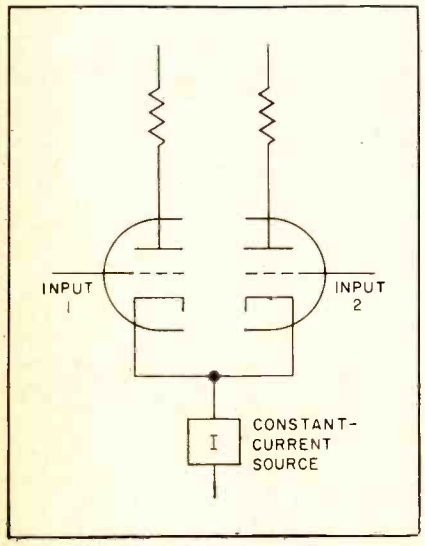


FIG. 2—Identical comparator tubes with constant-current source keep output responsive only to input difference

remain constant. Any difference between the voltages applied to the grids, however, will cause a change in the output. If the tubes are not identical the constant current divides unequally between them and the division of current will vary as the level of the equal input voltages changes.

This produces false error voltages at the plates even though the grids are driven by identical signals. Consequently errors will occur in the output of the circuit of Fig. 3 where the comparator is connected to a high-gain feedback amplifier to cause the output to follow a given input. The division of current between the tubes when the grid voltages are identical can be adjusted for any input level by resistor R_1.

Tubes do not normally remain balanced over the whole dynamic range of input voltages, however, and a further source of error in this sample system results from the fact that amplifier A has a finite gain. Hence some voltage difference must occur in order that the output may follow the input even approximately. Refinements to the basic circuit are therefore necessary to mitigate these defects.

If the simple comparator of Fig. 3 is balanced at one particular value of cathode current and input voltage, this condition will remain undisturbed as long as the cathode current and plate voltage remain constant. As the cathodes are already supplied from a constant-current source, it only remains to provide a source of constant potential for the two plates. This can be achieved in principle by the circuit shown in Fig. 4 where the cathode followers V_{2a} and V_{2b} provide the plates of V_{1a} and V_{1b} with a voltage which always exceeds E_o (and at balance E_i) by the constant voltage-difference E_1, represented here by a battery. With this arrangement only the small imperfections in the operation of the constant-current and constant-voltage circuits can influence V_1 and R_1 can be used to correct any initial asymmetry of the circuit.

An additional advantage of this arrangement is that, since the plate potential of the comparator tube remains constant, the maximum possible gain of $0.5\ g_m R_L$ is provided for differences between the voltages applied to its grids; the factor 0.5 arises because the voltage difference between the two grids is shared equally by the tubes.

In a practical system there still remain errors due to the finite gain of the amplifier which follows the comparator, since some change of voltage at the input to the amplifier must occur in order that its output follow any changes in the input to the complete unit. For an ideal unity-gain comparator followed by an amplifier of gain A, an error voltage E_o/A must exist at the input to the amplifier. If the amplifier gain is known this error voltage may be artificially produced by reducing the output voltage by a potentiometer chain in the ratio $(A-1)/A$ before applying it to the comparator. In this way E_o can remain equal to E_i while the comparator produces a control voltage of E_o/A.

Residual errors due to differences between the gain of particular amplifier and the gain for which the correction was designed will still remain if a fixed correction circuit is used, but if unusually high accuracy is required for a short period the correction circuit can be adjusted to suit the gain existing at the time of use. Alternatively negative feedback with n the amplifier may be used to stabilize its gain.

Practical Two-Way Switch

The circuit of a two-way sampling switch employing two compensated comparators is shown in Fig. 5. The currents of comparator tubes V_1 and V_2 are maintained constant by V_{3A} and V_{3B} while V_4 is the compensating tube which maintains constant plate voltage on these tubes. The 47,000-ohm resistor R_1 is shared by V_{3A} and V_{3B}, which are controlled by switching pulses, allowing only one of the constant-current tubes to conduct and only one of the comparators to function at any particular time.

To avoid discontinuities in the output voltage of the system the switching pulses should be arranged so that when one comparator is switched off the other becomes operative. The output of the compensating tube V_4 is applied to a differential amplifier V_5 to reduce the effects of supply-voltage variation and stray pickup, and this is coupled to the output cathode follower V_7.

Any loss of either gain or dynamic range associated with the d-c coupling circuit between V_5 and

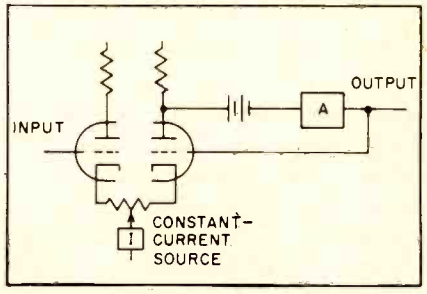


FIG. 3—Feedback added to comparator pair of Fig. 2

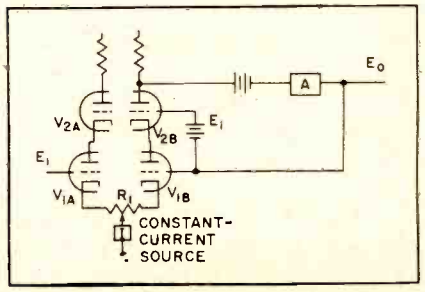


FIG. 4—Constant comparator potential is maintained by cathode followers

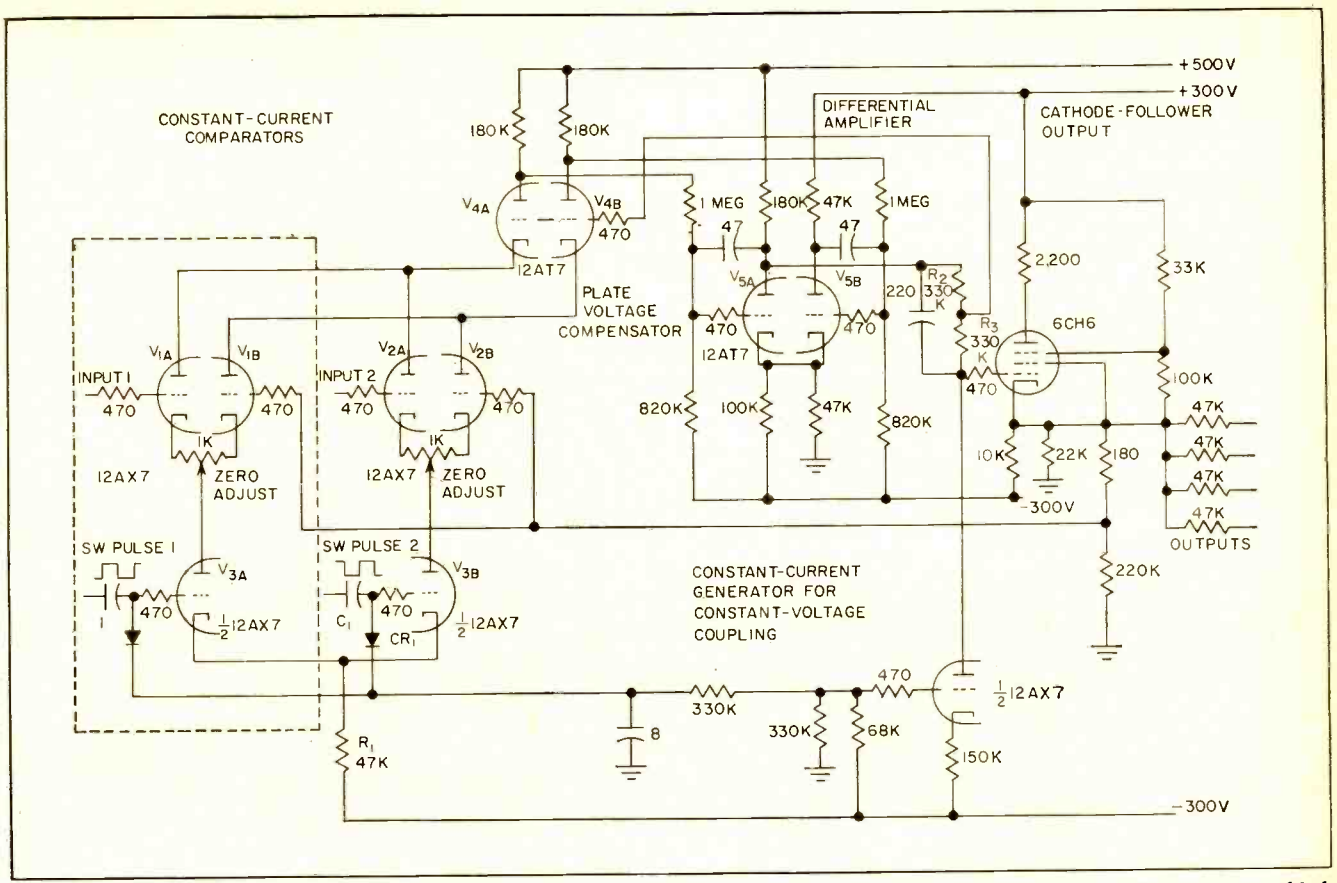


FIG. 5—Circuit of 2-way electronic sampling switch. Two compensated comparators are shown, any number of positions may be added. Used as multi-way switch, circuit needs three extra tubes for every two additional switch positions

V_7 is avoided by a constant voltage-difference coupling comprising R_2 and R_3 and constant-current tube V_6. Since the current in the coupling resistors is kept constant by V_6 the potential at their junction will exceed the grid voltage of V_7 and hence the output voltage by a fixed amount. This potential is thus suitable for supplying the grids of tube V_1.

The output cathode-follower stage V_7 was designed for a particular application in which it was desired to feed a number of long cables via the series resistors shown. This stage therefore had to be capable of supplying the charging current required by the cables when the output voltage changed from its maximum negative value to its maximum positive value or conversely. The unit will maintain a voltage accurate to ±0.1 percent at the ends of the remaining cables even when two of them are short-circuited.

If an extremely low output impedance is desired connection can be made directly to the cathode of V_7, the impedance at this point being about 0.1 ohm. Extremely high input impedance is another feature of the circuit due to the potentials of both plate and cathode of the input comparator tube following changes in the grid potential. Thus in the absence of external leakage resistance and stray capacitance the input impedance would be infinite.

Switching arrangements for balancing the comparators are not shown, but provision is necessary for switching off each comparator in turn and grounding the input of the alternate one. The circuit then operates as a cathode follower and the output voltage at the cathode of V_7 can be set to zero by the potentiometer in the cathode circuit of the active comparator.

Practical Applications

The unit shown can be enlarged to allow for additional input sources merely by adding sub-units similar to that enclosed by the dashed lines of Fig. 5. Conversely, by deleting the portion of the circuit within the dashed lines, the unit can be reduced to a precision cathode follower. In this case the switching pulse coupling capacitor C_1 can also be omitted and CR_1 replaced by a simple leak resistor.

As a cathode follower the circuit is valuable in the detection, transfer or measurement of voltages whenever the output device must not load the source. Typical applications arise in scientific instruments and analog computers.

As a multi-way switch the circuit requires three extra tubes for every two additional switch positions. However an n-way electronic switch can be used in conjunction with n electromechanical stepping switches of x ways each, to give a total of nx discrete selections. Each electromechanical switch would then receive a stepping impulse as soon as it has been sampled by the electronic switch. It must then complete its step during the time taken by the electronic switch in sampling the outputs of the remaining $(n - 1)$ stepping switches.

The author thanks H. S. Tomlin, who was responsible for the associated experimental work and the Admiralty for permission to publish.

Cathode-Ray Recorder

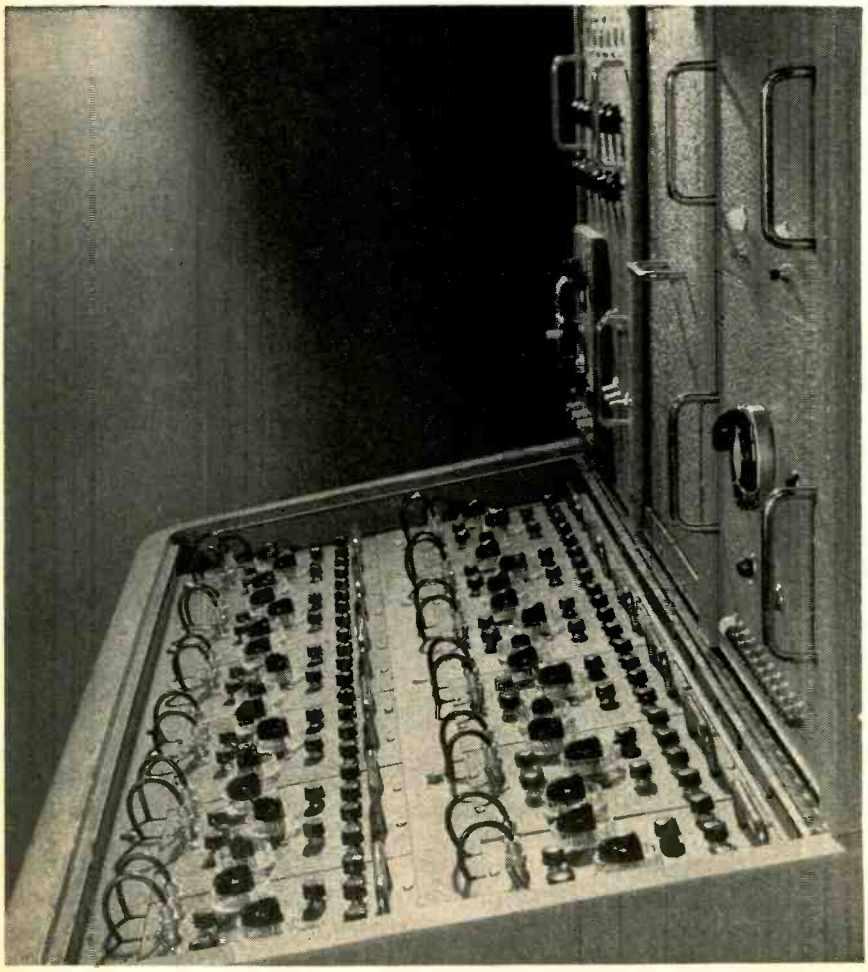
SUMMARY —— Selected portions of time base lines of different channels can be related and examined. Sweep speed is recorded. Closely-grouped cathode-ray tubes for each of 12 channels are photographed on 4 by 5 in. film. Projector, located in reading desk, enlarges film negative images to twice crt display size and presents four crt images simultaneously

By C. W. HARGENS Senior Staff Engineer, The Franklin Institute, Laboratories for Research and Development, Philadelphia, Pa.

IN RECORDING electrical phenomena simultaneously it is frequently desirable to show their relationship on different time bases or to select a portion of a time base and exclude the rest. This requirement led to the development of an electronic recorder system which permits the important portion of the trace to be selected and examined critically.

Twelve closely-grouped cathode-ray tubes, one for each channel of the system, are photographed by a 4 by 5-in still camera.

To study the records, a projector is used to enlarge the film negative to twice the size of the crt image. A reading desk which incorporates the projector permits close examination of four crt images simul-



Cathode-ray tube controls for each of 12 channels. Telephone-program dial is at right

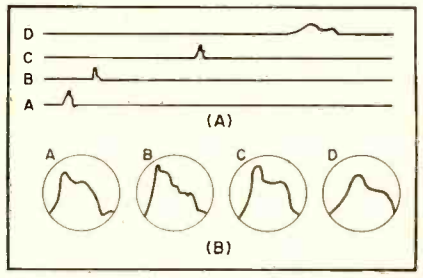


FIG. 1—Four signals are observed on common time-base records (A) and in closeup records

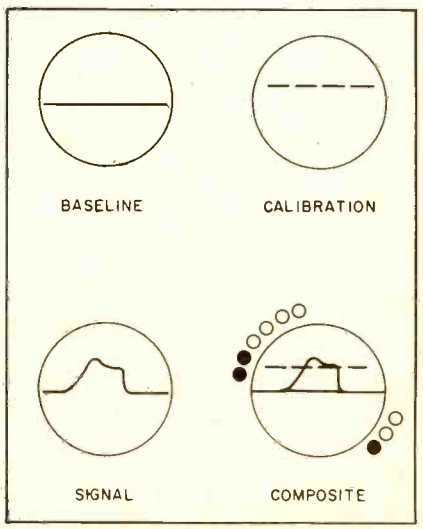


FIG. 2—Components of final film image are a base trace, a dotted calibration line and the signal transient

Compares Transients

taneously. Time bases of all channels can be related to each other. Other pertinent data are also recorded on the film automatically by auxiliary coding.

Timing

System timing is provided by an initiator pulse produced by the instrument for triggering the phenomenon or device under study. At various times thereafter signals arrive at the channel inputs to be recorded. Since each channel has its own crt display with an individual sweep circuit, any arrival time may be accommodated.

In a typical signal sequence, shown in Fig. 1, the signals vary in duration as well as occurrence time. Considerable variety in sweep speed and delay is required. For example, signal *A* might have a duration and a delay of approximately 1/4 millisec. On the other hand, signal *D* appears best using a 2-millisec sweep and a delay of 4 millisec.

Calibration

In addition to the signal, other traces are provided on the cathode-ray tubes. A solid baseline trace appears followed by a displaced trace composed of dashes. Since the displacement between traces provides the signal amplitude calibration and the dashes are of accurate time duration, this presentation provides calibration in both the X and the Y directions. Following these two calibrating traces, the signal transient is presented on a third sweep. The three steps are shown in Fig. 2 together with the composite image which appears on the exposed film.

Along the periphery of the composite presentation a series of illuminated dots appears. These indications register on the film and are permanent records of the sweep delay and attenuator settings of a particular channel.

Sweep-Speed Record

Provision was made for five sweep delays and for three attenuator settings. Since the same set of time marks is used for all channels, the dashed sweep provides a permanent record of the sweep speed used in each case. These time marks are 1/4 millisec duration and appear in numbers corresponding to the sweep speed on the screens.

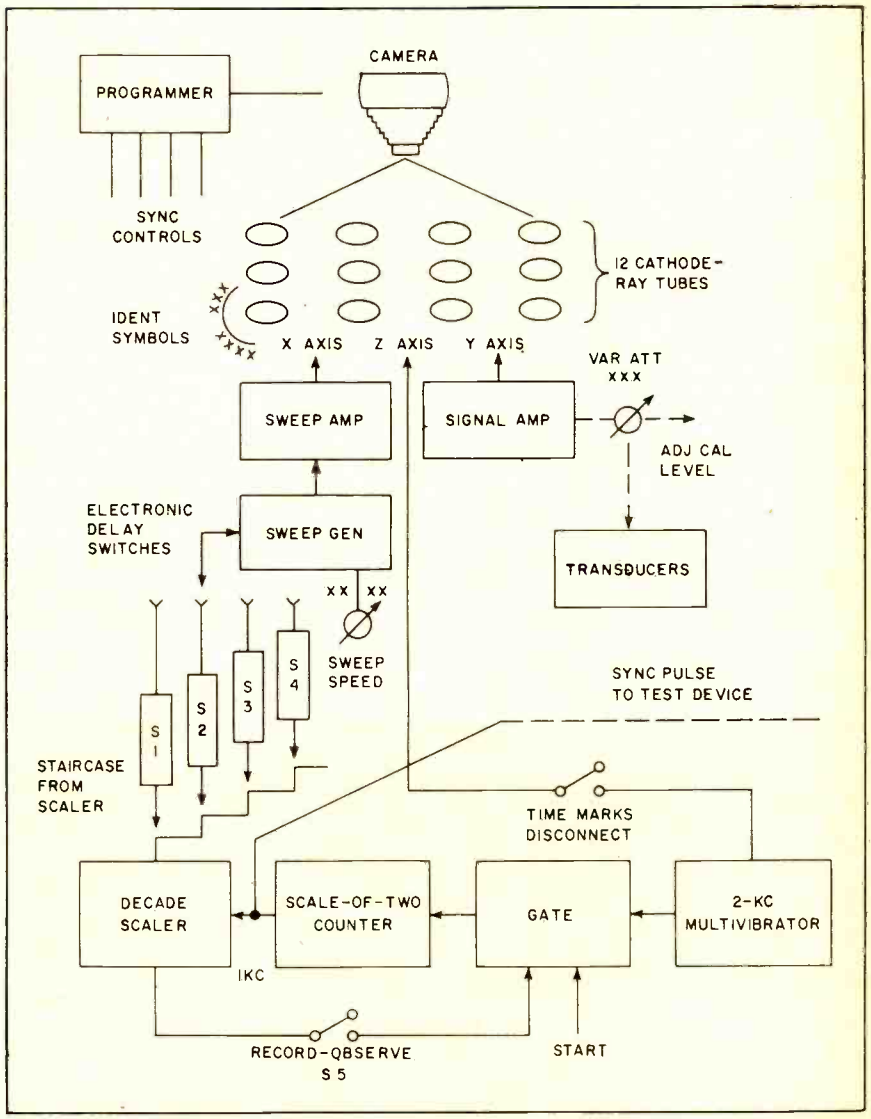


FIG. 3—System diagram for 12 cathode-ray tubes shows sweep generators and amplifiers for only a single channel

Electronic System

The novelty of the system rests upon the timing and synchronizing circuits. Time constants-supplied are illustrative and can be changed to suit the intended application of the instrument.

The synchronizing method may be traced in the system block diagram of Fig. 3. Twelve cathode-ray tubes of the display with their associated X, Y, and Z axis connections are indicated. Sweep generators and amplifiers are shown for a single channel. Signals originating in the transducers on the right pass through the variable attenuators and into the channel signal amplifiers.

Modulation

Timing pulses generated in the 2-kc multivibrator modulate the Z

axis of all cathode-ray tubes, thereby producing the timing marks. The marks may appear depending upon the demands of the programming system for a dashed or solid trace. They can be removed by the action of the program switching system, simplified in the diagram by the time marks disconnect switch.

The 2-kc square waves also pass through an electronic gate to a scale-of-two circuit in which they are counted down to 1 kc. The 1-kc pulses are then introduced into a decade scaler consisting of four binaries connected to produce a scale-of-ten and a 1-millsec step decade staircase.

Single Trace Recording

A single 100-cps output pulse is also produced and returned to the electronic gate. When only a single trace is required on the oscilloscopes the record switch closes the gate and prevents the further passage of the basic 2-kc pulses.

Staircase output from the decade scaler is applied to two electronic switches S_1 and S_2 which operate at preset voltage levels. Each switch is set to produce a pulse at the time occurrence of a selected level on the staircase wave.

Delay pulses that are spaced at 1-millisec intervals are selected to trigger the sweep generators of the twelve oscilloscopes. Each channel may be switched individually to any of the five fixed delays.

Trace Types

Two types of operation are available. If the reset-pulse return path from the decade scaler to the gate is opened, the system runs free and traces constantly appear on the cathode-ray tubes. This is useful in making adjustments.

In the normal recording operation, the free-run switch S_5 is manually closed, and a single trace is produced each time the gate is switched to the start condition. A synchronizing pulse, made available after passing through the gate and scale-of-two circuit, can initiate the test device being studied.

Common Delay

Individual crt sweeps are, therefore, related by a common delay system keyed to the initiator pulse. By providing a finite number of delay possibilities for any channel, it is possible to code the record with the channel delay.

This form of coding is done by having the program turn on a number of tiny lights arranged around the periphery of each tube. Each light corresponds to the delay selected. The start of each trace is consequently known relative to the zero time reference represented by the initiator pulse.

Similarly, the sweep speed of each trace is adjustable in steps. Sweep speed is coded on the record by programming an extra sweep and simultaneously modulating the beam intensity. The resulting dashed trace indicates the prevailing sweep speed as a function of the length, spacing or number of dashes.

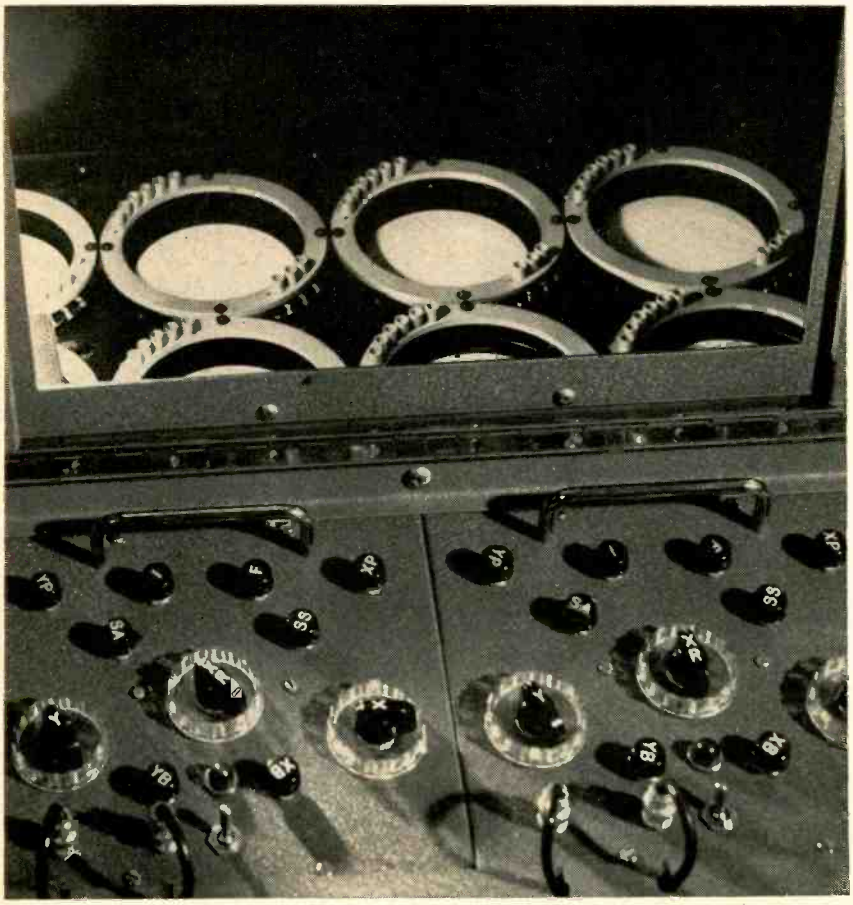
Synchronizing Circuits

Gate V_2 of Fig. 4 controls the passage of 2-kc pulses produced by free-running multivibrator V_1. Pulses on one grid are amplified and can be cut off by a suitable d-c voltage on another grid.

Bistable multivibrator V_3 divides the signal to 1-kc pulses which provide the basic delay increments for the system. The 1-kc pulses are passed through the four binary circuits and the staircase output is applied to cathode follower V_{8A} and then to a parallel group of electronic delay switches.

The delay switches transform the staircase timing wave into a series of delay pulses suitable for application to the synchronizing inputs of the oscilloscope sweep circuits.

There are a total of five electronic switches in this design, each producing a 1-millisec delay. Overall delays of 0, 1, 2, 3, 4, and 5 millisec can be selected.



With central door of compartment opened, display tubes are visible during channel adjustments. Attenuator and delay code lights can be seen around periphery of each tube

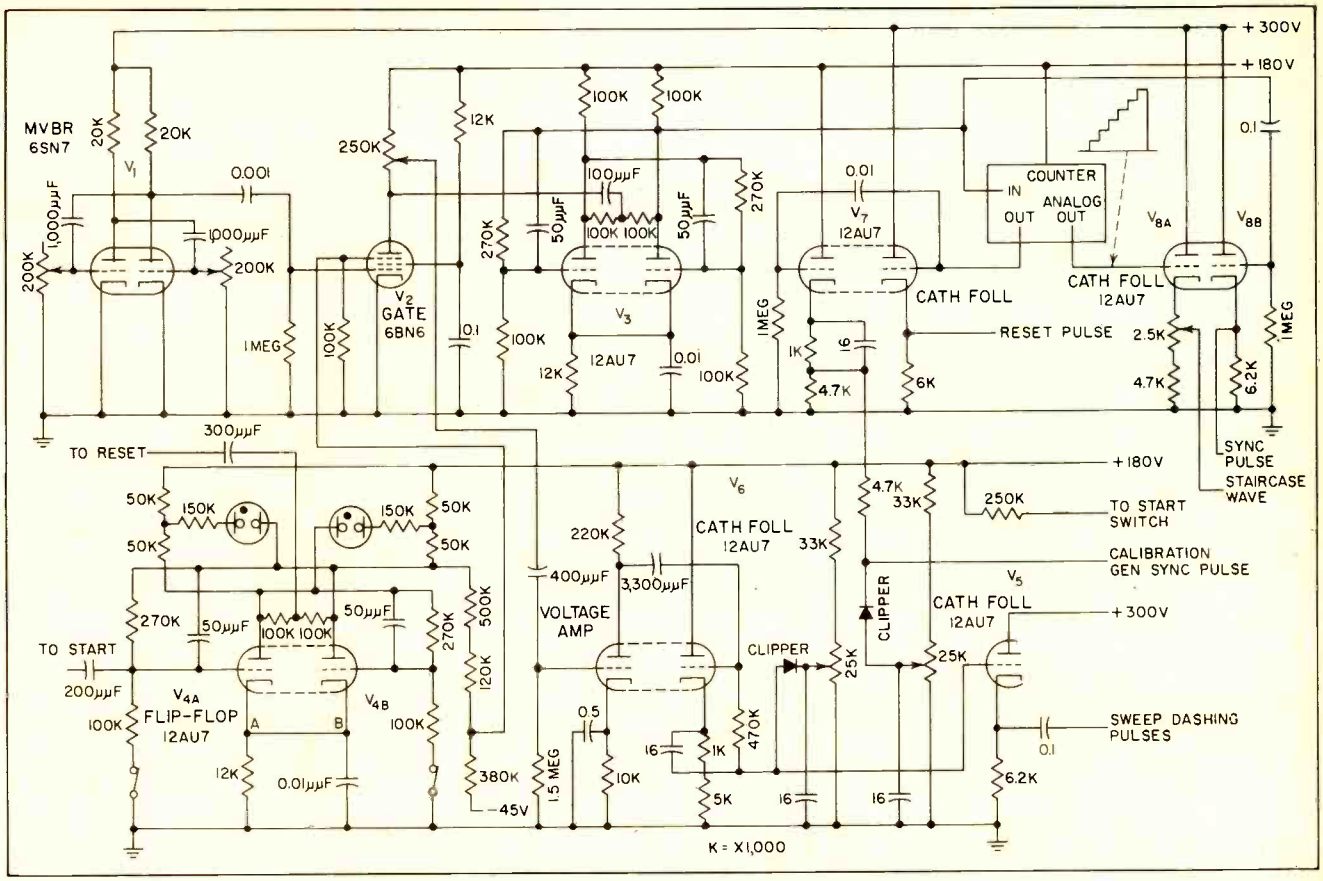


FIG. 4—Synchronization circuit has free-running 2-kc multivibrator which sets the basic time reference of the system

Each electronic delay switch responds to one of the successive steps in the staircase wave. Selector switches connect the individual channels to one of the delay busses. These are multiple-circuit switches which energize the correct number of code lights on all channels corresponding to delay settings.

Biased monostable multivibrators are the electronic delay switches. When the staircase voltage rises to the bias level of the cathode-coupled multivibrator, a rapid exchange of conducting and nonconducting states between its two halves produces a sharp output pulse. This pulse is applied to the delay busses and switched to synchronize the oscilloscopes.

Staircase Generation

In normal operation with the gate opened by the program circuits, each pulse advances the counter one step; the staircase rises the correct amount to apply a millisec delay pulse to one of the delay buses.

When the tenth pulse signals the end of a recording cycle, no more traces are produced on the oscilloscopes. Reset action is achieved by applying the counter output pulse to flip-flop V_4. This stage provides a control voltage for opening and closing the gate.

Tube V_4 may be switched on manually and reset electronically by the output of the counter. It remains in either of the two stable conditions indefinitely. When the B half is nonconducting, the gate will be open; when the A half is nonconducting, the gate will be closed.

Operation

System operation is initiated when the manually dialed program applies a pulse to the start terminal of V_4.

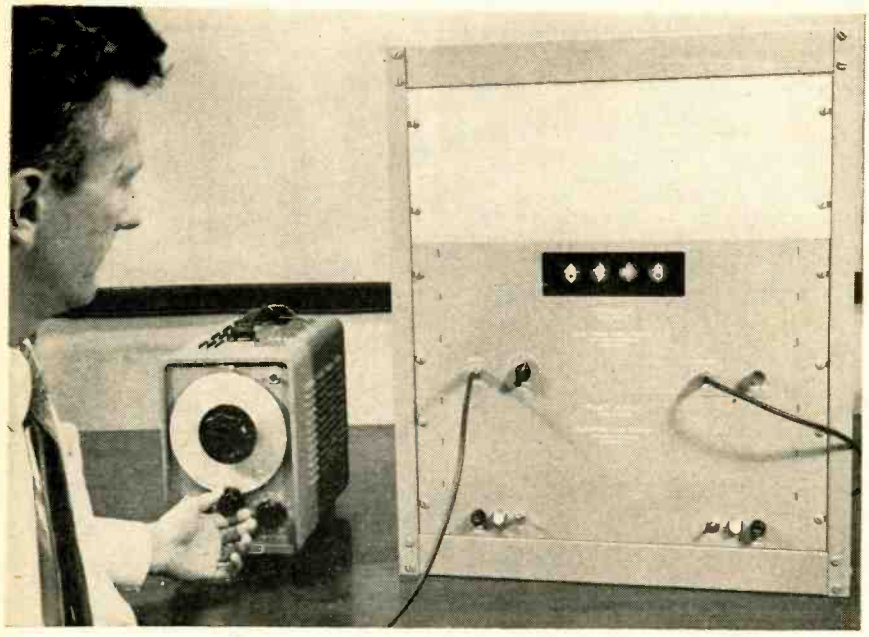
The gate, V_4, is opened and the oscillator pulses pass. The first pulse is the time index for all events that follow and each electronic sweep is precisely timed with respect to it. The initial start pulse is produced by the program circuits and is derived simply from a charged capacitor.

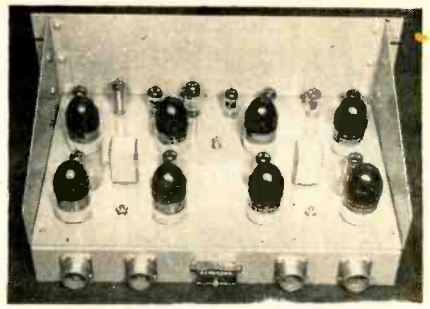
Sweep and delay settings are manually adjusted. The sweeps may be expanded in the critical regions and the necessary delays introduced to make recording conditions optimum for the signal in each channel. Programming for both calibration and recording is thereafter automatic.

Application

This system can be useful in recording mechanical strains, in studying chemical kinetics where drum cameras have been employed in the past and possibly in neurological research. Expensive precision mechanical parts of the drum camera have been eliminated.

Thanks are due to J. C. Heselwood for his contribution in designing the main structure of the recorder; J. H. Brinton and R. H. Field who assisted with the electronic components. Development of the system was sponsored by the Army Ordnance Corps, Watertown Arsenal Laboratory.





Rear view of the counter shows the neat layout of the eight beam-switching tubes used for both counting and storing functions

Front-panel view of the counter shows a visual storage readout. Trigger-level control and zero-set button are seen at the right of the two front-panel connections. The operator is using a laboratory oscillator to provide the drive signal

Decade Decimal Counter

SUMMARY —— High-speed circuit uses magnetron beam-switching tubes to sample, store and provide multioutput functions without stopping the original count or losing input information during readout. Use of decimal counter obviates need for decoding unit to translate when adding-machine printers are used. Readout may be presented visually, or printed

By **ROGER W. WOLFE**
Manager, Applications Engineering Department, Electronic Tube Division, Burroughs Corporation, Plainfield, New Jersey

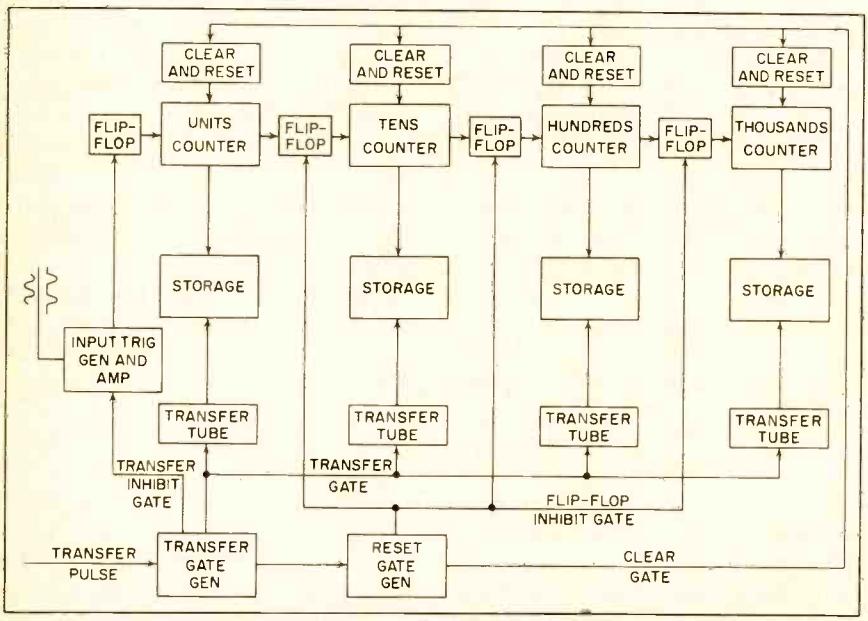


FIG. 1—Block diagram of the four-decade counter. Counts are stored until a transfer pulse is received. The counter is zero-set automatically and the unit continues to count input pulses without loss of sampling. Readout is continuous except for 30 μsec transfer time

THE TIME-INTERVAL COUNTER to be described incorporates two fundamental changes that overcome limitations of some existing electronic-counter circuits. First, the transfer-storage counter uses a basic circuit that stores the old sample while a new one is being taken. And second, the improved counter uses a decimal instead of a binary system. The first change allows the sample to be processed by printing or visual observation while a new sample is taken. The second change, use of a decimal storage element, greatly simplifies the problem of using a decimal printer.

Called the Optimeter for occurrences-per-time-interval meter, this instrument is a four-decade counter having a maximum input frequency of 100 kc. As shown in the block

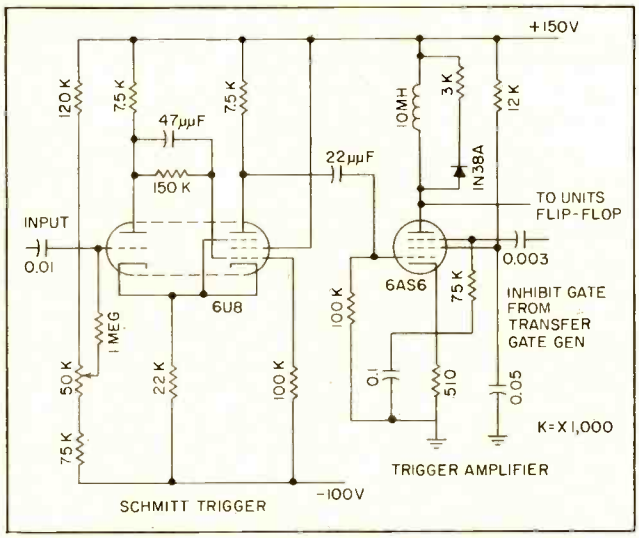


FIG. 2—Input trigger generator and amplifier. The trigger can be set on any desired portion of the input waveshape. The amplifier drives the flip-flops and inhibits the input pulses during the 30 μsec time interval it takes to transfer the count

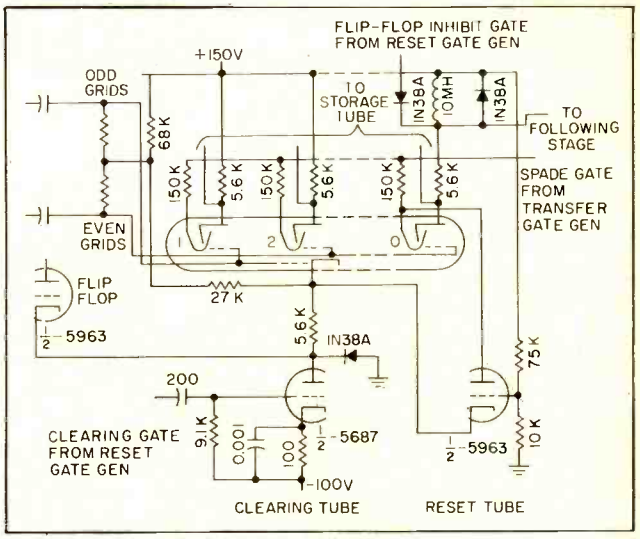


FIG. 3—Basic decade counter circuit. The counter is cleared by action of the reset tube cutting off a series triode in the cathode of the beam-switching tube. Circuit presents high impedance to initiating gate, important if resetting several decades

Speeds Printed Readout

diagram, Fig. 1, each decade consists of one beam-switching tube and a flip-flop driver. A second beam-switching tube, associated with each decade, serves as a temporary storage element.

Upon receipt of a transfer pulse, which may be from a time base generator, the count is stored until receipt of the next transfer pulse. After the count has been stored, the counter is reset to zero automatically and may continue to count input pulses. The entire operation of transferring, storing, and resetting to zero is done in 50 μsec.

Readout

Readout connected to the storage tubes, may consist of either relays or a type 6844 Nixie numerical indicator. When the 6844 is used, the readout is continuous except for a 30-μsec transfer time, too short to be observed. When measuring a constant input frequency, the readout is continuous and, assuming an appropriate transfer time is used, will directly indicate the input frequency. If the input frequency varies, the readout will follow the frequency variations at a rate determined by the transfer time. The actual process of counting is not displayed on the readout device.

The Schmitt trigger input circuit, Fig. 2, accepts either sine waves or pulses. An adjustable input level control allows the trigger to occur on any desired portion of the input waveshape.

An amplifier drives the flip-flop of the units decade directly. The pentode, with suppressor grid characteristics suitable for gating, inhibits the input pulses during the 30-μsec interval it takes to transfer the count to the storage tubes.

Zero Set

The primary design problem was to find a method of zero setting the switching tube and its associated flip-flop, and keep the load on the reset gate as small as possible. The tube is cleared by cutting off a series triode in the cathode of the beam switching tube as in Fig. 3.

The clearing-tube current keeps both the cathode of the flip-flop and the beam-switching tube cathode resistor clamped to ground by the clamp diode. When the clearing tube is cut off by the reset gate, the cathodes of both the flip-flop and the beam-switching tube rise in potential. This clears the beam-switching tube and sets the flip-flop to the odd-grid state.

The beam-switching tube is zero set automatically by the action of the reset tube. When the beam-switching tube clears, the reset tube loses its cathode bias voltage supplied from the cathode resistor of the switching tube. The reset tube conducts and lowers the zero spade which sets the beam to zero. Cathode bias is restored to the reset tube as a result of the beam current in the switching tube and the reset tube cuts off until a new reset gate signal is received.

It takes about 12 μsec to clear and zero set. A high current bleeder, connected from the plate of the clearing tube to B+ would speed up the clearing time, but this would increase power consumption. The zero-setting circuit is straightforward, reliable and presents a high impedance to the initiating gate.

Transfer-Storage

Figure 4 shows the connections of switching and transfer tubes used to store the accumulated count. Transfer-storage operation takes place as follows:

A suitable gating waveform, supplied to the transfer tube and the

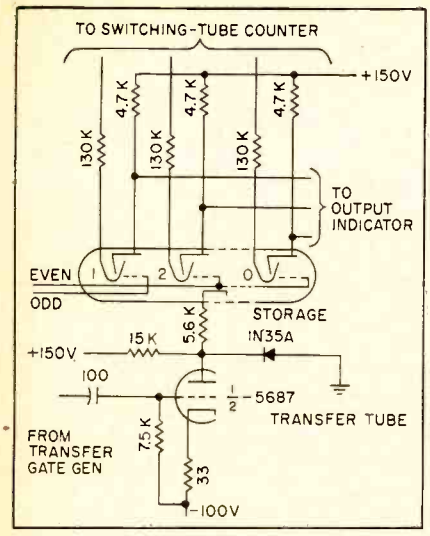


FIG. 4—Transfer-storage circuitry shows connections of beam-switching tube and transfer tube that are used to store the accumulated count

beam-switching tube counter (see Fig. 3), cuts off the transfer tube and raises the spade voltage on the counter switching tube. Spade voltage rise establishes a sufficient difference between the spades of the storage tube and insures that the storage tube will be set to the lower spade voltage.

The interruption of current through the bleeder resistor causes the storage tube cathode to rise rapidly toward B+, clearing the storage tube. As the transfer gate, applied to the transfer tube, begins to decay through the relatively short grid coupling time constant, the transfer tube plate is pulled down to the clamping level established by the clamping diode. When the cathode-to-spade potential of the storage tube reaches the critical voltage, a beam is formed in the position having the lowest spade voltage. This position, of course, corresponds to the one in which the beam is located in the counter tube.

At the termination of the gate, the reduced spade voltage on the counter tube lowers the target voltage of the counter and insures that the beam will not advance in the storage tube as the counter continues to count the input pulses. The spade connections to the storage tube are wired so that nine additional counts must be received by the counter before the leading spade in the storage tube is lowered. This precaution insures beam stability in the stored position.

The spade load resistor values were chosen to insure that spade current, available during transfer is sufficient to set the storage tube. The target resistors maintain the target voltage above the knee of the target pentode characteristic. The storage tube grid operates at a high potential to further insure stability. Since the storage tube is not switched in the conventional manner, the grid electrodes are not used for switching. A diode clamps the cathode resistor of the storage tube at ground potential for a stable reference level.

It is important that the cathode-to-spade voltage on the storage tube is not increased so rapidly that the beam fails to form. Five microseconds is about the maximum speed. Since the capacitance associated with the spade is about 8 $\mu\mu$f, a spade time constant of about 1 μsec results. This means that the spade must be allowed approximately 5 μsec to reach a stable condition.

There is no limit to the speed at which the storage tube can be cleared, in theory. A practical limit occurs, however, because increasing the speed at which the storage tube clears depends upon increasing the bleeder current through the bleeder resistor. This current, of course, is supplied by the transfer tube, thus increasing plate dissipation of the transfer tube.

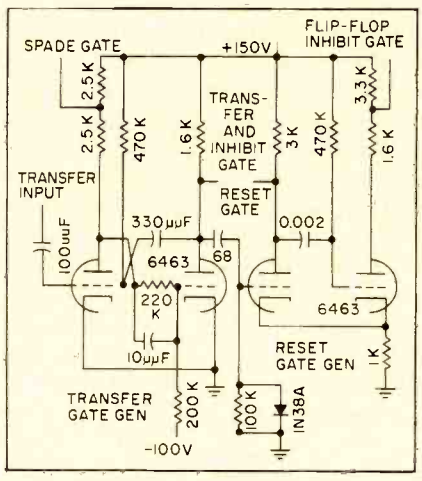


FIG. 5—Two monostable multivibrators generate the transfer and reset gates that control the operation of the time-interval counter with a high degree of accuracy

Two monostable multivibrators, Fig. 5, generate the gates: the transfer-gate generator and the reset-gate generator.

The transfer-gate generator is triggered directly upon receipt of a transfer pulse. Waveshapes from this generator control the following functions.

(1) Increase spade voltage on all decade counters to increase the target voltage in preparation for transferring the count to storage.

(2) Cut-off the series triode in each of the storage tubes to clear the storage tubes and start storage of a new count.

(3) Inhibit input counts for the duration of the transfer time.

(4) Initiate the rest-gate generator at the termination of the count.

The reset-gate generator which is triggered by the termination of the transfer-gate waveform:

(1) Clears all of the decades so that they will zero-set automatically.

(2) Inhibits the operation of all the decade counter flip-flops so that the zero setting action, which generates an output pulse in the zero position, will not falsely trigger any of the flip-flops.

The percentage error in the count is dependent only on the sampling time and equal to: $\frac{50\times10^{-6}}{2}\times100$

where t is the sampling time in seconds. The factor 50×10^{-6} is the transfer and resetting time. Since transfer and resetting time is constant and known, a correction applied to the readout count would give accurate results to within 1 count or cycle.

Further circuit refinements could increase the maximum operating frequency to approximately 500 kc. At higher frequencies, basic changes to the interstage coupling networks would achieve the desired results.

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Tropo-Scatter System Design Charts

SUMMARY —— Design charts facilitate estimation of system parameters for any frequency-division multiplex tropospheric scatter system, either f-m or ssb a-m. By consecutive use of graphs with a tracer line the unweighted signal-to-thermal noise power ratio for a single hop system may be obtained. Charts may also be entered at any point or from both ends to determine only unknown if all other parameters in graphs are known

By L. P. YEH Fellow Engineer, UHF Communications Engineering Section, Electronics Division, Westinghouse Electric Corporation, Baltimore, Maryland

SCATTER GEOMETRY is based on smooth spherical earth with a minimum scattering angle $\theta = d/r$ and both transmitter and receiver antennas at zero height, where d is the path length and r is 5,000 miles, the modified radius of the earth.

Use of the Charts

The unweighted channel signal-to-thermal noise power ratio for a single hop may be obtained by the consecutive use of graphs 1, 2, 3, 4-A or 4-B, 5-A or 5-B and (for f-m only) graph 6. First read the median total transmission loss from graph 1 at predetermined path length, carrier frequency and antenna aperture. If only the path length is known, graph 1 may be used to determine the optimum carrier frequency to be employed with various antenna apertures. The optimum frequency should be the one that gives minimum total transmission loss.

Then read the median ssb peak or f-m average received carrier power in graph 2 with the known transmitter power. If only the ssb average transmitter power is known, it is suggested that a peak factor of 10 db (99.9 percent time) be used to obtain the peak power. Next locate the number of channels in graph 3 and locate the channel thermal noise power in graph 4-A or 4-B with the known effective receiver noise figure. For the f-m system obtain deviation ratio M_F from graph 8 with the desired channel signal-to-thermal noise power ratio at threshold and number of channels in the system.

Then for ssb read the channel median signal-to-thermal noise power ratio from graph 4-B with the known effective receiver noise figure, or for f-m from graph 5-A with the known deviation ratio. Finally read the unweighted channel signal-to-thermal noise power ratio from graphs 5-B or 6 at the required allowance for fading L_F as determined by graph 7-A or 7-B.

Example for SSB

Given a path length of 200 miles, a carrier frequency of 2,000 mc, an antenna aperture of 30 ft, a transmitter power of 1 kw peak and a system capacity of 24 channels between 12 and 112 kc; a receiver noise figure of 10 db, system reliability of 99.5 percent, dual-combiner diversity, channel spacing of 4 kc and channel bandwidth of 3 kc, the following results are obtained by a tracer line starting from graph 1.

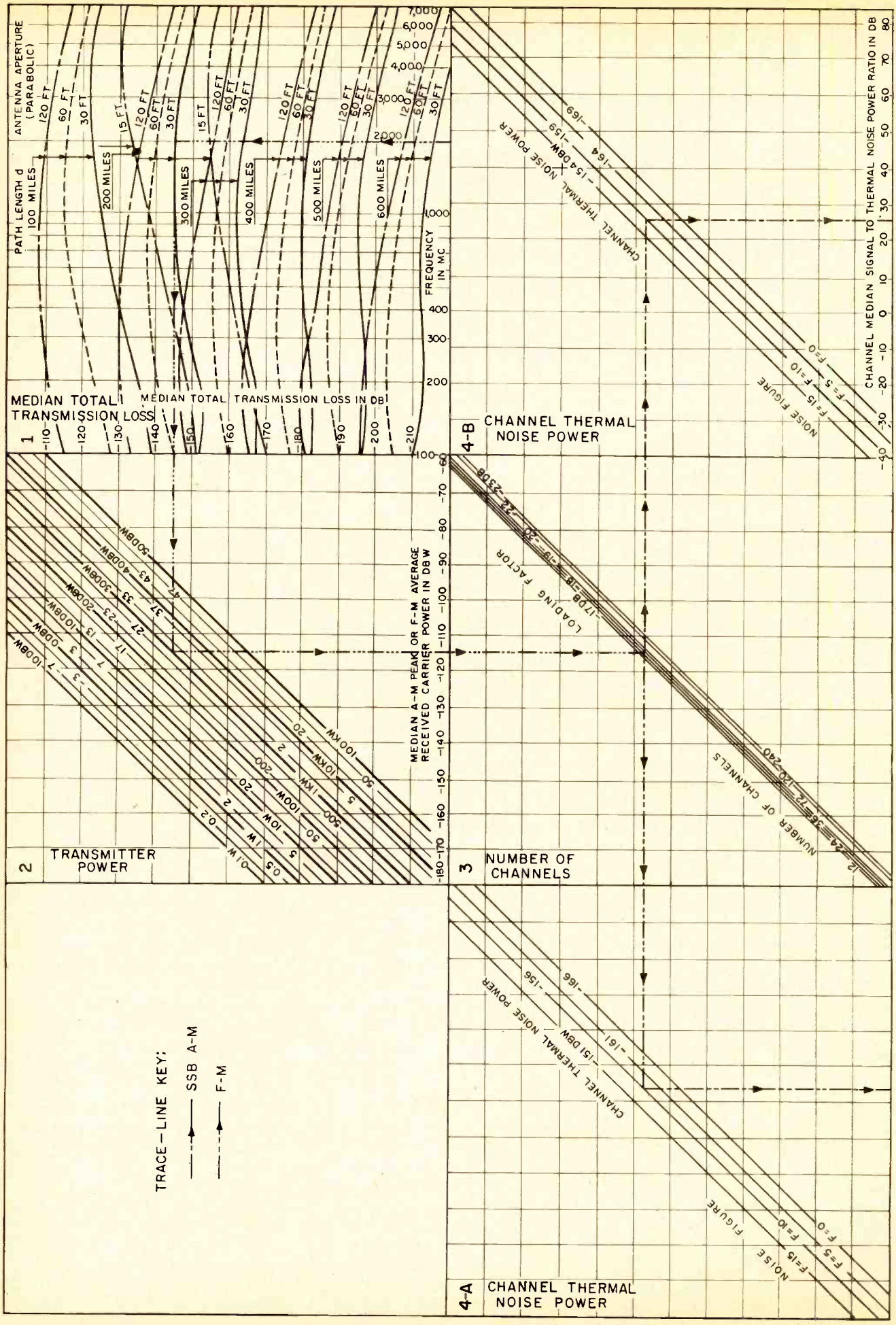
A median total transmission loss of -145 db is found from graph 1. The system median peak received carrier power from graph 2 becomes -115 dbw. Graph 3 shows the number of channels to be 24, and from graph 4-B the channel median signal-to-thermal noise power ratio for $F = 10$ is found to be 26 db. The value of allowance for fading, $L_F = (11.5 - 1.5) =$ 10 db, is obtained from graph 7-B for 99.5 percent system reliability with dual-combiner diversity. Finally for this value of L_F graph 5-B indicates a channel signal-to-thermal noise power ratio of 16 db.

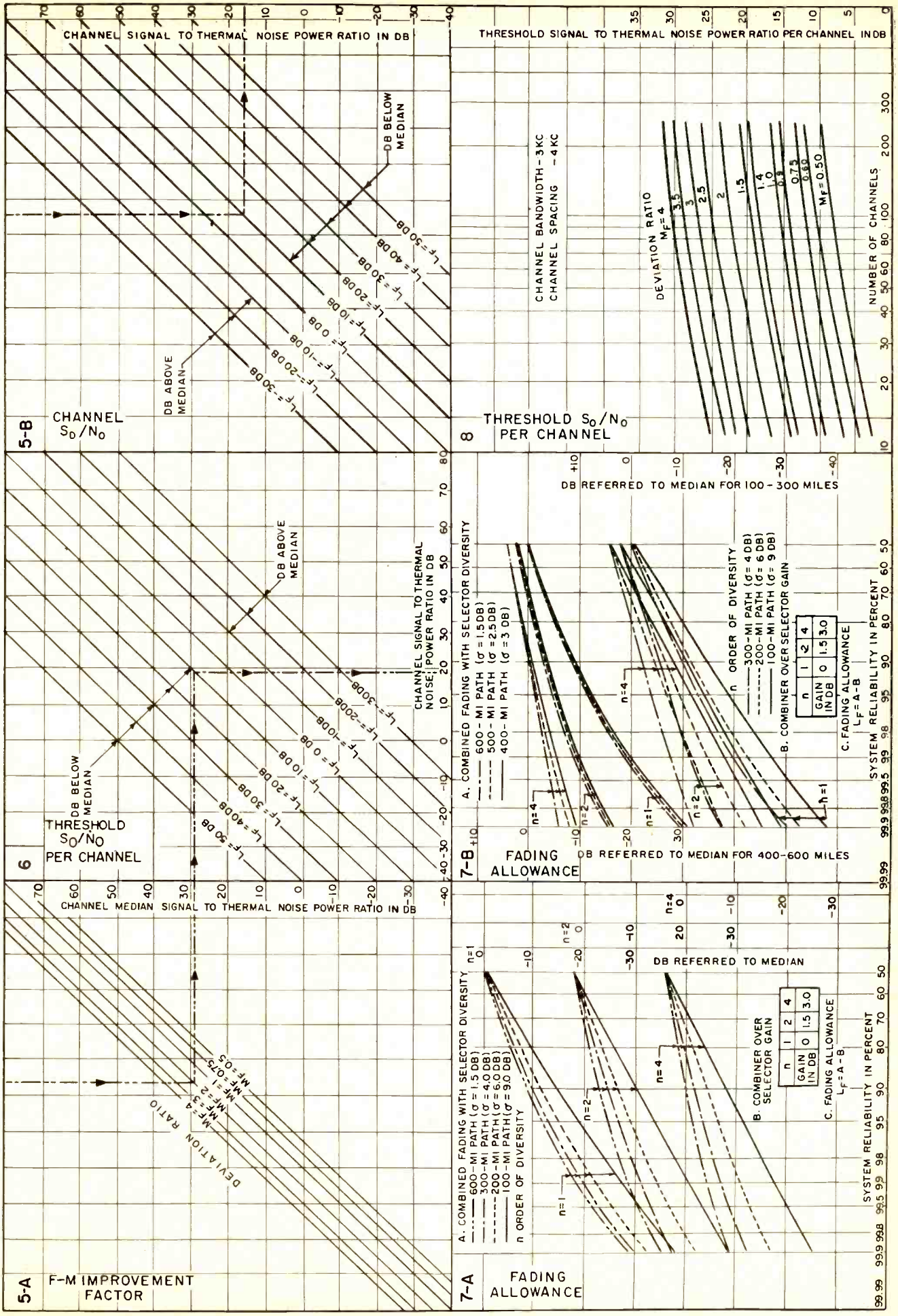
Example for F-M

Given the same operating conditions as for ssb, except that the transmitter power is 1 kw average and the channel signal-to-thermal noise power ratio at threshold is 20 db, the results for f-m will be identical as a trace line run through graphs 1, 2 and 3.

Then on graph 4-A locate the channel thermal noise power with the known noise figure, the result being -156 db. From graph 8 the value of M_F is found to be 2. Using this figure on graph 5, the channel median signal-to-thermal noise power ratio becomes 29 db.

A value for L_F of 10 db is obtained from graph 7-A, which in turn is used to determine from graph 6 a channel signal-to-thermal noise power ratio of 19 db. Since this is below the threshold, the desired 99.5-percent reliability could not be obtained.


1
MEDIAN TOTAL TRANSMISSION LOSS
ANTENNA APERTURE (PARABOLIC)
120 FT
60 FT
30 FT
15 FT
PATH LENGTH d
100 MILES
200 MILES
300 MILES
400 MILES
500 MILES
600 MILES
FREQUENCY IN MC
MEDIAN TOTAL TRANSMISSION LOSS IN DB
2
TRANSMITTER POWER
MEDIAN A-M PEAK OR F-M AVERAGE RECEIVED CARRIER POWER IN DBW
3
NUMBER OF CHANNELS
LOADING FACTOR
NUMBER OF CHANNELS
4-B
CHANNEL THERMAL NOISE POWER
CHANNEL THERMAL NOISE POWER
CHANNEL MEDIAN SIGNAL TO THERMAL NOISE POWER RATIO IN DB
NOISE FIGURE
4-A
CHANNEL THERMAL NOISE POWER
TRACE-LINE KEY:
SSB A-M
F-M


5-B
CHANNEL S_0/N_0
CHANNEL SIGNAL TO THERMAL NOISE POWER RATIO IN DB
DB BELOW MEDIAN
DB ABOVE MEDIAN
L_F = 50 DB
L_F = 40 DB
L_F = 30 DB
L_F = 20 DB
L_F = 10 DB
L_F = 0 DB
L_F = -10 DB
L_F = -20 DB
L_F = -30 DB
8
THRESHOLD S_0/N_0 PER CHANNEL
THRESHOLD SIGNAL TO THERMAL NOISE POWER RATIO PER CHANNEL IN DB
CHANNEL BANDWIDTH - 3 KC
CHANNEL SPACING - 4 KC
DEVIATION RATIO M_F = 4
3.5
3
2.5
2
1.5
1.4
1.0
0.8
0.75
0.60
M_F = 0.50
NUMBER OF CHANNELS
6
THRESHOLD S_0/N_0 PER CHANNEL
CHANNEL SIGNAL TO THERMAL NOISE POWER RATIO IN DB
7-B
FADING ALLOWANCE
DB REFERRED TO MEDIAN FOR 100 - 300 MILES
DB REFERRED TO MEDIAN FOR 400-600 MILES
A. COMBINED FADING WITH SELECTOR DIVERSITY
600 - MI PATH (σ = 1.5 DB)
500 - MI PATH (σ = 2.5 DB)
400 - MI PATH (σ = 3 DB)
n ORDER OF DIVERSITY
300 - MI PATH (σ = 4 DB)
200 - MI PATH (σ = 6 DB)
100 - MI PATH (σ = 9 DB)
B. COMBINER OVER SELECTOR GAIN
n | 1 | 2 | 4
GAIN IN DB | 0 | 1.5 | 3.0
C. FADING ALLOWANCE L_F = A - B
SYSTEM RELIABILITY IN PERCENT
99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50
5-A
F-M IMPROVEMENT FACTOR
CHANNEL MEDIAN SIGNAL TO THERMAL NOISE POWER RATIO IN DB
DEVIATION RATIO
M_F = 0.5
M_F = 0.75
M_F = 1
M_F = 2
M_F = 3
M_F = 4
7-A
FADING ALLOWANCE
A. COMBINED FADING WITH SELECTOR DIVERSITY
600 - MI PATH (σ = 1.5 DB)
300 - MI PATH (σ = 4.0 DB)
200 - MI PATH (σ = 6.0 DB)
100 - MI PATH (σ = 9.0 DB)
n ORDER OF DIVERSITY
DB REFERRED TO MEDIAN
B. COMBINER OVER SELECTOR GAIN
n | 1 | 2 | 4
GAIN IN DB | 0 | 1.5 | 3.0
C. FADING ALLOWANCE L_F = A - B
SYSTEM RELIABILITY IN PERCENT
99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50

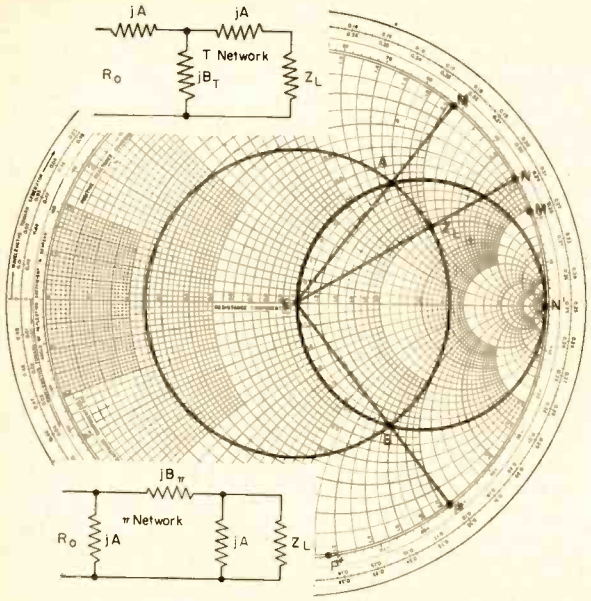


FIG. 1—Construction method used to determine jA when matching $Z_L=(2+j2)R_o$ to R_o for either network

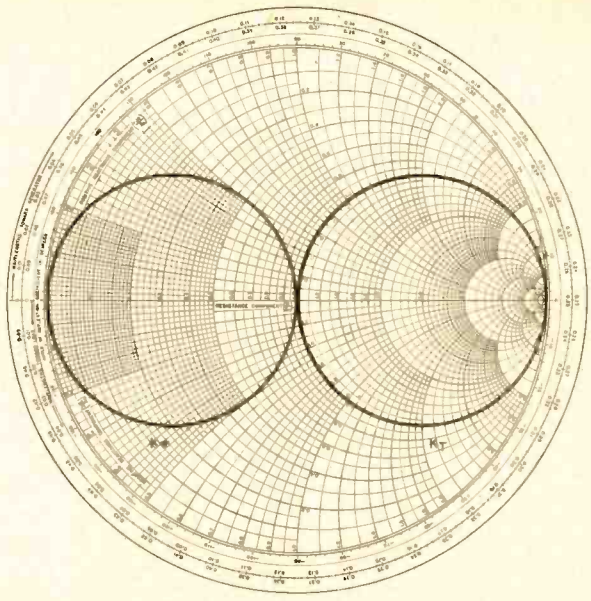


FIG. 2—Diagram shows values of Z_L for which no proper T or π network exists

T and Pi Network Design

SUMMARY —— Technique using Smith chart speeds design of T and pi networks and uses lumped parameters. Second chart shows at a glance impedances that cannot be matched with either T or pi networks

By H. F. MATHIS Goodyear Aircraft Corp. Akron, Ohio

SMITH CHARTS are useful tools for designing matching networks. As an example, it is desired to match the impedance $Z_L = (2 + j2)R_o$ to R_o with the T matching network shown in Fig. 1 or the π matching network also shown in Fig. 1. Elements in these matching networks are assumed lossless. All impedances are normalized with respect to R_o.

Plotting Points

A circle, with its center at the center C (Fig. 1) of the chart, is drawn through Z_L. The points of intersection of this circle with the $R = 1$ circle are denoted by A and B. Lines are drawn from C through A, B and Z_L. The points of intersection of these lines with the $R = 0$ circle are denoted by M, P and N, respectively. The point N' is located at $Z = \infty$. The points M' and P' are located on the $R = 0$ circle so the distance from N' to M' is the same as the distance from N to M and the distance from N' to P' is the same as the distance from N to P. It is necessary that M', N' and P' be in the same order as M, N and P. Two possible values of jA are read off the chart at the points M' and P'. These values are $j5.16$ and $-j1.16$.

Values of B_T are computed from:

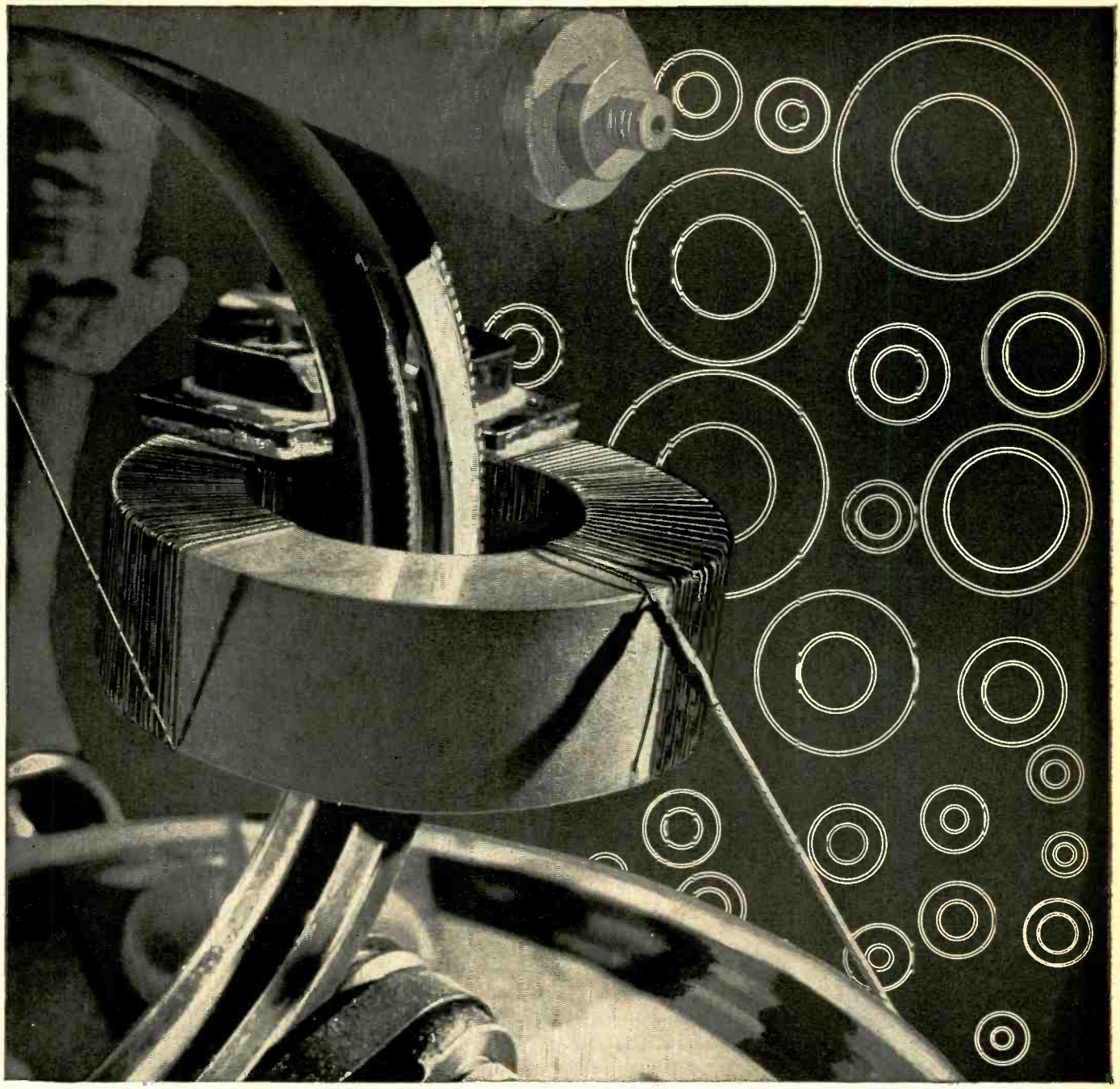
$$B_T = \left(\frac{X}{R-1}\right) - A,$$

where $R + jX = Z_L$. In this case, $B_T = -3.16$ when $A = 5.16$ and $B_T = 3.16$ when $A = -1.16$. Values of B_π are computed from:

$$Bn = -(AR - A - nX)A/(AR - A - X).$$

In this case, $B_\pi = -1.896$ when $A = 5.16$ and $B_\pi = 1{,}896$ when $A = -1.16$.

The values of Z_L which cannot be matched with lossless T and π matching networks are indicated in Fig. 2. When Z_L lies on the circle K_T, there is no proper T matching network and only one proper π matching network. When Z_L lies on the circle K_π, there is no proper π matching network and only one proper T matching network. These remarks are not valid when $Z_L = 0$, 1, or ∞.



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**Paper 57-206, Proposed Size Standards for Toroidal Magnetic Tape Wound Cores. Report of the Magnetic Amplifiers Material Sub-Committee, at the 1957 Winter General Meeting, A.I.E.E.*

Number Reader Speeds Paper Work

Hand written number reader can operate other data-processing gear

HANDWRITTEN numbers can be identified by a device about the size of a portable typewriter. With modifications, the equipment can be made to read handwritten letters as they are being written.

The system has just been announced by Bell Labs and is expected to be a boon in the processing of the paper work for about two billion long-distance telephone calls a year. Bell thinks it may find applications wherever it is necessary to write and identify large quantities of numbers.

In order that written numerals may be read with a minimum possibility of error, mild restrictions must be placed on their size and form. The constraints consist of two vertically aligned dots, around which the numerals must be formed. Three radius vectors extend out from each of these dots, a seventh joins the two. Numerals are then sensed by determining which of these radius vectors are crossed.

Information as to which vectors have been crossed is transmitted to a translator, which contains transistorized logic circuits. Since each numeral has a corresponding set of crossings which is unique, the translator needs only to be able to distinguish each of the sets in order to produce a different output for each numeral. The outputs are employed in the utilization circuit to illuminate a number, operate a teletypewriter, feed the information to a computer or perform any other desired operation.

To recognize written numerals, a specially prepared plate is employed on which each radius vector appears as a closely spaced, insulated parallel set of conductors. The numerals must be written with a conductive pencil on a sheet of paper or a card. When this writing is superimposed on the printed plate and properly oriented, the appropriate sets of conductors are shorted out.

To recognize numerals as they are being written, a writing surface is provided on which there are two guide dots and in which seven radius vectors, made of conducting material, are embedded in plastic. The writing is done with a metal stylus on the writing surface. Whenever a conductor is crossed, the information is fed to the translator and logic circuit.

As necessary crossings are made for a particular numeral, the translator again sends the proper information to the utilization circuit. To clear the system for the start of the next numeral, a conducting plate is touched by the stylus.

Transistorized Trigger and Delay Generators

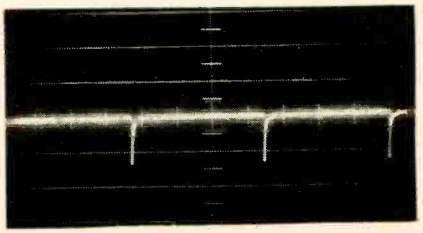
By H. L. ARMSTRONG*
Pacific Semiconductors, Inc.
Culver City, Calif.

PULSE TECHNIQUES are used in a variety of modern electronic equipment, including digital computers, pulse code modulation systems, telemetering and radar. The advantages of transistors are being exploited more and more in these pulse circuits. The blocking oscillator type trigger generator and the multivibrator delay generator described here are examples.

Trigger Generator

The circuit shown in Fig. 1 is a trigger generator that generates relatively narrow pulses at an adjustable repetition rate. The trans-

* *Formerly with National Research Council, Ottawa, Canada*



Vertical scale of 2 volts per cm and horizontal scale of 3 milliseconds per cm to show trigger generator output

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- **REGULATION** (for line or load) 0.03% or 0.003 Volts (whichever is greater)
- **RIPPLE** 3 mv. rms
- **RECOVERY TIME** 50 microseconds
- **STABILITY** (for 8 hours) 0.03% or 0.003 Volts (whichever is greater)

- 0.005% resolution with 10 turn voltage control.
- Continuously variably output voltage without switching.
- External overload and short circuit protection included.
- Either positive or negative can be grounded.
- Units can be series connected.
- Suitable for square wave pulsed loading.
- Power requirements: 105-125 volts, 50-400 cycle.
- Terminations on front and rear of unit.
- High efficiency.
- Low heat dissipation.
- Compact, light weight.
- Color: grey hammer tone.
- Suitable for bench or rack use.
- Voltmeter and ammeter provided.

*VOLTAGE REGULATED POWER SUPPLIES

Model	Output Volts	Output Amps.	Output Impedance Ohms DC-1 KC	Output Impedance Ohms 1 KC-100 KC	Rack Mount W	Rack Mount H	Rack Mount D
SC-32-0.5	0-32	0-0.5	0.02	0.2	19"	3½"	11"
SC-32-1	0-32	0-1	0.01	0.1	19"	3½"	11"
SC-32-1.5	0-32	0-1.5	0.01	0.1	19"	3½"	11"
2SC-32-1.5 DUAL OUTPUT	0-32 0-32	0-1.5 0-1.5	0.01 0.01	0.1 0.1	19"	7"	11"
SC-32-2.5	0-32	0-2.5	0.01	0.1	19"	3½"	11"
SC-32-5	0-32	0-5	0.005	0.05	19"	5¼"	13"
SC-32-10	0-32	0-10	0.001	0.01	19"	8¾"	13"
SC-32-15	0-32	0-15	0.001	0.01	19"	10½"	13"
2SC-100-0.2 DUAL OUTPUT	0-100 0-100	0-0.2 0-0.2	0.1 0.1	1.0 1.0	19"	5¼"	11"
SC-150-1	0-150	0-1	0.05	0.5	19"	5¼"	13"
SC-300-1	0-300	0-1	0.1	1.0	19"	8¾"	13"

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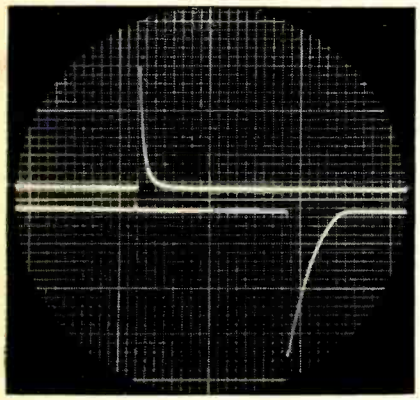
SC-32-1
SC-32-1.5
SC-32-2.5



Double-beam oscilloscope was used to show positive trigger in and negative trigger out of delay generator

former for this blocking oscillator is not a regular pulse transformer but a miniature audio type giving a three-to-one step down from collector to base. The 2.5 megohm variable resistor controls repetition rate.

Delay Generator

It is often desired to introduce a controllable delay somewhere in the train of pulse circuitry. For example, to see the leading edge of a multivibrator pulse on an oscilloscope, the scope would have to be triggered before the multivibrator. This can be done with the delay generator shown in Fig. 2.

Output of the trigger generator can be applied directly to start the oscilloscope sweep and at the same time applied to the delay generator. After a set time, the delay generator will produce a pulse that is used to trigger the multivibrator.

The delay generator is a transistorized monostable multivibrator. The trailing edge of the pulse at the collector of T_1 is sharpened and used as the delayed trigger. The delay is controlled by the 10,000-ohm potentiometer.

In some cases, it may be possible to dispense with the potentiometer,

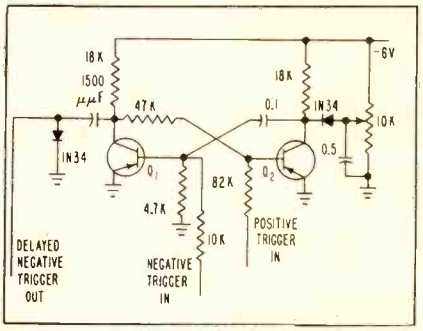


FIG. 2—Positive or negative delayed triggers can be gotten from transistorized monostable multivibrator

as well as the associated diode and capacitor. The delay may be controlled by switching in other capacitors in place of the 0.1 μf capacitor that couples T_2 to T_1. A variable resistor of up to a few thousand ohms in series with this capacitor will also give a certain amount of control of the delay.

These circuits are quite economical of battery power. The delay generator draws about one milliampere, of which half goes to the 10,000-ohm potentiometer for the delay control. The trigger generator, in typical use, drew only 15 microamperes.

Although *pnp* transistors were used in these circuits, *npn* types would work as well. Then all polarities would be reversed, and the diodes used in the delay generator would have to be reversed.

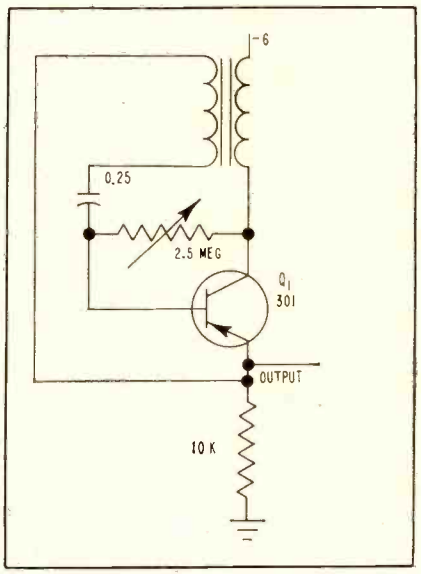


FIG. 1—Audio transformer is used to provide positive feedback in blocking oscillator type trigger generator

A-C Zero Locator

By L. Costrell
National Bureau of Standards
Washington, D. C.

The circuit of Fig. 1 locates the zero of an a-c voltage within a small fraction of a cycle. Its operation is independent of input signal amplitude over a wide range.

Because of the nonlinear dividing action between the oppositely connected diodes and the series resistors in stages 2 and 3, the output of V_3 has steep sides and rounded top and bottom. The signal is differentiated at the input to V_4 and the lower half of the positive pulse is eliminated by grid limiting in the second half of V_4. The output of V_4 locates the zeros with 0.1 μsec for a 50 kc input signal between 0.15 and 30 volts peak-to-peak. Both accuracy and range can be increased by adding more diode stages and improving stage V_1 linearity. For high input signals the first stage can be omitted. The output stage V_5 is tailored to the particular application.

In one application an accurate measurement of the time interval between a given number of cycles

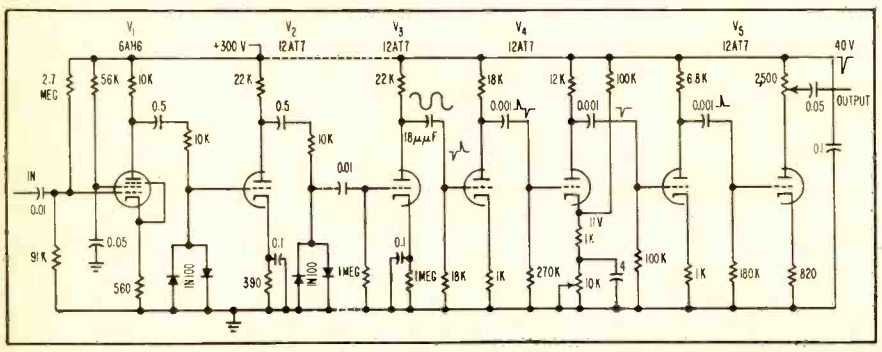
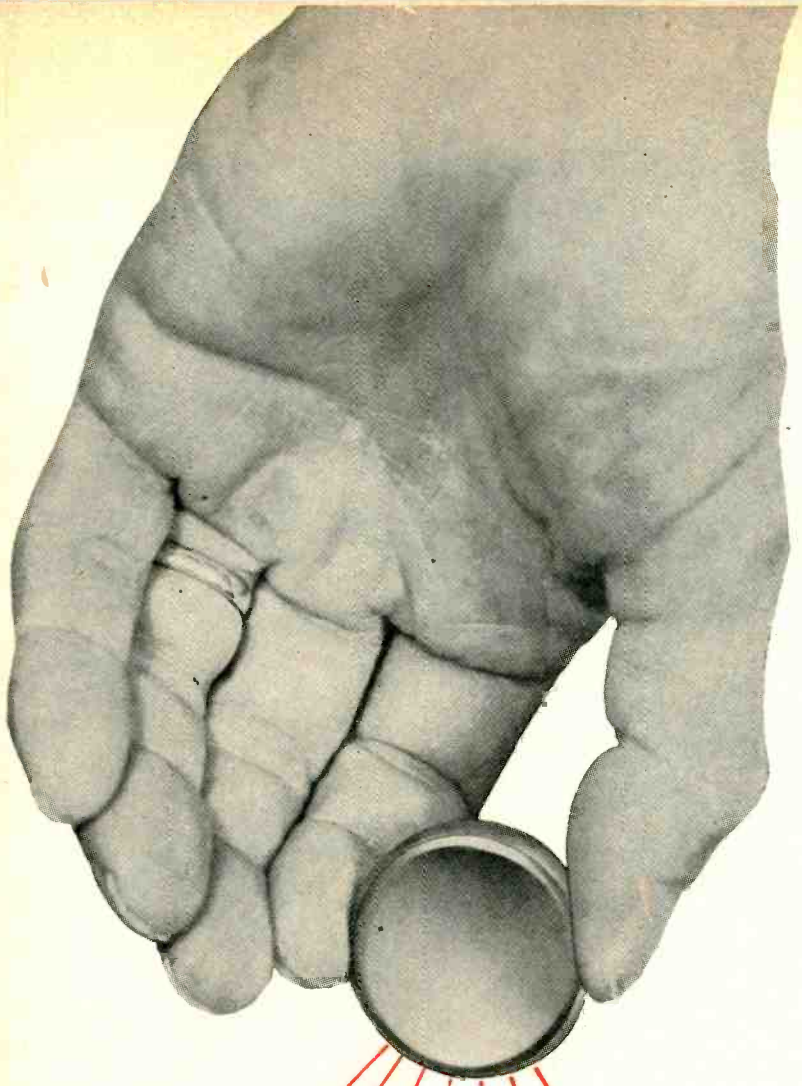


FIG. 1—The a-c zero locater circuit uses oppositely connected diodes and series resistors for wave shaping. Zeros are located within 0.1 μsec for 50-kc input signal between 0.15 and 30 volts peak-to-peak



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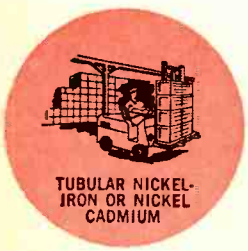

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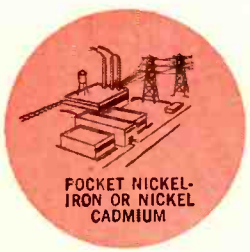

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of an exponentially decaying 50-kc signal was required. An accuracy of 0.1 μsec necessitated location of a specified point, such as the zero crossing, within 1/200th of a cycle. The lowest input voltage that could be accurately handled was determined by the signal to noise ratio of the preceding amplifier.

With a sharply tuned amplifier the maximum phase shift θ resulting from a signal to noise ratio of S/N occurs when $(S/N)\sin\theta \pm \sin(\theta + \pi_2) = 0$. This gives $\csc\theta = \pm S/N$. The maximum time jitter due to noise is therefore $\pm[\csc^{-1}(S/N)]/(2\pi f)$ sec. For reasonably high signal-to-noise ratios this becomes $1/[2\pi f(S/N)]$.

At frequencies below the 50 kc the coupling and cathode bypass capacitors should be increased to reduce phase shifts.

Designing Cold-Cathode Tube Circuits

By M. H. Goosey

Savannah River Laboratory
E. I. du Pont de Nemours & Co.
Aiken, South Carolina

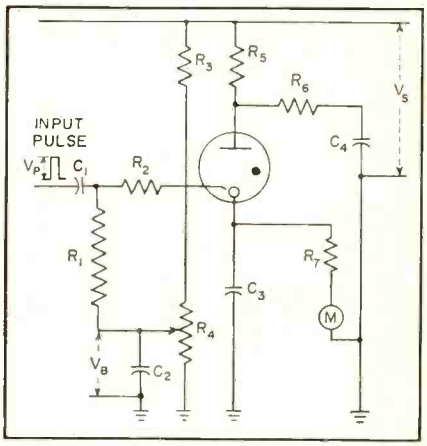

FIG. 1—General cold-cathode count-rate circuit

In typical, three-element, cold-cathode tubes, the trigger is located physically between the anode and the cathode, much like the grid in a conventional thyratron. The anode-cathode and trigger-cathode gaps are each characterized by two voltages and a value of current.

The ignition potentials of the anode-cathode gap and the trigger-

cathode gap, V_{Ia} and V_{It} respectively, are the minimum voltages which, when applied independently to the specific gap, will cause spontaneous conduction in that gap. Once conduction occurs, the voltage drop across the gap—V_{Ma} or V_{Mt}—can only be maintained if the current in the gap exceeds a certain minimum value, I_{Ma} or I_{Mt}.

The useful feature of the tube is that the anode-cathode gap may be made to conduct, even though the applied potential is less than V_{Ia}, by applying a potential V_{It}, or greater, to the trigger. Since the power required to cause conduction in the trigger-cathode gap is much less than the power that can be controlled in the anode-cathode gap, the cold-cathode tube exhibits a power gain.

Once the anode-cathode gap has been ignited, the trigger loses control until conduction in the gap has been extinguished by some external means. This can be done by either supplying the anode voltage from an alternating potential source or by employing a self-extinguishing circuit, such as the one composed of the resistor-capacitor network, R_3C_4 shown in Fig. 1, which takes advantage of the finite value of I_{Ma}.

Count-Rate Circuit

The design of a cold-cathode, count-rate circuit can best be understood in terms of the functions of the components in a basic circuit such as that shown in Figure 1. The capacitor, C_1, which serves to isolate the input source from the trigger bias supply, is usually made as small as possible so that the input time constant, R_1C_1, is of the same order of magnitude as the length of the input pulse. This insures that the actual bias voltage appearing at the trigger will not be rate-dependent.

Resistors R_3, R_4 and capacitor C_2 form an adjustable bias supply. The bias is set so as to satisfy the condition: $V_B + V_p > V_{It}$. The resistor R_2 serves to limit the instantaneous trigger current to the value recommended by the manufacturer of the particular tube. The value of resistor R_5 is determined by first obtaining the value of I_{Ma}, either from the tube specifications or by measurement, and then substituting this

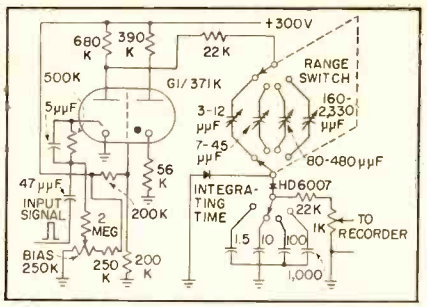

FIG. 2—Cold-cathode probe circuit for radiation monitor

value into the relation

$$R_6 > \frac{V_S - V_{Ma}}{I_{Ma}}$$

This condition insures that the tube will be incapable of maintaining conduction from the supply voltage and will, therefore, be extinguished when the voltage at the anode drops to V_{Ma}. Resistor R_6 limits the instantaneous anode current to a safe value. The value of R_6 is determined by substitution in the relation:

$$R_6 \geq \frac{V_s}{I_i}$$ where I_i is the

maximum instantaneous anode current recommended in the tube specifications.

The combination R_7C_3 forms an integrating network. The values of R_7 and of C_3 are subject only to the condition that

$$C_3 \gg C_4$$

The lower limit to the value of C_4 may be found by substitution in the relation

$$R_5C_4 \geq T$$

where T is the deionization time for the tube. A straightforward analysis of the circuit shows that for any desired output current i_o, with a count-rate of n per sec

$$C_4 = \frac{i_o}{n(V_s - V_{Ma})}$$

It should be noted, however, that if the value of C_4 obtained from this equation results in the condition that $R_5C_4 > \frac{1}{4}n$, the capacitor C_4 does not fully recharge to the supply potential before the arrival of another trigger pulse. This causes a loss of linearity, since the tube does not transfer the same amount of charge per pulse. Furthermore the restriction $R_5C_4 > 1/4n$ is valid only for uniformly spaced input pulses. In radiation monitoring

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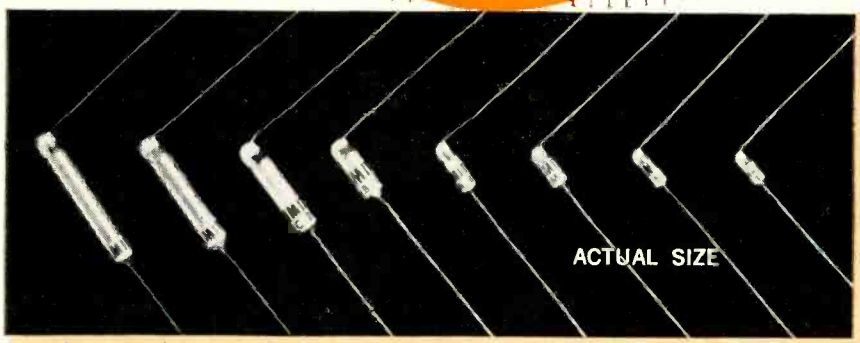

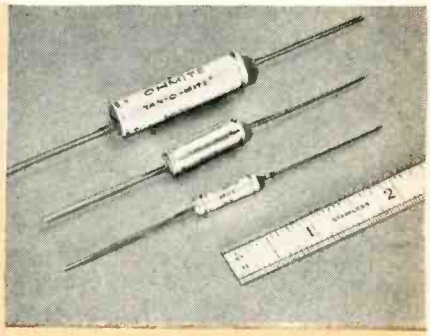

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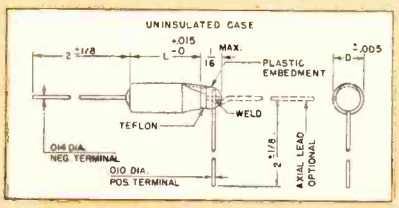
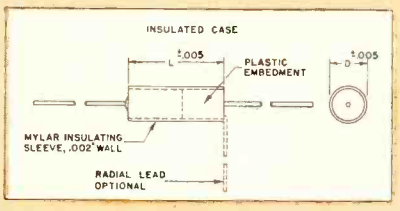
These new subminiature, wire-type units feature greater capacitance per unit volume, lower leakage current and power factor, and small capacitance drop at extremely low temperatures as compared to other types of electrolytics. Ultrasmall for low-voltage DC transistorized electronic equipment, these new tantalum capacitors have *high stability, high capacitance, long shelf life, and excellent performance* under temperature extremes of —55°C to + 85°C. Available in eight subminiature sizes; 0.1 to 80 mfd. over-all capacitance range.

SIZE	UNINSULATED		INSULATED	
	D (inches)	L (inches)	D	L
*T	.075 (5/64)	.156 (5/32)	.082	.203
*S	.075 (5/64)	.187 (3/16)	.082	.234
*M	.095 (3/32)	.172 (11/64)	.100	.218
*A	.095 (3/32)	.250 (1/4)	.100	.312
*B	.125 (1/8)	.312 (5/16)	.134	.375
C	.125 (1/8)	.500 (1/2)	.134	.562
D	.125 (1/8)	.625 (5/8)	.134	.687
E	.125 (1/8)	.750 (3/4)	.134	.812

Smallest size is .075 (5/64) x .156 (5/32) inches; the largest is .125 (1/8) x .750 (3/4) inches. Five stock sizes (*) are available in a wide range of capacitances and voltages. Units insulated with a tough Mylar® plastic sleeve can be furnished. *Write on company letterhead for Bulletin 148B.*





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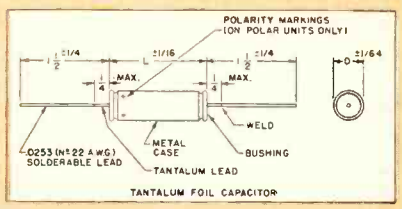
These capacitors are tantalum foil, electrolytic units designed for low voltage AC and DC applications where small size, top performance, and stability of electrical characteristics are required. Units feature unusually long shelf and operating life.

CASE SIZE	D*	L*
J	3/16"	11/16"
K	9/32"	7/8"
L	3/8"	1 7/16"

**Add 1/16" to L and 1/32" to D when insulating sleeve is used.*

Three sizes now available; .25 to 140 mfd. over-all capacitance range. Standard tolerance is ±20%. Working voltage up to 150 volts. Polar and nonpolar units are available. *Bulletin 152.* Design and construction meet military specification MIL-C-3965, paragraph 3.3.



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work the input pulses are randomly distributed in time and in this case an additional restriction will be necessary to insure linearity. The probability of m pulses occurring within an interval in which the average number of pulses is x, is

$$P(m) = \frac{x^m e^{-x}}{m!}$$

If n is the average count-rate to be associated with the value of C_4, and if it is desired to reduce to one percent the probability that an input pulse occurs within a time R_5C_4 after the previous one, we have

$x = n R_5C_4$ = average number of pulses

$m = 1$

$P(m) = 0.01$

and if $n R_5C_4$ is small, as is usually the case,

$$0.01 = n R_5C_4$$

or

$$C_4 = \frac{0.01}{n R_5}$$

This condition defines the upper limit to the value of C_4 from the standpoint of linearity. The limits on the value of C_4 determine a range of values for the output current i_o through the equation $i_o = n C_4 (V_s - V_{M_4})$. The application of these equations will determine the circuit parameters to an accuracy within that of the components (± 20 percent) in most cases. Capacitor C_4 is generally made up of a fixed capacitor plus a variable one in order that the output current may be adjusted to the desired value.

Applications

A complete monitor, suitable for detection of alpha particles, is shown in Fig. 2. The light output from a ZnS screen coupled to the 6292 photomultiplier is sufficient to give the required pulse height at the photomultiplier anode, for operation of a sensitive cold-cathode tube without further amplification. The cold-cathode tube used in this case contains four elements; an anode, a trigger, a cathode, and an auxiliary cathode.

A small amount of current is permitted to flow between the trigger and the auxiliary cathode. This current, limited by R_{15}, creates a supply of ions just less than the amount necessary to cause ioniza-

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tion of the gas in the anode-cathode gap. A negative voltage pulse applied to the auxiliary cathode causes a momentary increase in the current flowing between the trigger and the auxiliary cathode, this, in turn, creates a larger number of ions and subsequently causes ionization of the anode-cathode gap. Capacitor C_4 permits this momentary flow of current due to the input pulse without allowing the voltage at the trigger to fall below the extinguishing potential. In all other respects this tube operates much as the three element tubes already discussed. It should be noted, however, that if counting losses are to be restricted to 5 percent or less, it will not be possible to use a conventional microammeter owing to the small output current from the circuit. Millivolt recorders of the chopper-amplifier type, however, can be substituted. The practical maximum counting rate for this circuit is of the order of 100 counts per second, depending upon the circuit parameters.

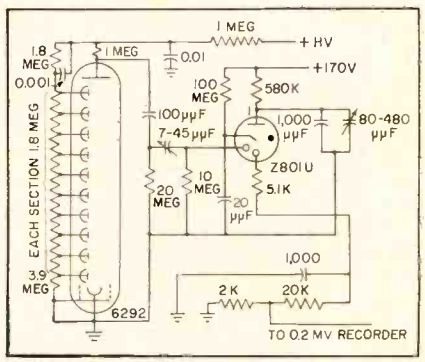
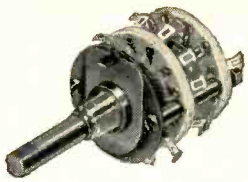


FIG. 3—Count rate circuit using diode section to eliminate photosensitivity of triode section

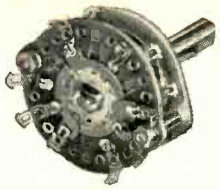
A circuit having a much greater maximum counting rate is shown in Fig. 3. This circuit uses a cold-cathode tube of the triode type which contains a separate cold-cathode diode. The purpose of this diode section is to produce a glow discharge that illuminates the trigger-cathode gap of the triode section to eliminate the photosensitivity shown by most cold-cathode devices. The practical maximum operating speed of this tube, for counting purposes, is approximately 2 kc.

The input pulse should be at



Type F: Miniature 12-position, 30-60° throw, can be mounted in 1-5/16" circle; phenolic, Mycalex or steatite.

Type H: Standard 12-position; 1-7/8" diameter; 15-30-60° throw; phenolic, Mycalex or steatite.



Types J, K, N: 1-17/32" diameter; provides for flexibility of layout; interchangeable sections, phenolic or steatite.

Type L or DL: Using dual eyelet fastening; 18-position; mounts in 2-9/32" circle, phenolic, Mycalex.

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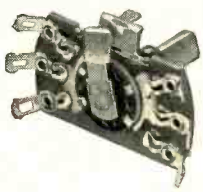

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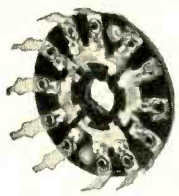

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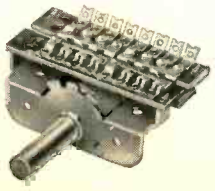

Type 185: New lever-operated version of the standard Oak rotary switches.

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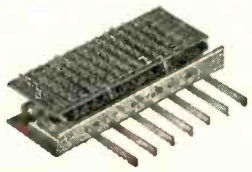
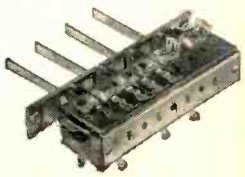
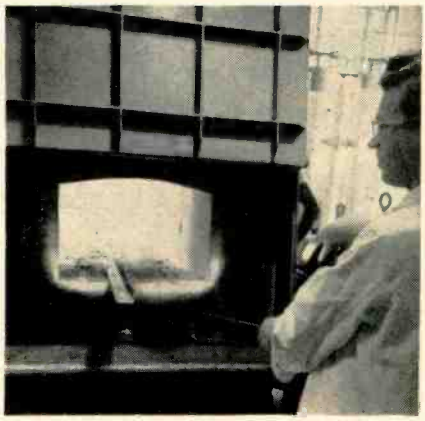


Type 80 Pushbutton: Very adaptable. Used in communication equipment; economical for less complex applications.



least +30 v high and 20 μsec long. Since this tube has a fairly well defined threshold, the bias control can be used as a simple integral discriminator in some applications.

Cube-Oriented Steel Magnetizes More Easily



Cube-oriented steel coming out of lab furnace promises more efficient airborne transformers and relays

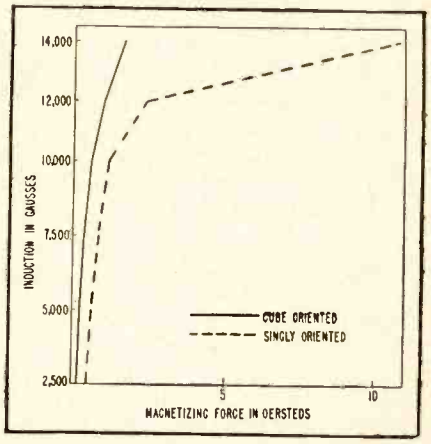


Fig. 1—The shaded area shows the increase in energy required to magnetize nonoriented steel

METALLURGICAL developments can have far-reaching implications for the electronics industry. This was proved recently by a development announced by Westinghouse called Cubex.

The three-percent silicon-iron alloy itself is not new. However, a method for orienting the crystal structure has been developed that can cut manufacturing costs and improve efficiency of transformers, motors, relays.

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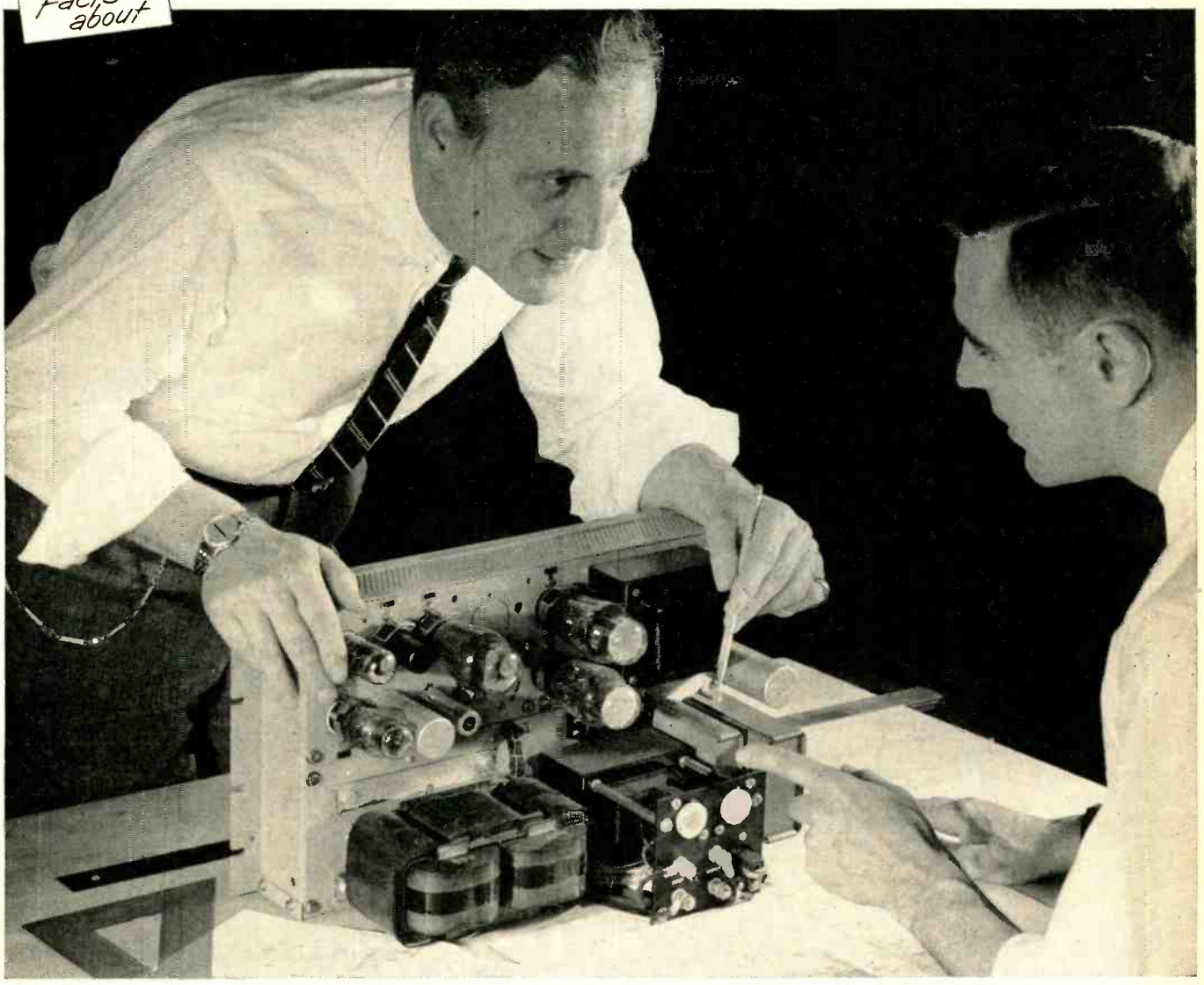

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cube-oriented silicon-iron were originated in Germany by the Vacuumschmelze division of Siemens-Halske. Westinghouse is working to provide more basic information about the alloy and to extend the range of useful thicknesses.

Three-percent silicon-iron was selected for the study because it has a saturation magnetization close to that of pure iron, a high resistivity, one crystal structure up to the melting point and is basically an inexpensive raw material.

The alloy has a cubic crystal structure. Cube edges provide the easiest path of magnetization when a magnetic field is applied parallel to the cube edges.

If the cubes in a sample are positioned randomly, there is no easy path for magnetization of the sample. An applied magnetic field cannot be oriented in such a way that it is always parallel to cube edges.

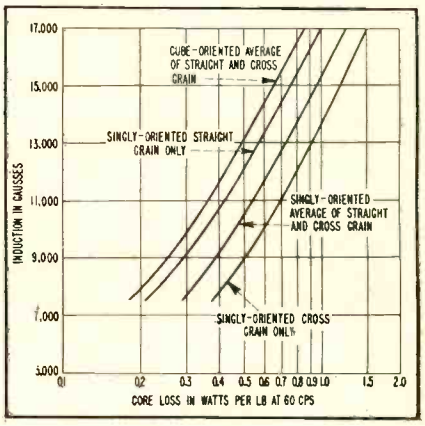
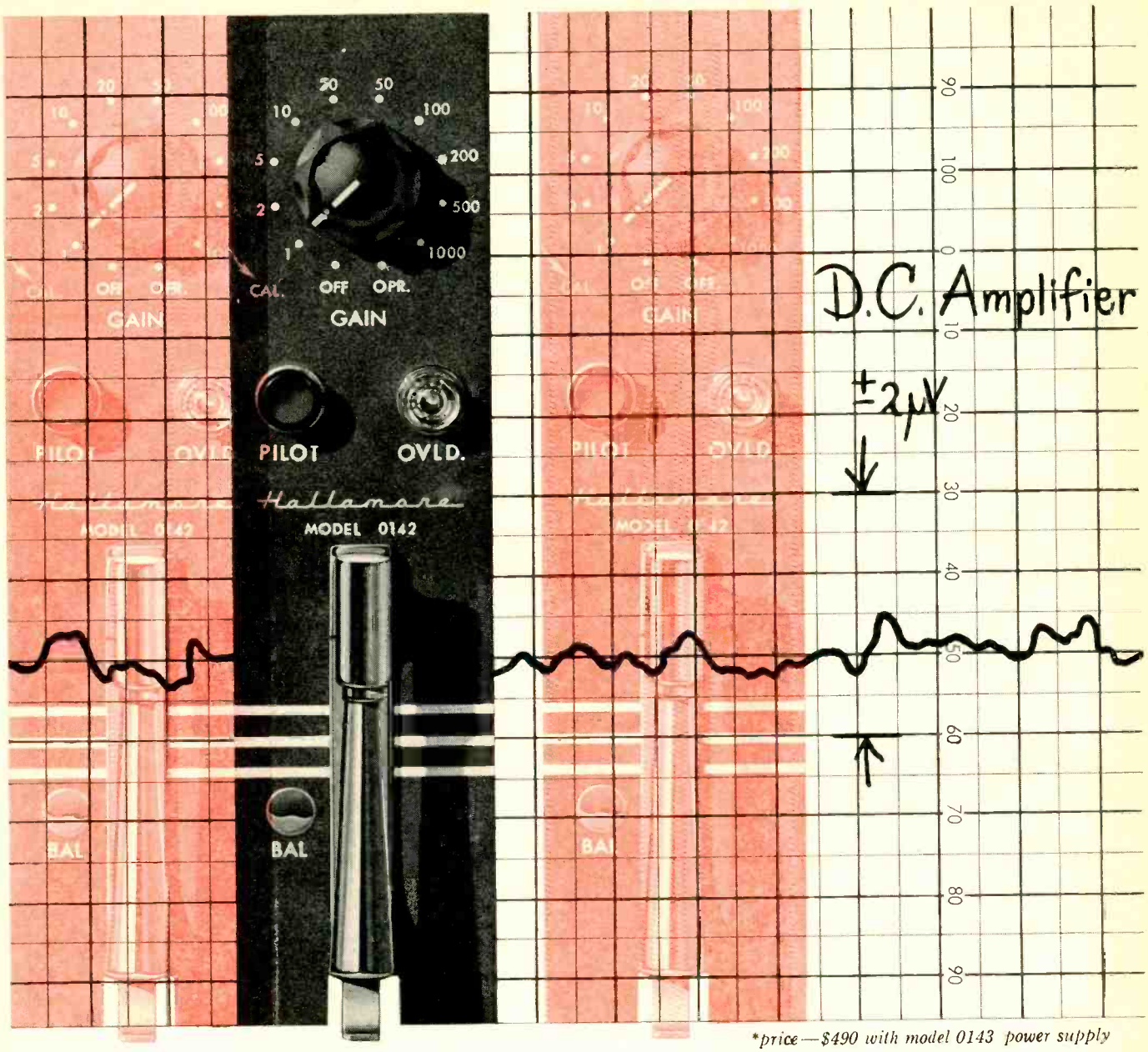


Fig. 2—Cube-oriented alloy has lower average losses for two directions than singly oriented in the direction of the grain

In the singly oriented silicon-iron often used for transformers and motors, the cubes are oriented so that an easy path of magnetization exists in one direction of the sample. The graph in Fig. 1 shows the difference in energy required to magnetize randomly oriented and singly oriented samples.

In the new material, crystals are oriented so that cube edges are parallel to length, width and height of the sample. Therefore, easy paths of magnetization exist in these three directions. The loss curves shown in Fig. 2 demonstrate the improved efficiency of cube oriented



*price—$490 with model 0143 power supply

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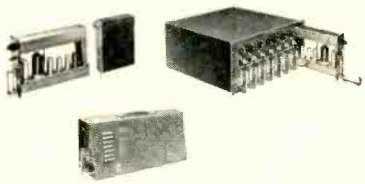


NEW HALLAMORE DC AMPLIFIER The combination of low drift and noise with high stability and broad bandwidth constitutes an instrument very nearly ideal for applications requiring the amplification of DC signals. The Hallamore Model 0142 affords DC gain accuracy of 1% or better and DC gain stability of .05%, with a drift of less than ± 2 microvolts, referred to input with 10% regulated line. Applications include telemetering, data handling and process control. The unit is also employed as an oscilloscope pre-amplifier, galvanometer driver, or error amplifier. Model 0142 is immediately available as a plug-in unit or as an element in a module of eight amplifiers with eight Model 0143 power supplies or one Model 0144 regulated power supply. For general laboratory use, the amplifier has been combined with a Hallamore power supply in a convenient, portable cabinet, Model 0146. Write or phone for PUB 543, full description of Model 0142 DC Amplifier. Address: 8352 Brookhurst Avenue, Anaheim, California.

HALLAMORE ELECTRONICS COMPANY *a division of the SIEGLER CORPORATION*

86

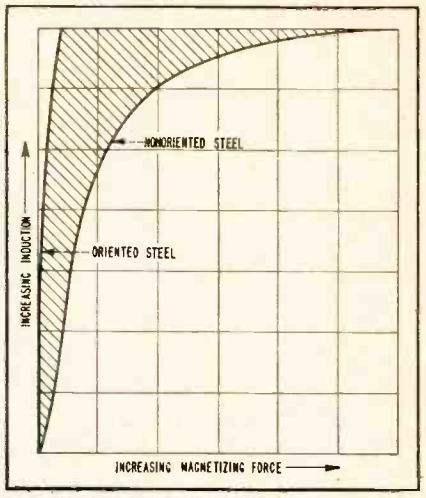


Fig. 3—As well as being more easily magnetized, cube-oriented steel only requires 0.175 oersted coersive force, while single oriented requires 0.40 Oersted

over single oriented structure in 2-mil samples.

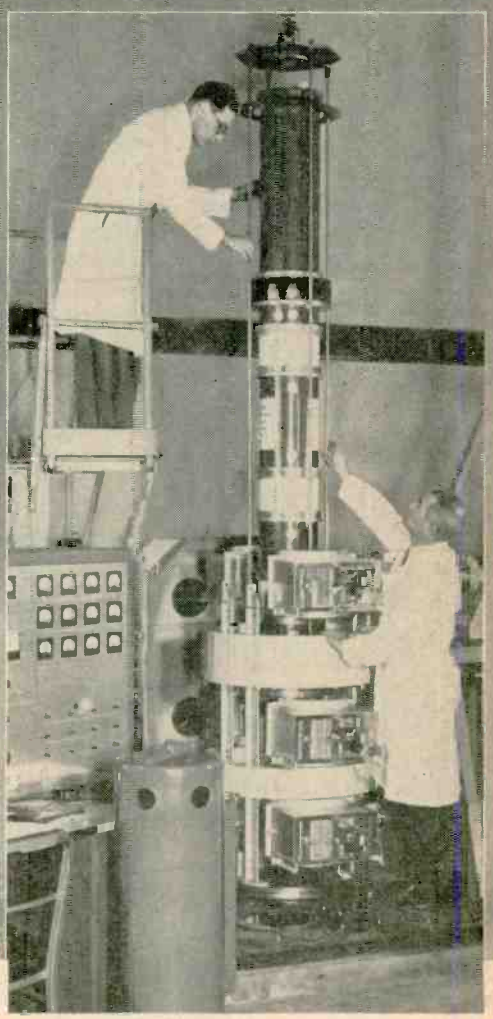
In some transformer manufacture, four separate pieces are cut and welded together into a rectangular frame in order to get easy paths around the rectangle. Cube makes it possible to make the rectangular frame out of one stamping from a single sheet. The graph in Fig. 3 shows the reduced amount of magnetizing force required when one-piece rectangular frames are cut from singly oriented and cube-oriented silicon-iron.

General Electric is also producing cube-oriented steel experimentally. The firm believes that eventually the new material can be produced at approximately the same cost as presently used materials. It adds, however, that it cannot predict at this time how long it will be before it is produced in quantity.

Gold Measures River Flow

RADIOACTIVE GOLD is being used to test the volume of water flow in a fast-moving stream. The technique, originally designed for use in petroleum refineries, has been adapted to stream measurement in the planning of flood control and irrigation programs and in map-

CIRCLE 66 READERS SERVICE CARD →



Eimac super-power klystron being lowered into circuitry in Eimac laboratory.

Eimac Klystron Produces Super Power For Missile Tracker

Development of the super-powered radar ballistic missile tracker, now in operation at the Lincoln Laboratory of Massachusetts Institute of Technology, required an electron tube that would produce tremendous amounts of RF energy at the desired frequency. Long experience in pioneering ceramic-metal power klystrons enabled Eimac to design a super klystron that efficiently and reliably produces the tremendous RF pulse power required for this application. It was built for Continental Electronics Manufacturing Company, the transmitter manufacturer, under sponsorship of the Air Research and Development Command's Rome Air Development Center of the United States Air Force.

Similar to the tube shown above, this super klystron is the largest electron tube in the world; even this ten-foot giant will soon be dwarfed by 17-foot Eimac klystrons now under development.

Equipment engineers throughout the world are finding that the uniqueness of Eimac klystrons makes the difference in simple, efficient and reliable equipment design for tropospheric scatter, commercial television, telephone relay and high power radar applications. Eimac today manufactures CW and pulse amplifier klystrons covering the spectrum into the X Band and to megawatts of power.

For further information on Eimac klystrons write our Application Engineering Department for a copy of Klystron Facts Case 4

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

Eimac First for high power amplifier klystrons

Eimac®

Products Designed and Manufactured by Eimac

Negative Grid Tubes
Reflex and Amplifier Klystrons
Ceramic Receiving Tubes
Vacuum Tube Accessories
Vacuum Switches
Vacuum Pumps

Includes the most extensive line of ceramic electron tubes

ping watershed run-off.

The test, which would have required several days to complete with conventional water-flow measurement apparatus, took less than two hours.

A solution of radioactive gold particles is dropped into the water. Then about a mile downstream personnel measure radiation from the passing gold with a Geiger counter on the end of a fishing pole. Calculations based on the number

Sensing head of Geiger counter is lowered into position in river to gage flow of water containing radioactive gold

count rate as the gold flows past disclose how many cubic feet of water per second move past the point of measurement. The flow of the American River in California was measured at 1,060 cu ft per sec.

Previously tested under laboratory conditions indoors and on the small Navarro River 100 miles north of San Francisco, the new technique promises to save time and labor in surveying water resources in regions not equipped with regular gaging stations, which require dams or weirs to gather water flow data.

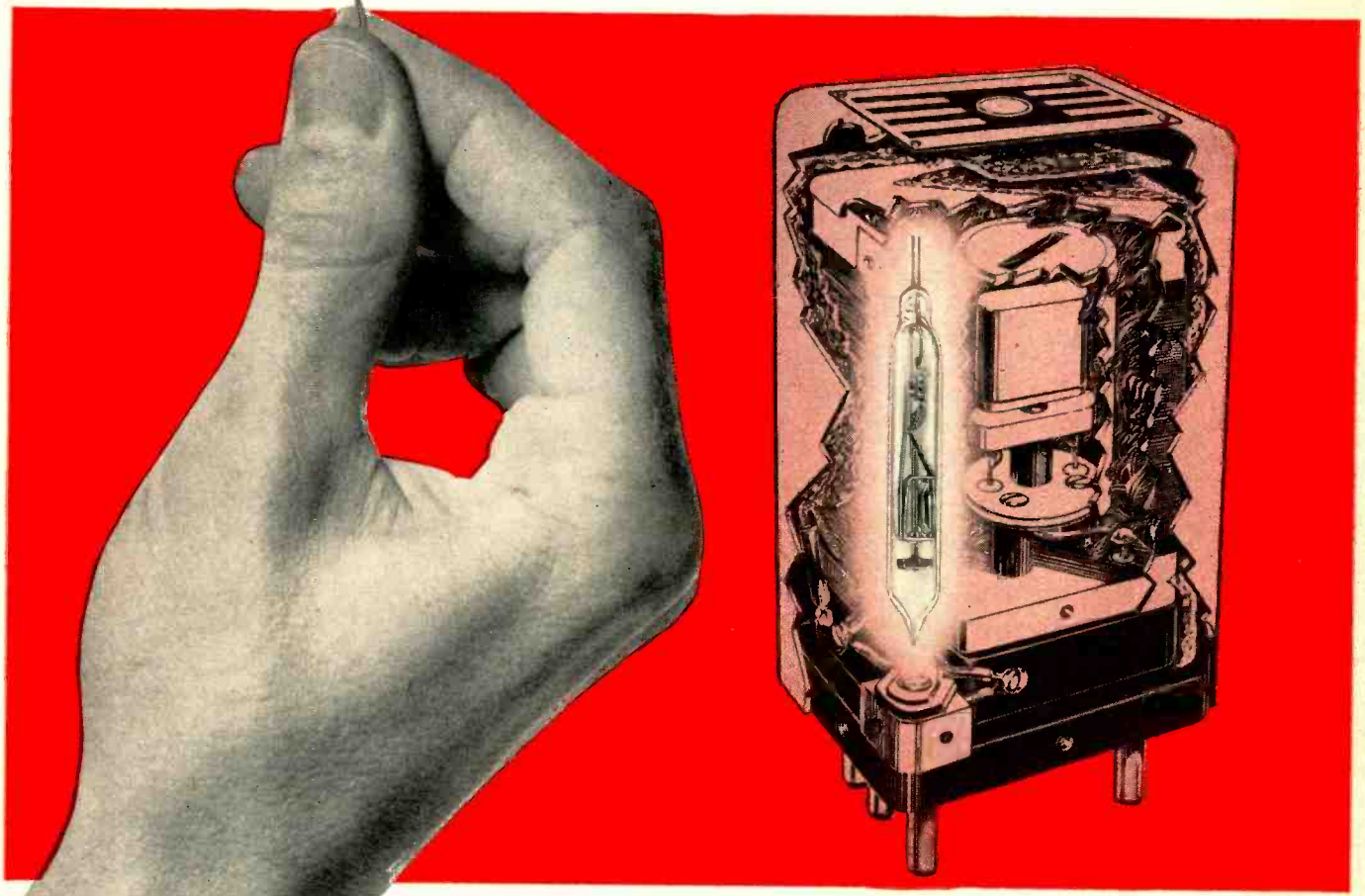
Use of a gold isotope eliminates any radiation hazard—gold loses its radioactivity in a few days compared to some metals which retain it for years.

The technique developed by California Research Corp. will be available for general use under license.

THOMAS A.

EDISON

sealed thermostats feature close control, lasting stability



Edison Sealed Thermostats are widely used in crystal ovens, electronic ovens and oscillator compartments—and many other electronic components adversely affected by temperature variations. Capable of maintaining temperatures within 0.2° C, Edison sealed thermostats offer these special features:

- Slow-make, slow-brake principle, insures small temperature differential.
- Protective gas atmosphere minimizes effects of contact arcing under heavy loads, resulting in high stability.
- Radiant energy, and conducted or convected heat is rapidly transmitted to the bimetal by the highly conductive gas fill.
- Long bimetal arm is highly sensitive to temperature changes and assures accurate control, predictable performance.

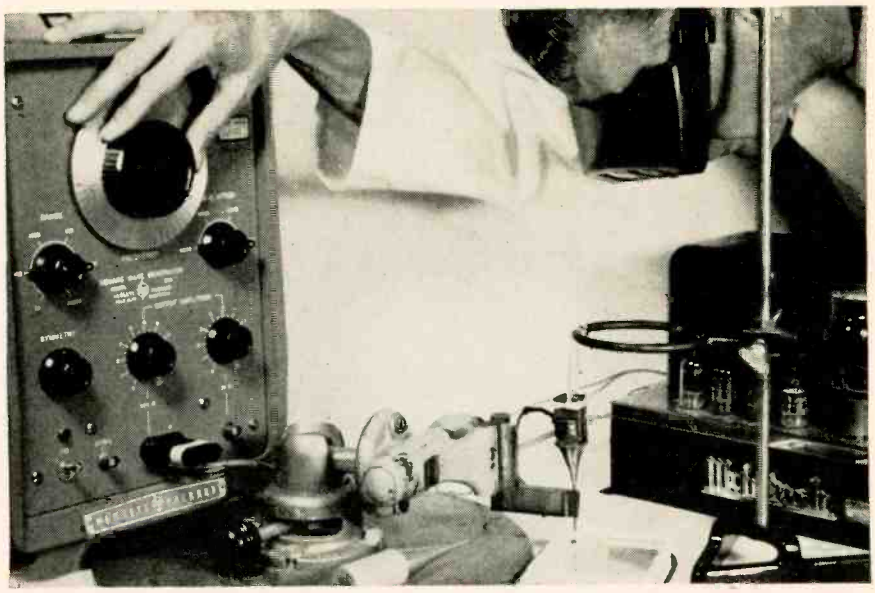
For complete data on Edison Sealed Thermostats, write for Bulletin No. 3009B.

Thomas A. Edison Industries
INSTRUMENT DIVISION
54 LAKESIDE AVENUE, WEST ORANGE, N. J.

McGRAW EDISON

Waveform Rotates Ultrasonic "Jack Hammer" Drill

By N. K. Marshall
Missile Systems Division
Lockheed Aircraft Corp.
Palo Alto, Calif.



Operator wears magnifying glass to observe cutting action of ultrasonic drill while adjusting square wave generator for maximum cutting action and rotary drilling motion

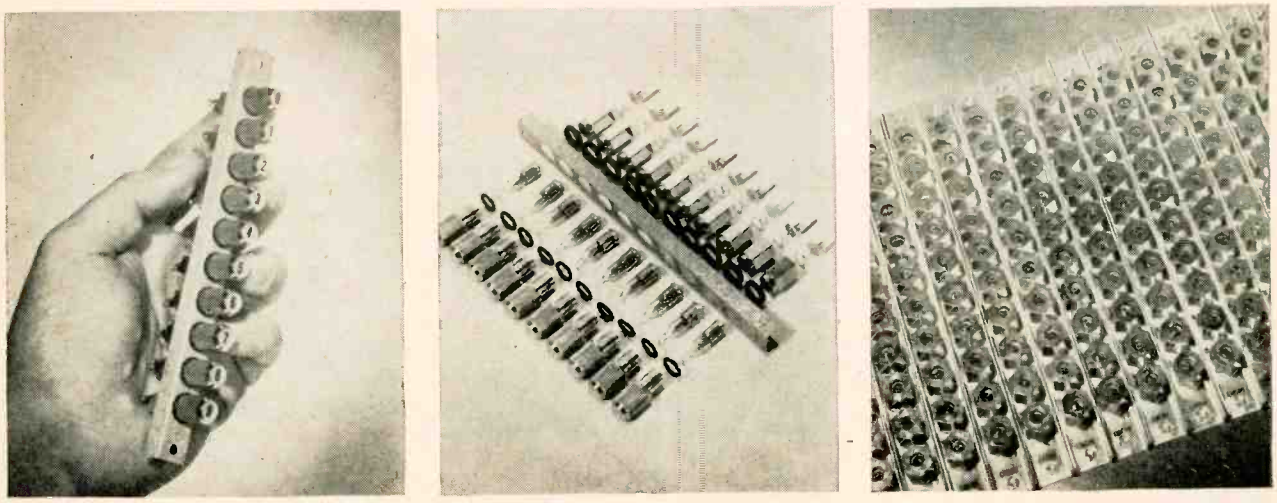
Ultrasonic rotating drill is useful for drilling small holes in ceramic magnets, ferrite magnetic memory cores and other parts made of glass-hard materials. A shaped waveform drives the transducer, producing a novel rotating "jack hammer" action which increases drilling speed and accuracy.

The drill was devised after other drills, abrasives and etches failed to produce accurate 0.015 inch holes required in ferrite cores for experimental purposes. The drill is adaptable to production needs.

Basic parts of the drill are a driving oscillator, power amplifier, magnetostrictive unit, exponential cone horn and diamond paste-loaded drills. Operating frequency is 28 kc. The drill will produce precision holes as small as 0.005 inch.

A cemented stack of permendur laminations is used as a magnetostrictive unit, but other core material may be used. After the cone is cemented in place, 50 turns of number 28 Formvar or Ceroc wire is loosely wound over the laminations. This Teflon serves as a spacer until the coil cement has dried. Flexible cable is attached to the coil. A ferrite magnet with transverse field of 30 gausses is inserted

DESIGN TRENDS: Preassembled Indicator Decades

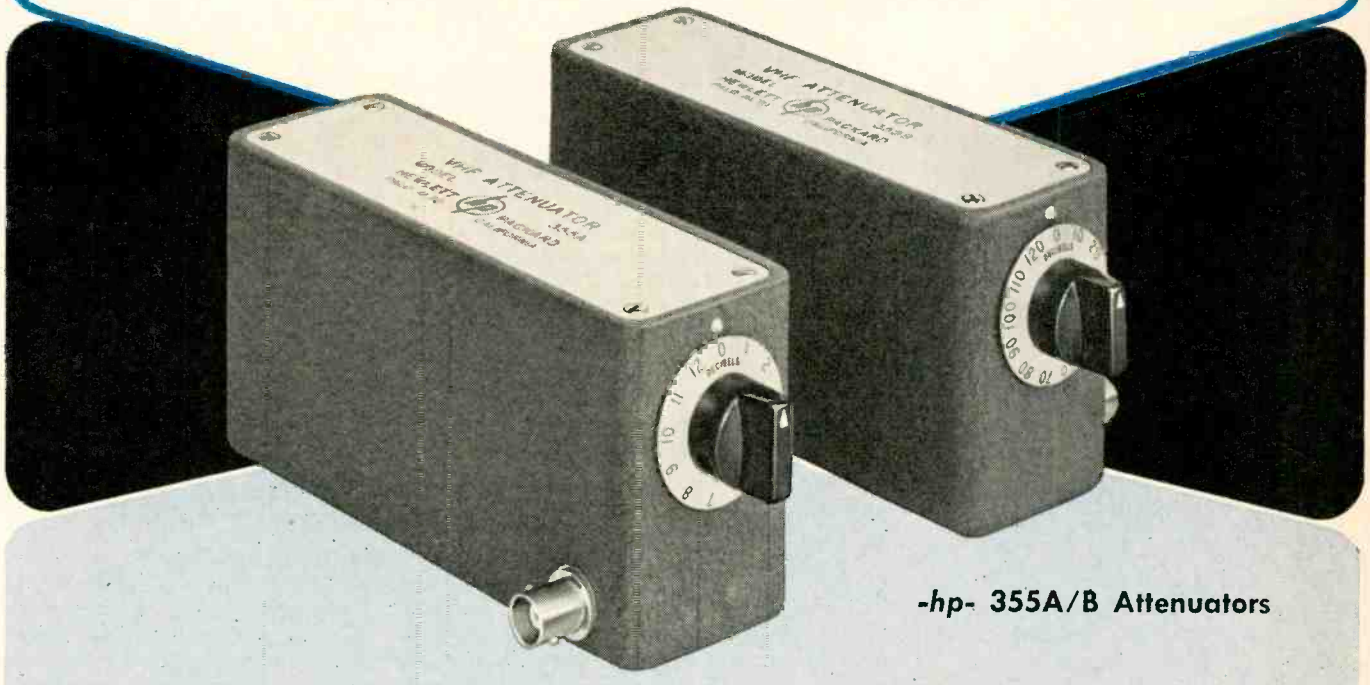


Preassembled strips of numbered indicator lamps form complete decades for use singly or in combination in computers, annunciators, matrizes and readouts. Designed by Circon Component Corp., Goleta, Calif., each decade is assembled and installed in its channel in a single, automatic feed, punch press operation. Each channel is mounted with 2 screws or rivets, reducing number of fastenings for 24-decade panel from 240 to 48

Standard size is ½ by 1 by 6 inches. Incandescent strips take lamps ranging from 1.3 v to 28 v. Strips for neon lamps may have built-in dropping resistors for line voltage operation. Normal neon power consumption is 0.04 watt, current drain is 0.0003 amp and average lamp life is 25,000 hours. Lights may be combined in one strip. Photos show assembled decade (left), exploded view (center) and rear of unwired panel

New design 50 ohm attenuator

0 to 132 db in 1 db steps— DC to 500 MC



-hp- 355A/B Attenuators

¼ db accuracy full range for low attenuation values. Maximum error at full attenuation 2 db. "One-knob" control. Super compact design—size approximately 2½" x 2½" x 6".

These are characteristics of the new, rugged, simple -*hp*- 355A/B attenuators.

-*hp*- 355A provides 0 to 12 db in 1 db steps. -*hp*- 355B provides 0 to 120 db in decade steps. Together, 132 db of attenuation from DC to 500 MC is available, with simplest possible controls, premium accuracy, and no complex setup. A solid-shield 50 ohm connector may be used to interconnect the two attenuators.

These new -*hp*- attenuators have balanced capacities and completely shielded sections. They are enclosed in a sturdy metal case, yet weigh only 1½ pounds.

Ask your -*hp*- representative to show you these practical, minimum-space attenuators this week.

SPECIFICATIONS

Attenuation: -*hp*- 355A, 12 db in 1 db steps. -*hp*- 355B, 120 db in 10 db steps

Frequency Range: DC to 500 MC

Overall Accuracy: -*hp*- 355A, ±0.25 db, DC to 500 MC. -*hp*- 355B, ±1 db, DC to 250 MC, ±2 db, 250 to 500 MC

Nominal Impedance: 50 ohms

Maximum SWR: 1.2 to 250 MC, 1.5 to 500 MC

Max. Insertion Loss: 0 at DC, 0.4 db at 60 MC, 1 db at 250 MC, 1.5 db at 500 MC

Power Dissipation: 0.5 watt average; 350 v peak

Connectors: BNC

Size: 2-3/16" wide, 2-5/8" high, 6" long. Net weight 1½ pounds

Price: -*hp*- 355A, $125.00. -*hp*- 355B, $125.00

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

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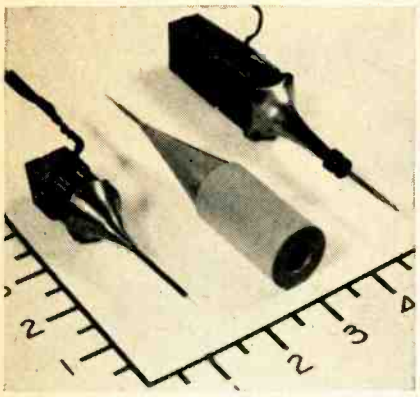
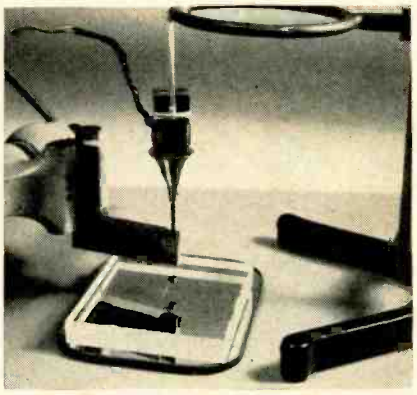
CABLE "HEWPACK" • DAVENPORT 5-4451
FIELD ENGINEERS IN ALL PRINCIPAL AREAS

hp offers over 350 quality electronic test instruments



Drill assemblies at left and right have permendur magnetostrictive units. Experimental center unit has barium titanate



Bottom of ferrite core is viewed in mirror placed under glass mounting block. Drill is suspended from elastic

into the air gap.

Profile of the cone follows an exponential curve. Dimensions are calculated using the velocity of sound in brass, the material used. A brass rod, 0.013 in diameter, fitted loosely into a 0.020 inch hole centered in the end of the cone, serves as the drill. The loose fit allows the drill to rotate.

The completed assembly is suspended from an adjustable bracket by a spring or rubber band so that the drill rod can balance the entire weight on a thin point. The driving oscillator can be any instrument capable of producing square or triangular waves at 20 to 30 kc. A model 211A Hewlett-Packard generator serves. A 20 to 40 watt power amplifier, in this case a 30 watt McIntosh, is also employed.

The cores are cemented to ¼ inch plate glass with Duco. The glass is placed on top of a mirror so the drill may be seen cutting through the core bottoms.

The drill is centered on the hole location. The amplifier is turned up to 10 or 15 watts. Oscillator frequency is varied until dust appears at the drill point. Oscillator frequency is then adjusted for maximum cutting action. The hole is started dry with a previously-used drill for greater accuracy. After the hole is started, bits of diamond paste are applied with a toothpick as needed. Amplifier gain is slightly raised and the waveform generator readjusted to produce the rotary action.

After the core is drilled, it is removed from the glass with a razor blade and slipped onto a paper clip to prevent loss. The cement is dissolved in solvent. Fine copper wire is threaded through the holes to provide excitation and pickup windings. Four holes are used.

Dip Brazing Assembles Magnesium Waveguides

By William J. Graves
Dalmo Victor Co.
Belmont, Calif.

Magnesium dip-brazed joints demonstrate sufficient structural integrity for waveguide systems. Basic design of some newer waveguide systems is influenced by availability of the method, which is somewhat similar to aluminum dip brazing in that parent metal base filler alloys as well as chloride base fluxes are used.

Parts are joined by submersion

Magnesium waveguide rotary joints and flanges ready for flux bath

Cooling for electronic reliability...by AiResearch

SPECIFICATIONS

COOLING CAPACITY	Full 1.5 kw at 50,000 ft. ambient pressure altitude and inlet conditions as follows:
AMBIENT AIR	TEMPERATURE: 10°C. PRESSURE: 1.7 psia FLOW: 3.6 lb/min
CONTAINER GAS	TEMPERATURE: 85°C. PRESSURE: 20 psia FLOW: 9.8 lb/min

The AiResearch unit shown above solves another critical electronic cooling problem in the following manner:

The larger fan, at top left of unit, draws cooling ambient air through the heat exchanger. Simultaneously, the smaller fan, at bottom center of unit, circulates dense, non-toxic sulfur hexafluoride (SF_6) through the heat exchanger and over the electronic equipment. The cooled gas maintains the sealed electronic equipment at the desired temperature.

The 20 by 24-inch honeycomb mounting base for the cooling components is designed by AiResearch to form an integral part of the pressurized electronic equipment container.

This cooling package, incorporating standard, proved components, was developed by AiResearch in minimum time. It and other air or liquid-cooled units for similar purposes are based on almost 20 years of experience in the development of cooling systems for aircraft, missile and nuclear applications.

Send us details of your problems or contact the nearest Airsupply or Aero Engineering office for further information.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

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in a molten flux bath whose temperature is below the melting point of parts to be joined but above the melting point of the brazing or filler alloy.

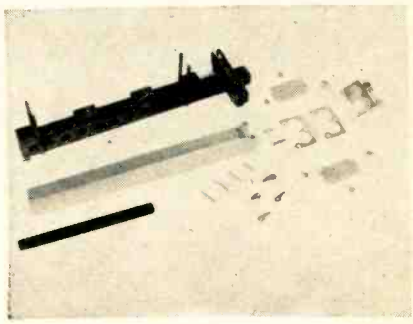
Successful parent material alloys include MIA and A Z31B (FSI); brazing filler alloy is A Z 125, and brazing flux is Dow 452.

Parts must be deburred to facilitate even filler alloy flow. Parent metal parts and filler metal are cleaned by degreasing, light sanding with aloxite cloth or electrolytic caustic dip, followed by hot water rinse and air blast drying. Dow has several other treatments.

Assembly

Filler metal shims and strips can be formed or stamped. The parts are assembled in a brazing fixture, if needed. Proper clearance for filled metal flow is 0.004 to 0.006 inch per side, depending on joint size. Staking, self-positioning or spring-loading fixtures or tack welding with M1A rod are some methods of assembly.

Fixtures should be of minimum



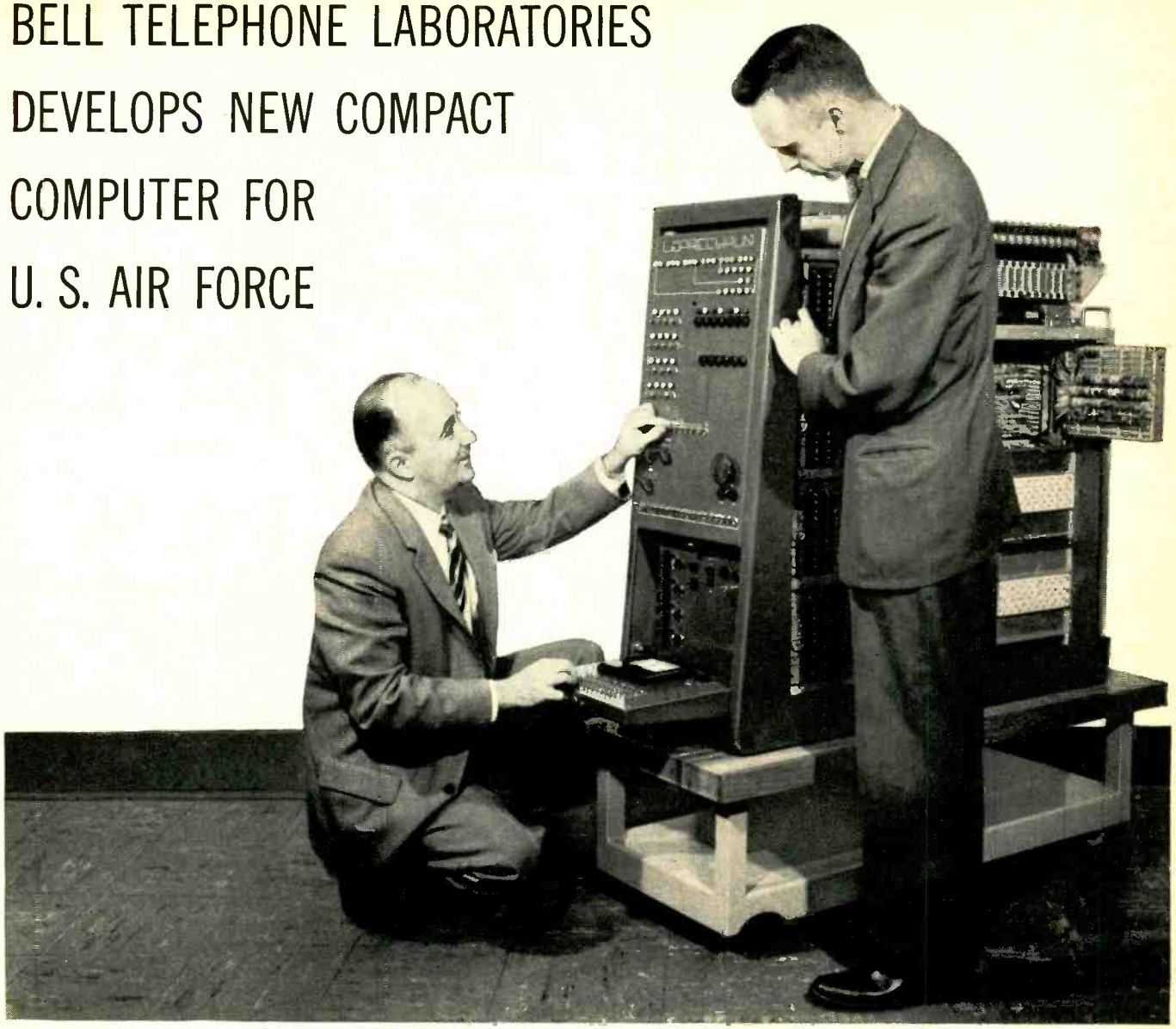
Waveguide parts and brazing before assembly in brazing fixture (top)

size to lessen flux bath temperature loss and to avoid flux drag-out. Fixture design must avoid flux entrapment and permit free flow of water. Corrosion-resistant materials should be used. Different expansion of magnesium and fixture steel with temperature must be considered.

Brazing

The assembly is preheated in an oven at 850 F to evaporate moisture and reduce heat loss of the flux bath. The assembly is then immediately immersed in the flux for ½ minute to 3 minutes, depending on size. Immersion time

BELL TELEPHONE LABORATORIES DEVELOPS NEW COMPACT COMPUTER FOR U. S. AIR FORCE



J. A. Githens, B.S. in E.E., Drexel Institute of Technology, and J. A. Baird, Ph.D. in E.E., Texas A. & M., check the control panel of Leprechaun, a new high-speed computer which solves extremely complex problems in one-tenth of a second. Small size and low power are made possible by new design principles and Bell Laboratories' invention of the transistor.

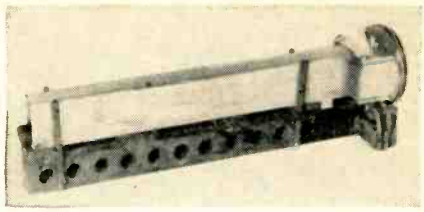
The United States Air Force assigned Bell Labs an interesting assignment: develop a new kind of electronic computer. The major requirement was greater simplicity. Of course, no computer is simple, but this one (known as "Leprechaun" to its designers) is much smaller and simpler than most of the computers currently in use.

It has only some 9000 electrical components; 5000 of them are transistors. As a result, Leprechaun has less than one-third the components of conventional computers. This facilitates testing, experimentation, assembly and service.

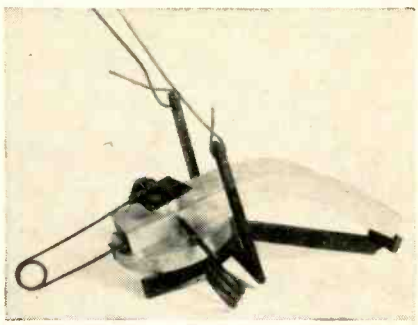
Even in its experimental state, Leprechaun is a stimulating example of great strides in the simplification and miniaturization of circuitry . . . a problem of profound interest to all Bell Laboratories researchers as they develop radically new equipment for your future telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



Waveguide in fixture after brazing



Spring fixture used to hold rotary joint and waveguide assembly

should be the minimum required for filler flow because alloying of filler with parent metal would wash out or undercut the joint.

After removal from flux bath, the assembly is allowed to cool to about 600 F and then plunged into boiling water to remove the bulk of frozen flux. A 1-minute dip in Dow 1 is followed by a 2-hour boil in a 5-percent sodium dichromate solution. Finish machining or protective coating completes the joint.

Preliminary tests of lap joints indicates shear strength of 12,000 to 14,000 psi. Various configurations withstand internal pressure of 35 psi. Percentage of leakers is less than 1 percent. Some strength loss in the parent material may occur.

Moldable Boards for Printed Wiring

A NEW MANUFACTURING process for printed wiring boards eliminates etching or plating and permits molding of three-dimensional board shapes at the same time that the circuit is molded. Hole concentration can be twice that of punched XXXP parts, and holes can be tapered or stepped in depth freedom of creative designing. In addition, the technique forms a resin skin seal over all edges and hole walls, reducing moisture absorption.

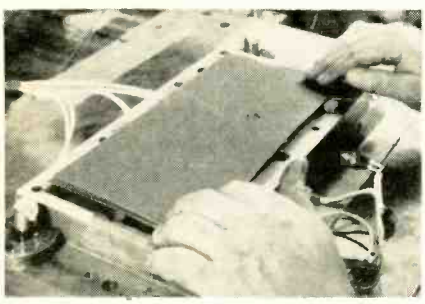
The molding material for the

process, a cellulose sheet impregnated with a Bakelite phenolic resin, is supplied uncured by Rogers Corp., Rogers, Conn.

Basically, the technique consists of a die-stamping or die-blanking operation which fixes the design on the board, and a molding operation which fully cures the board.

In the first step, an adhesive-backed copper sheet is laid over the uncured board and the circuit pattern stamped into it. The punch impresses the copper below the surface of the board, adhering those parts which will form the circuit. Excess copper is then stripped away by hand for salvage as scrap.

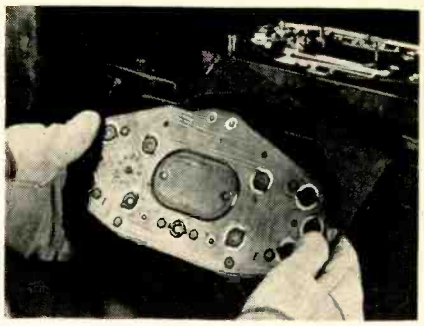
Raised pattern on heated die corresponds to desired printed wiring pattern



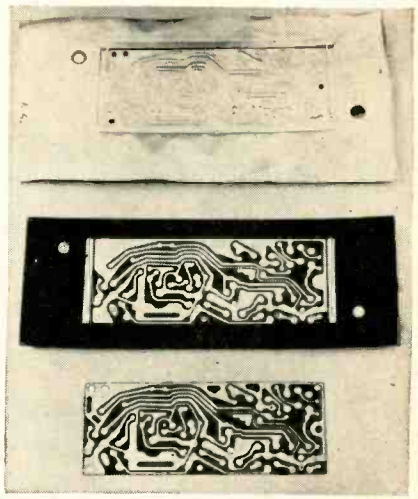
Copper sheet is placed over die first, then uncured board

To complete the operation, the board is fed to a standard compression molding press, where its final mechanical and electric properties are obtained by curing at the proper time, temperature, and pressure cycle. The mold cavity reproduces the design features of the finished board. Once the design is printed and the board cured, the assembly is completed in the conventional manner by mounting the electric components and dip soldering.

An inherent advantage of this molding process is the formation of



Removing punched and trimmed cured board from press, ready for use as behind-dashboard wiring for automobile. Dash lamp sockets snap into molded holes



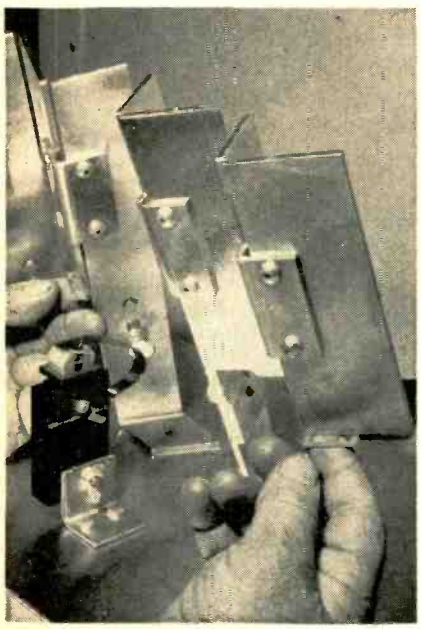
Auto radio printed circuit, showing copper punched into molding board, pattern on board with excess copper stripped away, and final molded circuit

a resin skin on all surfaces of the board during the cure cycle. This furnishes a protective seal over edges and holes, appreciably reducing moisture absorption. In addition, a safety factor may be incorporated, where necessary, by molding a cover sheet of the same material as the circuit board over the printed circuit. The molding boards themselves are available in thicknesses from 0.031 inch through 0.125 inch. Heavier thicknesses can be obtained by molding two or more boards together.

Dispenser Jig Feeds Single Laminations

A LAMINATION DISPENSER and coil holder have speeded and improved the process of interleaving laminations in plastic-shell transformer coils at Lenkurt Electric Co., San

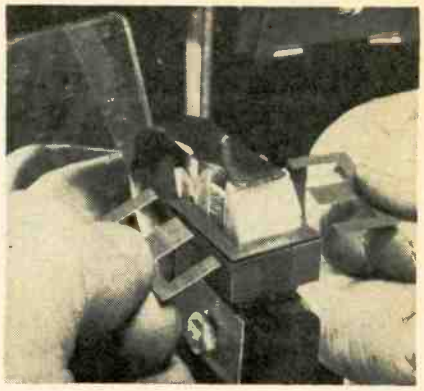
Arrangement of four lamination dispensers, with stacking jig in center



Operator withdraws lamination from bottom of stack with one finger

Carlos, Calif. The idea, originated by Dave Tiedemann of the firm's Transformer Dept., results in less lamination scrap through reduced handling of the laminations, which are now easily drawn from a dispenser-type jig.

Previously, laminations were picked out of a box or from piles arranged at the operator's work space. Operators now can use both hands for stacking, since the coil is held firmly by a phenolic block and spring. Before, one hand was

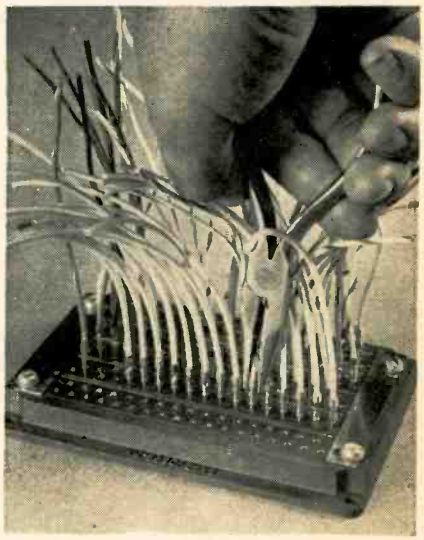


Phenolic block and spring hold coil, freeing both hands

needed to hold the coil. The new process increases stacking speed about 20 percent.

Panels Hold Taper-Pins

A COMPACT TAPER-PIN panel assembly meeting flexibility requirements of electronic equipment for a missile launcher has been developed by Burndy Corp., Norwalk, Conn. The panels take the firm's new Stapin solderless taper pins.



Inserting Stapin-terminated conductors in panels of holding frame

Versatility is achieved with an aluminum frame in which shielded panels are snapped and locked. While a frame will accommodate as many as five or eight panels, no more need be used than each application requires. The frames can also take bussed panels, panels for coaxial cable, or grounding inserts. The taper-pin sockets are

molded into the panel.

Insertion of Stapin-terminated wires into the panel is speeded by an insertion tool in which the pin is locked by a twisting action and from which it is released only when the inserting cycle is completed. Uniform, tool-controled impact secures the pin in the panel socket, from which it can be removed with a pair of needle-nose pliers. The Stapins are made from solid stock, eliminating seams that might be opened by the impact of insertion, or weak points that could easily bend and break.

Adhesive Foam Tape

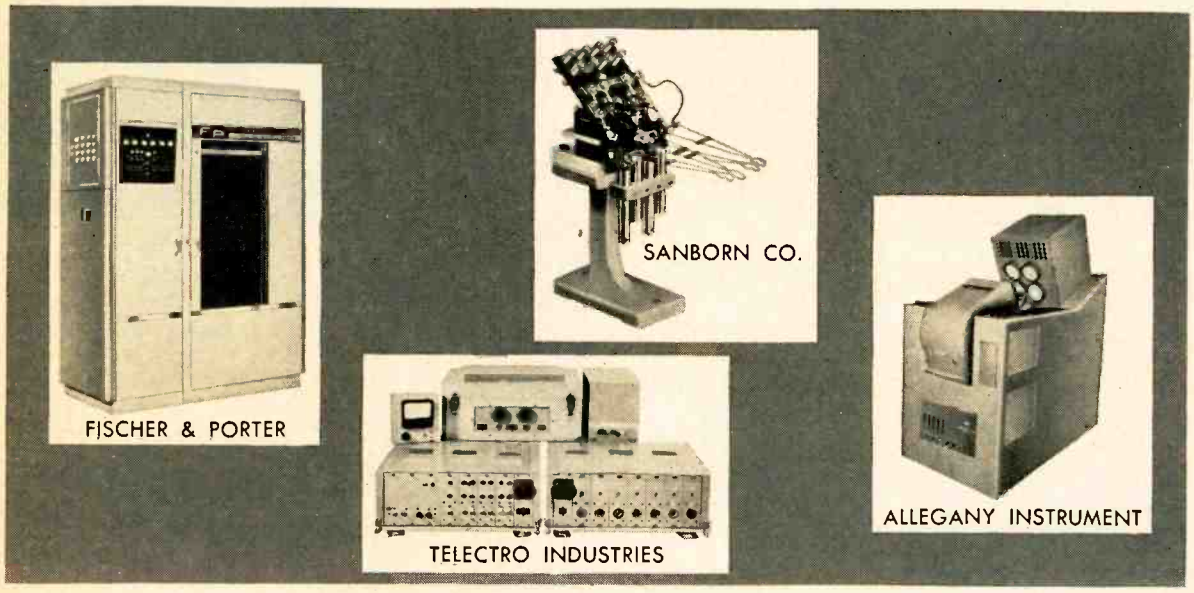
Tape is pressed on radio dial and cut with scissors, for cushioning and dust exclusion

PLASTIC FOAM TAPE with chemically cemented adhesive backing is used as cushioning, sealing, dust-excluding or sound proofing material for components, instruments or housings.

The foam is a polyurethane. A polyvinyl-chloride foil laminated to the foam forms the carrier for a pressure-sensitive, inorganic adhesive. A peel-off tape protects the adhesive until use. Maximum service temperatures are 212 F dry heat, 140 F wet heat or 250 F intermittently.

Supplied in various widths to 18½ inches and thicknesses of $\frac{1}{8}$, $\frac{1}{4}$ and $\frac{1}{2}$ inch, the tape can be cut by scissors or dies and made fast by light pressure. American distributor is United Mineral and Chemical Corp., New York, N. Y., for P. Beiersdorf Co., West Germany.

Data Recorders Push Ahead



Benefit Systems Designer

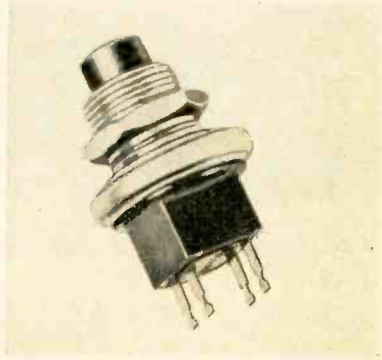
TODAY'S weapons systems and other complex designs require that human participation in the computation process be held to an absolute minimum. This points up the need for data processing equipment.

Telectro Industries Corp., 35-16 37th St., Long Island City, N. Y., (275) announces model TR-781, an airborne two-speed data recorder consisting of four shock mounted major units and a portable test meter. It is designed primarily for recording, simultaneously, data from 14 telemetering channels of d-c to 100 kc information. The unit accommodates 1-in. wide by 2,400 ft long magnetic tape on 10½ in. diameter reels.

For recording on-off events, **Sanborn Co.**, 175 Wyman St., Waltham, 54, Mass. (276), has available 4, 8, 16, 24 and 32-channel event recorders. The portable units consist of standard recorders with a four-styli Multi-Marker in place of each conventional galvanometer. To supply Multi-Marker coil power, a series of special transistor amplifiers has also been developed. Input impedance is 3,000 ohms (min.), with 2 v (max).

Fischer & Porter Co., Hatboro, Pa. (277), has introduced a data logger which can handle anywhere from 200 to 2,000 input variables depending on the scanning method used. It performs a variety of functions and records all readings on an automatic typewriter in digital form. If desired, readings can be recorded on a punched tape which can then be used with an analog computer for closed-system control of the process variables.

Model 204-A12 dynamic temperature and strain recorder is offered by **Allegany Instrument Co., Inc.**, 1091 Wills Mountain, Cumberland, Md. (278). It features 12 channels of simultaneous data in addition to a calibrated linear time base and zero time on a 10 in. wide by 31½ in. long record.



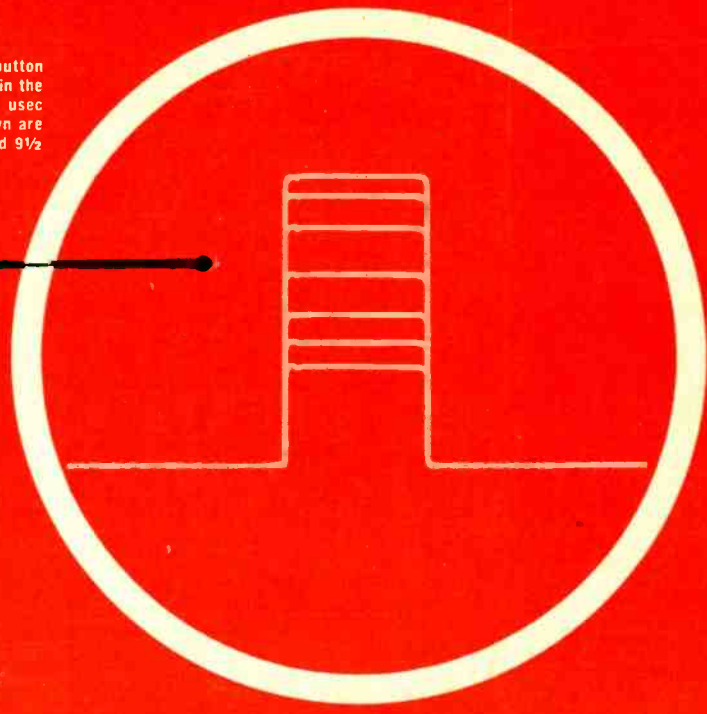
Push Button Switch double-pole model

GRAYHILL, INC., 561 Hillgrove Ave., La Grange, Ill. The company's line of miniature push button switches has been extended to include a new precision-built double pole model. It is a silent-action, momentary contact, dpst switch, which is rated ½ ampere, 115 v a-c, resistive load. It is claimed to have a life expectancy of over 100,000 operations (manual).

Housing and button are of electrical grade molded phenolic. The switch is equipped with 15/32 in.–32 threaded mounting bushing with a hex nut. Designated as Model 35-1, it is now being furnished as

For more information use READER SERVICE CARD

Fidelity of 404 push-button attenuation is shown in the multiple exposure of a 1 usec pulse. The db levels shown are ½, 1½, 3½, 5½, 7½ and 9½



0.018 usec RISE TIME

100,000 pps REP. RATE

Du Mont

404

Pulse Generator

- Repetition rates up to 100,000 pps, manual trigger for single pulse
- 0.018 usec maximum pulse rise and fall time
- Pulse width continuously adjustable from 0.05 to 100 usec
- 50 volts maximum output into 50 ohm impedance
- 59.5 db of attenuation in 0.5 db steps with no pulse degradation
- Hard tube circuitry eliminates jitter due to hydrogen thyratron erratic firing.

The Du Mont 404 Pulse Generator sets new standards for stability and versatility, outmoding pulse generators employing hydrogen thyratrons. The performance of the 404 reflects the entirely new "hard-tube" circuitry concept employed.

The capabilities of the 404 provide excellent facilities for ultra-high frequency studies at moderate cost. Its hair-line firing of sharp-edged pulses, push-button stepped attenuation, high rep rate, minimum jitter, easy-to-use front panel and control layout, internal delay from 2 usec before trigger to 100 usec after—all add up to a multiple use instrument that's good for years of dependable performance.

Price $**675**

Rack-mounting model $690

Write For Complete Technical Details . . .

One of the 400 Series

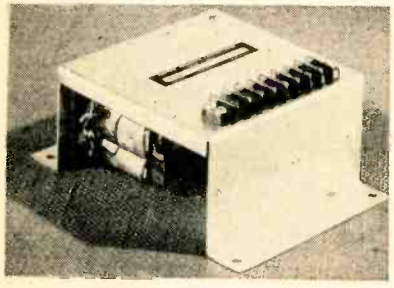
DU MONT SCIENTIFIC INSTRUMENT SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC.

normally open (with red button). Complete details and prices are available. **Circle 279 on Reader Service Card.**

Audio Oscillator
ultrastable, subminiature

C G Electronics Corp., subsidiary of Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J., has developed an ultrastable subminiature adjustable audio oscillator. It can be used as a stable tone modulator for energizing frequency sensitive relays in remote locations. Additional applications include its use as remote frequency audio decoders.

The oscillators are can mounted for plug-in construction and are available in frequency ranges from 200 to 1,000 cps. Characteristics include short period drift of 0.1 cycle and less than 0.5 percent over a temperature range of 0 to 150 F. Additional characteristics are: distortion, less than 5 percent; rms output, 0 to 30 v; and voltage drift tolerance, 0.1 percent shift range 33 percent. **Circle 280 on Reader Service Card.**

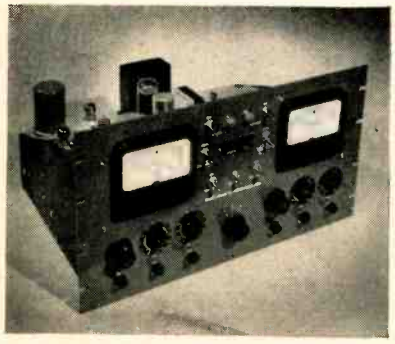


Amplifier Relay
for lower surface speeds

Electro Products Laboratories, Inc., 4500 N. Ravenswood Ave., Chicago 40, Ill., has devised a new over/under magnetic amplifier speed control relay for lower surface speeds.

Designed for use with a magnetic pickup which may be mounted near a rotating gear, model 3440 tubeless amplifier and relay will operate either over or under a preset critical speed. The chassis fits in a commercially available JIC approved wiring box.

Gear teeth passing the pickup at 0.005 in. spacing and traveling 40 to 50 ips peripheral speed provide a signal which is amplified by this device to provide spdt switching of electrical loads up to 5 ampere noninductive. Critical speed for the relay is set by adjusting spacing between the magnetic pickup and actuating metal. **Circle 281 on Reader Service Card.**

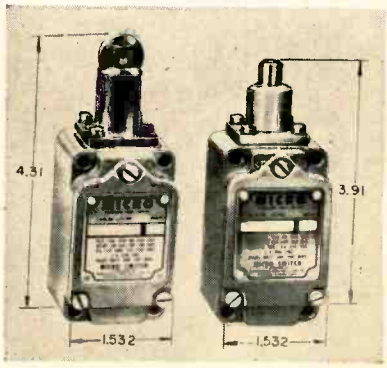


Oximeter Amplifier
used in medical research

Ensco Engineering Specialty Co., P. O. Box 19, Sugarhouse Station, Salt Lake City 6, Utah. The logarithmic Oximeter amplifier has been developed for use in conjunction with a Waters' type Cuvette or Earpiece. The nonlinear output of the Cuvette or Earpiece is fed directly into the Oximeter amplifier which incorporates all circuits and adjustments necessary for system balancing and calibration. The output of the amplifier is a voltage which is directly proportional to oxygen saturation or concentration of dye in blood flowing through the Cuvette or Earpiece, and it may be used to drive galvanometers, oscilloscopes or pen type recording equipment.

Use of this amplifier virtually eliminates the need for calibration from Van Slyke oxygen concentration determinations. Two-point calibration for oxygen saturation is accomplished quickly by observing outputs corresponding to zero and 100 percent saturation. Two-point dye curve calibration is accomplished by observing outputs corresponding to control blood and a blood sample with known dye concentration.

Two models of the Oximeter amplifier are available. The OSA-1 is a single channel unit. The OSA-2 is a dual channel unit with independent input and output circuits and a common power supply. **Circle 282 on Reader Service Card.**

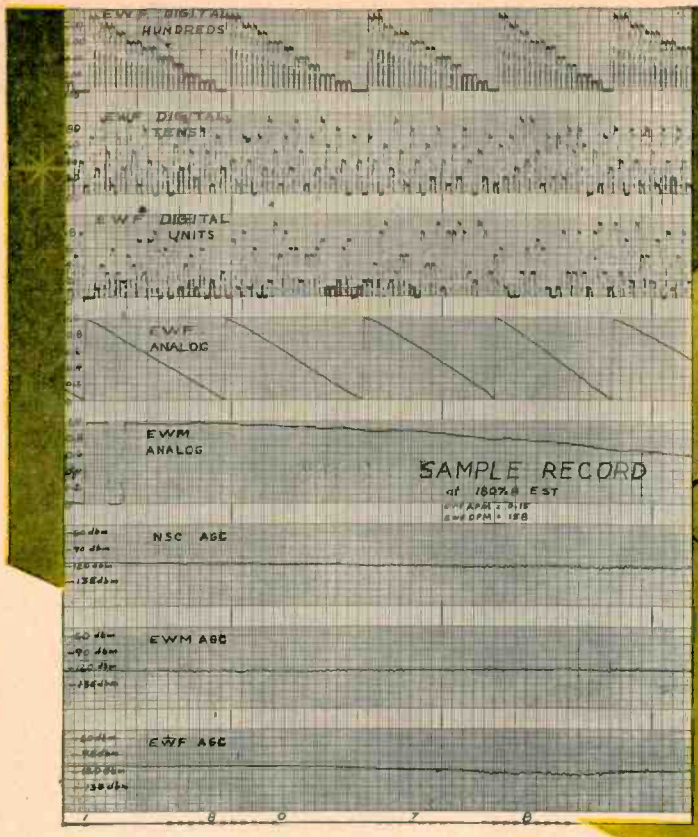


Limit Switches
two-circuit devices

Micro Switch, a Division of Minneapolis-Honeywell, Freeport, Ill. A pair of new two-circuit limit switches that are compact in size and have high electrical capacities is now available. These precision limit switches include a roller-plunger-actuated switch and a (push or in-line) plunger-actuated switch.

The roller-plunger switch (5LSI) which is especially effective for cam or slide operations, can be rotated 90 deg from the switch cover plate. The plunger-actuated type (2LSI) offers a full ¼ in. of overtravel. Both are completely sealed and are highly resistant to abuse and wear.

Contact arrangements of the two switches are double-throw two-circuit, single-pole double-break. A spdt unit can be obtained by tying together one normally-open and one normally-closed terminal and



. . . recording satellite tracking signals — on 16 channels of

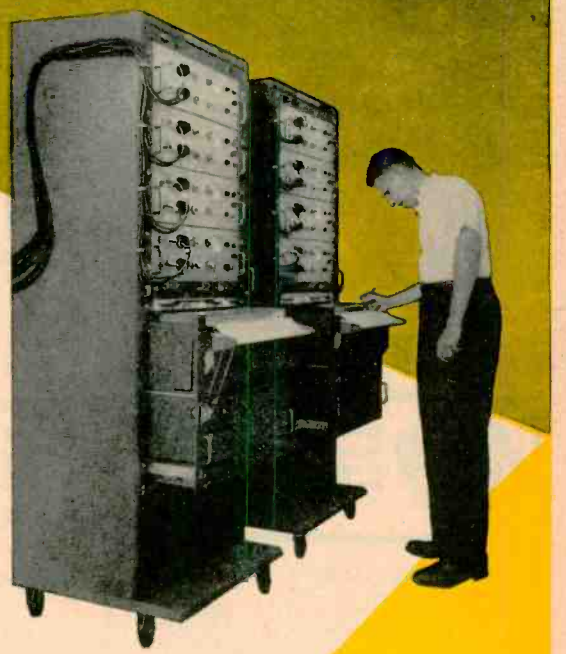
SANBORN SYSTEMS

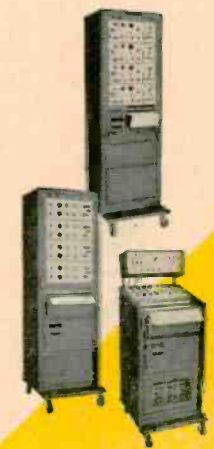
Radio tracking of IGY earth satellites poses some of the most difficult problems—and is one of the more elaborate phases—of the entire satellite program. The Minitrack tracking system, developed by the U. S. Naval Research Laboratory, receives the satellite's signals and converts them for recording on 8-channel Sanborn oscillographic recording systems.

At each of ten stations in the Minitrack chain, two 8-channel Model 158-5475 Sanborn systems with 150-2900VA Dual Channel DC Amplifiers record the data. Of the 16 Minitrack variables fed to the Sanborn systems, five are timing information and tracking system performance data, the remaining 11 relating to the satellite's position. Voltage analogs developed from phase angles of 5 signals will determine position. Since the analogs vary from 0-60 volts at rates up to 120 volts per second, with flyback from full scale to zero in less than 1 millisecond, the high linearity of the Sanborn recording systems becomes extremely important. Six more "position" channels will be used for digital recording—three for an "east-west" antenna pair, three for a "north-south" antenna pair. Because these recordings must be clearly readable to 1 part in 1000, each of the three channels will record tenths, hundredths and thousandths individually as shown in the actual digital recording of signals of the satellite transmitter carried in an airplane. To insure clean, easily read records, the Sanborn systems must record signals varying from 0 to 0.9 of full scale in a few milliseconds and recover from the transient in less than 15 milliseconds. The trace in the margin of the recording is serial coded timing information.

Ask Sanborn for specific recommendations on your oscillographic recording problems. Short form folder, or complete 16 page catalog, available on request.

INDUSTRIAL DIVISION
SANBORN COMPANY
175 WYMAN STREET, WALTHAM 54, MASS.



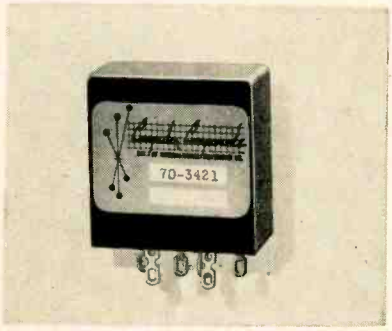


. . . recording the answers to industrial design, production and field testing problems

Flexible Sanborn "150" systems with interchangeable plug-in Preamplifiers are solving countless measurement and recording problems in industry. *Basic advantages of these systems* include clear, inkless recordings in true rectangular coordinates; 1% linearity; choice of 13 front ends including 11 plug-in Preamps; single to 8-channel systems; console or separate case housing. For analog computer readout, extensive use is made of Sanborn "150" systems equipped with Dual-Channel DC Amplifiers (as used in the Minitrack equipment), and the compact new 6- and 8-channel "5490" and "5495" mobile console systems wth the 183 Programmer for automatic control of various sequences.

using this as a common terminal.

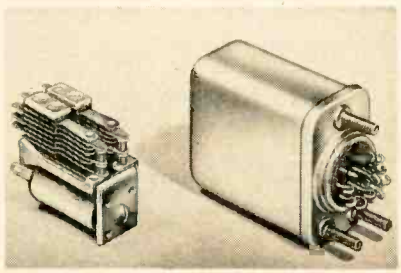
Electrical rating for the LS series is: 10 amperes, 120, 240 or 480 v a-c; ½ hp, 120 v a-c; 1 hp, 240 v a-c; 0.8 ampere, 115 v d-c; 0.4 ampere, 230 v d-c; 0.1 ampere, 550 v d-c. Pilot duty rating is 600 v a-c maximum. Circle 283 on Reader Service Card.



Pulse Transformer for digital recorders

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., announces a new pulse transformer for high speed digital recording applications. The transformer, series 70-3420, is suitable for high current magnetic recording head drive circuits. Primary and secondary as well as two secondaries are close coupled to permit use as a read-write circuit.

Packaging is designed for close stacking and maximum utilization of space. The entire unit is potted in a special high temperature moisture resistant epoxy. Turns ratio of 1:2:1 can be modified to match circuits for various heads. Circle 284 on Reader Service Card.



Multicontact Relay small size, low cost

Struthers-Dunn, Inc., Pitman, N. J., has introduced a new 180 frame midget telephone type relay featuring a wide variety of flexing spring contact arrangements in small size and at minimum cost. It finds wide use in low power military as well as in computer and other commercial equipment.

A maximum of 16 flexing contact springs can be supplied with 8 springs in each of two stacks. Minimum power requirements are on the order of 100 mw per pole. Standard coils for open-type relays withstand ambient temperatures to 85 C. Special coils are available for ambients of 125 C or for use in enclosed and hermetically-sealed relay types.

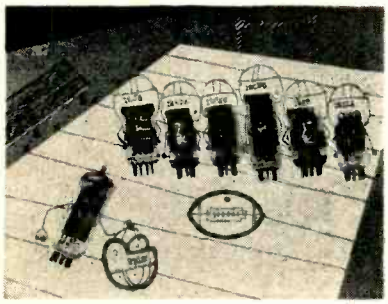
Standard contacts are nominally rated 115 v a-c and 28 v d-c noninductive at 5 amperes for silver and 2 amperes for palladium contacts. For voice or low level circuits, other contacts such as gold alloy or bifurcated palladium can be furnished. Circle 285 on Reader Service Card.

Megohmmeter battery operated

Freed Transformer Co., Inc., 1722 Weirfield St., Brooklyn 27, N. Y., has introduced their new 500 v d-c test potential portable megohmmeter, model 2030. This is a battery operated instrument with a transistor power supply. Especially suited for measuring leakage of transformers, cables and insulating materials wherever the power line is inaccessible or where battery operation is more desirable.

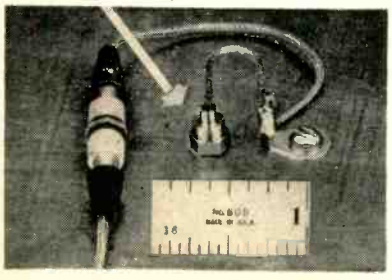
Resistance values are indicated on a 3-in. expanded scale meter

protected against overload. Low resistance in series with component under test provides very short charging time. Calibration position is provided to check accuracy of 500 v test potential. The 500 v test supply is regulated. Resistance is 5 megohms to 10 million megohms. Accuracy is ± 3 percent to 100,000 megohms, ± 5 percent to 10 million megohms. Voltage on unknown is 500 v d-c. **Circle 286 on Reader Service Card.**



Hybrid Tube used in automobile radios

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. A new addition to the 12-v line, the 12DL8 is a miniature 9-pin combined twin diode and space grid tetrode with independent unipotential cathodes. The diode section is intended for use as a detector while the tetrode section is a power amplifier designed to drive the transistor audio output stages. All tube elements, including the heater, operate at a potential of 12 v which is obtained directly from the automobile battery. **Circle 287 on Reader Service Card.**



Accelerometers weigh only 0.5 gram

Columbia Research Laboratories, MacDade Blvd. and Bul-

lens Lane, Woodlyn, Pa. A line of subminiature accelerometers of the 600 series, featuring light weight and small size have been developed for shock and vibration measurements of small components and systems.

The transducers employ barium titanate in compression for the sensing element attaining a high natural frequency of 150 kc and a sensitivity of 1 mv/g. An acceleration range extending from 1 g to 40,000 g with a frequency coverage from 5 cps to 50 kc provide wide operational characteristics. The units are equipped with 6 ft lengths of new subminiature low-noise cable designed for extreme flexibility to minimize spurious response of the test system resulting from whipping effects and cable loading. **Circle 288 on Reader Service Card.**

Voice Recorder now battery-operated

SOUNDSCRIBER CORP., Middletown Ave., North Haven, Conn., announces their portable dictation machine is now available in a battery-operated version. Four flashlight-size dry cells deliver 6 v to both the 4-transistor amplifier and the drive motor. Battery life is claimed to be 8 hr for standard cells and 20 hr for the heavy-duty type, making for an operating cost of 5¢ an hour.

The stylus embosses 260 lpi on a $3\frac{7}{8}$-in. vinyl disk which rotates at $33\text{-}\frac{1}{3}$ rpm. A square spindle and center hole prevent slippage during recording, while permitting compatibility with standard LP record players. Playing time is $7\frac{1}{2}$ min on each side and blanks sell at 5¢

each. Space and weight are saved by using the small dynamic microphone as a speaker as well.

The packaging of the recorder comprises its own case and carrying handle. Overall weight is 6 pounds, and the unit will easily fit the average dispatch case with room to spare for papers and personal articles. Circle 289 on Reader Service Card.

Test Oscillator battery-operated

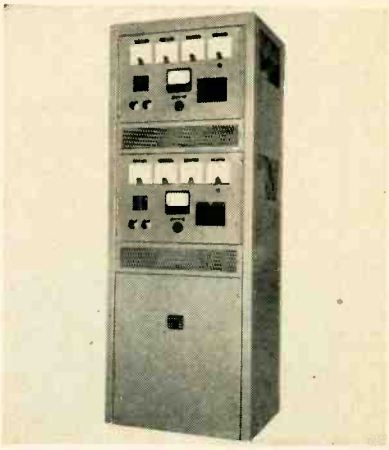
ALECTRA DIVISION, Consolidated Electrodynamics Corp., 325 North Altadena Drive, Pasadena, Calif. Model 20A portable test oscillator, featuring all-transistor circuitry, printed wiring and self-contained power supply, is continuously variable over a frequency range of 15 cps to 150 kc at a source impedance of less than 0.5 ohm.

The unit will maintain its output level within ± 2 percent as its frequency is changed from 15 cps to 150 kc. Its output impedance is less than 1 ohm. As a result, the impedance of the circuit into which it is operating can vary from 400 ohms to megohms without affecting the output level of the oscillator.

Normal warm-up period required by vacuum-tube equipment is eliminated, since inherent characteristics of transistors permit instant operation. The absence of drift caused by vacuum tube warm-up assures stable readings as soon as the instrument is turned on.

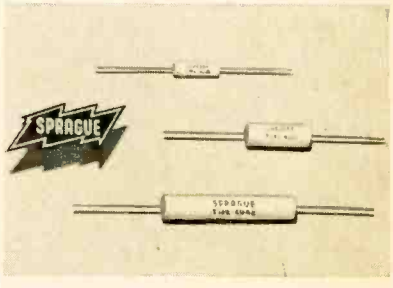
The 20A's compact, self-contained power supply (7 mercury cells) provides complete independence from line power and guarantees freedom from disturbances

caused by power-line transients. It weighs only 6½ lb and measures 6 by 8 by 6 in. **Circle 290 on Reader Service Card.**



Battery Charger
constant current

LEE ELECTRIC AND MFG. CO., 2806 Clearwater St., Los Angeles 39, Calif. Each magnetic amplifier-silicon diode module shown supply an adjustable output of 1 to 5 amperes ± 1 percent d-c. The current is constant into a silver cell battery system ranging from 1 to 50 cells. This permits automatic charging of many types of cell configurations with the same charging unit. Automatic shutoff is provided by the 4 meter relays shown. Other units are available. **Circle 291 on Reader Service Card.**



Film Resistors
small and stable

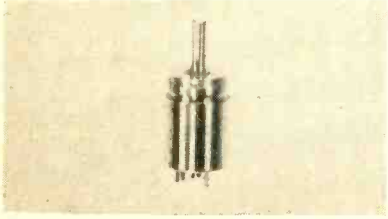
SPRAGUE ELECTRIC CO., North Adams, Mass., announces a new line of ceramic-jacketed film resistors, called Filmistors. These carbon film resistors are intended for close tolerance applications in military, commercial, and telephone

electronic equipment where small size and stability of electrical characteristics are important.

Types 402E, 403E and 404E are furnished in hermetically-sealed dense ceramic cases using ceramic-to-metal solder seals. Protection of all film resistance elements is most important since they are unusually sensitive to moisture and proper protection is the primary requirement for long-term stability of resistance. The ceramic Filmistor case not only sheds water but is vapor resistant as well. The ceramic also provides excellent physical protection against mechanical damage during handling or installation. Since the case is an insulator, Filmistors may be mounted in contact with conducting surfaces, thus saving space.

Ratings for the 402E, 403E and 404E are ½, 1 and 2 w respectively. The resistors are designed to meet performance requirements of Military Specification MIL-R-10509B.

The resistance element of Filmistors is made by the pyrolitic decomposition of a hydrocarbon gas which deposits an ultra-thin film of pure carbon on a smooth ceramic rod. The ends of the rod are coated with silver and the element is then spiralled to the desired resistance value. Special low-contact resistance, low-noise end terminations are pressed on and the unit is then sealed in the outer ceramic tube by soldering. Circle 292 on Reader Service Card.



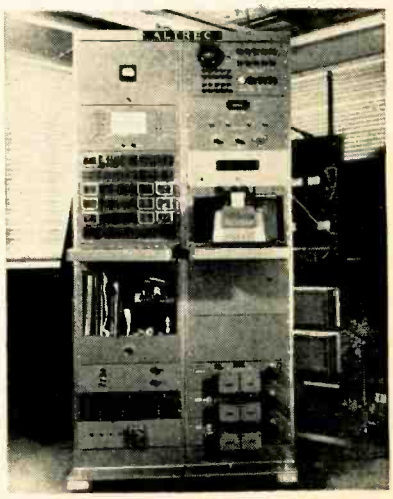
Precision Pots
single-turn devices

Helipot Corp., a Division of Beckman Instruments, Inc., Newport Beach, Calif., Series 5000 are new ½ in., single-turn precision potentiometers featuring a temperature range of — 55 to + 150 C. Power rating above 5,000 ohms is

2.5 w at 60 C, derating to 1 w at 150 C; below 5,000 ohms, 1.5 w at 60 C, derating to zero at 150 C. Standard resistance range is 500 to 70,000 ohms with a linearity tolerance to ± 0.50 percent. Best practical linearity tolerance is ± 0.25 percent.

Three models are available, each weighing 0.3 oz. Model 5001 features bushing mount; 5002, servo mount. For trimming applications the 5001 may be equipped with a shaft lock. The model 5016 high-torque trimmer with slotted bushing mount is available only in production orders. Mechanical stops are standard on the 5001 and 5016.

Series 5000 are available in linear and nonlinear versions. Circle 293 on Reader Service Card.



Testing System for electronic components

CANADIAN MARCONI CO., 970 McEachran Ave., Outremont, Quebec, Canada. Complete automation of environmental testing of components and systems is featured in ALTREC—a system for automatic life testing and recording of electronic components.

ALTREC provides in one instrument, facilities for environmental control and cycling; periodic sequential sampling and measurement; as well as a permanent printed record giving all relevant data regarding the test and operating conditions. This elimination of tedious manual testing means that large-scale statistical investiga-

tions of components and systems become possible and economical.

Components on test are divided into groups as required, each group being independently controlled by a patch board matrix determining test interval, test conditions and operating environment.

Measurements can be programmed at intervals from 1 to 1,000 hours. The measuring device is a digital voltmeter having automatic ranging to give four significant figures and permitting measurements from 1 mv to 999.9 v. On the printed record appears such information as component number, time, group, test designation, test voltages and the actual reading.

Typical uses of ALTREC are life testing of resistors, capacitors, photocells, tubes, diodes, equipments and the like. **Circle 294 on Reader Service Card.**

H-V Power Supply uses selenium rectifiers

BETA ELECTRIC Division of Sorensen & Co., Inc., 333 E. 103rd St., New York 29, N. Y. Model 4250-2, an air-insulated selenium-rectified 250 kv, 2 ma power supply, is now being offered. Rugged selenium rectifier stacks, advanced h-v circuitry, and new anti-corona techniques make it electrically and economically superior.

The 4250-2 has an input voltage of 105 to 125 V—50 to 60 cps—single phase; input power of approximately 1 kva; continuously variable output voltage; manually reversible polarity; approximately 2.5 percent ripple at maximum rated power output; internal impedance of 11 megohms; 0-250 kv voltmeter and 0-5 milliammeter and ±3 percent full scale accuracy.

Protective features include provision for external safety interlock, zero start interlock, fixed overcurrent and overvoltage relays preset for 110 percent of rated output, short circuit surge current limiting resistor, gaseous discharge devices for protection of relays and meters, and spark gap to ground from meters and transformer primaries. **Circle 295 on Reader Service Card.**

New Literature

MATERIALS

Silicone Rubber. Dow Corning Corp., Midland, Mich., has published a brochure devoted to the electrical insulating advantages of Silastic silicone rubber. It includes a tabular summary of dielectric properties of typical Silastic stocks at temperatures ranging from 25 C to 250 C. **Circle 351 on Reader Service Card.**

Wire Markers. Westline Products Division, Western Lithograph Co., 665 E. 2nd St., Los Angeles 54, Calif. A 12-page brochure describes E-Z-Code self-adhering markers for positive identification of wires from small or miniature wires and electronic components to wire, cables and harnesses of any size. **Circle 352 on Reader Service Card.**

COMPONENTS

Actuator Motor. The Viking Tool and Machine Corp., 20 Main St., Belleville 9, N. J. A new high torque motor featuring split-second starting and stopping with starting torque equal to running torque is described in an engineering bulletin. **Circle 353 on Reader Service Card.**

Capacitors and Power Supplies. Film Capacitors, Inc., 3400 Park Ave., New York 56, N. Y. A complete product catalog covering polystyrene, polyethylene, Teflon and mylar dielectric capacitors and a line of h-v packaged power supplies is available. **Circle 354 on Reader Service Card.**

Microwave Resistors. Filmohm Corp., 48 W. 25th St., New York 10, N. Y. A new four-page brochure describes metal film resistors especially designed for use from d-c to 90,000 mc. **Circle 355 on Reader Service Card.**

Plug Guide. Cannon Electric

of the Week

'Co., 3208 Humboldt St., Los Angeles 31, Calif. How to select a Cannon plug is concisely described in a 40-page plug guide—an orientation to the 53,000 connectors manufactured by the company. **Circle 356 on Reader Service Card.**

Portable Potentiometer. Technique Associates, Inc., P.O. Box 91, Indianapolis 6, Ind. New 6-page bulletin T-57 features the Thermotest portable pot for measuring temperatures and voltages. **Circle 357 on Reader Service Card.**

Pulse Transformers. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif. Specifications on the complete line of pulse transformers are listed in the company's latest general catalog, TR-57. **Circle 358 on Reader Service Card.**

Reflex Oscillator Klystron. Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N. Y., has available a 4-page loose-leaf perforated bulletin on the SRX-92 reflex oscillator klystron. **Circle 359 on Reader Service Card.**

Repeat Cycle Timers. The A. W. Haydon Co., Waterbury, Conn. Bulletin AWH RC-301 describes a new line of subminiature hermetically sealed repeat cycle timers. Timers discussed were designed specifically for aircraft, missile and rocket applications, and will find use in industry. **Circle 360 on Reader Service Card.**

Solderless Wiring Devices. Electrix Terminals & Connectors, Inc., 990 E. 67th St., Cleveland 3, Ohio. A newly revised catalog on solderless wiring devices describes and illustrates new time saving solderless terminals and connectors for crimping to wire extremities. **Circle 361 on Reader Service Card.**

Tape Wound Cores. G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J. A line of tape wound cores are illustrated and described in a two-color, eight-page

catalog (Bulletin TB-102). Circle 362 on Reader Service Card.

Transistor Data. Kahle Engineering Co., 1313 Seventh St., North Bergen, N. J. A 4-page chart features complete, up-to-date technical specifications and application data for almost 500 transistors. Circle 363 on Reader Service Card.

Variable Ratio Transformer. Vernistat Div., Perkin-Elmer Corp., Norwalk, Conn. Specifications and applications for the Vernistat variable ratio computing transformers are found in a new technical data sheet. Circle 364 on Reader Service Card.

EQUIPMENT

Airborne Communication. Collins Radio Co., Cedar Rapids, Iowa, has published a single sheet bulletin describing the AN/ARC-58 (XA-1) airborne system which provides single sideband suppressed carrier transmission and reception in the 2-29.999 mc range with global communication capability. Circle 365 on Reader Service Card.

Blocking Oscillator Pulse Generator. James S. Spivey, Inc., 4908 Hampden Lane, Washington 14, D. C. A single-sheet bulletin covers type 55 C blocking oscillator pulse generators. The transistorized modules discussed are miniaturized sources of pulses. Circle 366 on Reader Service Card.

Circuit Analyzers. DIT-MCO, Inc., 911 Broadway, Kansas City 5, Mo. A 22-page catalog describes the operation of the company's circuit analyzers, which are designed to expedite the testing of complex, multiple circuitry in the aircraft, missile, electronic and related fields. Circle 367 on Reader Service Card.

Combination Test Set. Microwave Electronics Division, Sperry Gyroscope Co., Great Neck, N. Y. A four-page folder deals with a general purpose test set for measuring all X-band radar parameters. The instrument discussed combines the functions of a frequency meter,

power meter, signal generator, spectrum analyzer and synchroscope. Circle 368 on Reader Service Card.

Electrical Controls. Assembly Products, Inc., Chesterland, Ohio. Simple all-purpose electrical controls, known as Versatrols and suitable for use with virtually any detectable variables, are described in 12-page bulletin 106. Circle 369 on Reader Service Card.

Flow Colorimeter. Beckman/Process Instruments Division, Fullerton, Calif. Descriptions and specifications for the new, improved ratio recording flow colorimeter are included in bulletin 4000. Circle 370 on Reader Service Card.

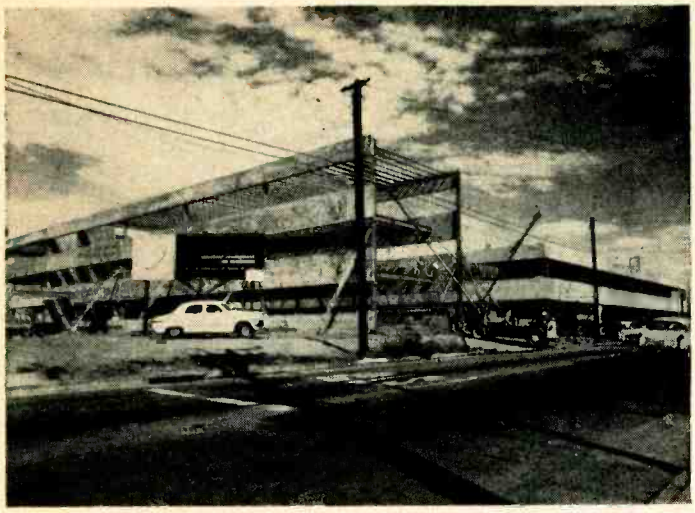
Nuclear Instruments. Radiation Counter Laboratories, Inc., 5121 W. Grove St., Skokie, Ill. The four-color, 132-page 1958 catalog contains the manufacturer's complete line of 200 items, ranging from Geiger Mueller detectors to transistorized multichannel analyzers. Circle 371 on Reader Service Card.

FACILITIES

Facilities Brochure. General Machine Products Co., Inc., Old Lincoln Highway at Pennsylvania Turnpike, Trevose, Pa., has issued a booklet describing its new 60,000 sq ft plant and outlining its manufacturing facilities for the electronic and communications industries. Circle 372 on Reader Service Card.

Missile Research Facilities. Aerophysics Development Corp., P. O. Box 689, Santa Barbara, Calif. Guided missile research and development facilities are featured in a 12-page illustrated bulletin. Circle 373 on Reader Service Card.

Wire Processing. Eubanks Engineering Co., 260 North Allen Ave., Pasadena, Calif. A 15-minute 16-mm color motion picture on a new automatic wire cutter and stripper is available on a loan basis. Circle 374 on Reader Service Card.



Your Plant—Lease Or Buy?

"FROM A standpoint of simple arithmetic, today it makes more sense for an electronic firm to lease its facilities rather than purchase them."

That's the informed observation of John M. Stahl, Beverly Hills, Calif., industrial developer.

Stahl has erected a number of new buildings (photo) on a lease basis for electronics firms in Southern California. His tenants include such companies as the Rand Corp., RCA, Burton Manufacturing Co., and Continental Electronics Corp. R & D centers, production units, offices and warehouses are represented in the above. Stahl also built a plant for Radar Corporation of America, a firm over which he presides and which has been active in component development.

Experts point out that leasing permits the companies to retain for corporate purposes the capital they otherwise might have tied up in real estate, had they elected to purchase the facilities.

With the electronics industry today in a state of dynamic expansion, some believe it behooves companies to keep fluid by holding as much capital as possible. No one argues the precept that an industry is best advised to direct its money toward the specific exploitation of its product.

Stahl backs up the feasibility of leasing with some pertinent figures. According to a National Credit Office survey, electronics companies, last year, earned 8.8% on their invested capital. In achieving even this percentage, it is reasonable to assume that the less capital frozen, the greater the actual earnings that can be realized.

The tax picture is another consideration that favors leasing. The lease cost is a deductible item. In today's money market companies can lease a facility for 8% of its total cost, according to Stahl. After taxes, this figure amounts to only 3⅝%. Leasing seems even more practicable when it's remembered that industries would be hard put to borrow money at a rate as low as their rental fee.

Businessmen cite several other positive advantages. For one thing, in any given area industrial developers are the experts on the most suitable sites available. Often a company is assured of ample space, accessible shipping networks, a nearby labor pool, and sundry other advantages because the local developer is in a better position to ascertain than the company.

Some organizations are geared to permit leasing of not only the land and basic shell, but equipment as well.

Such organizations, staffed with experts in real estate, planning, engineering, architecture, construction and financing, offer the added advantage of speed. In one of the three structures Stahl built for Rand Corp., the elapsed time from negotiation to operation of the plant was just 90 days. A study by Rand showed that had they attempted to coordinate the building themselves, it would have taken a minimum of 2½ years.

Despite arguments which favor leasing, some electronic companies choose to own their basic manufacturing plant. The reason most often given is that the company must be in complete control of the facility to be flexible. For instance, the company might wish to expand or to convert the plant to adapt to new processing methods. Leasing, they argue, would put them in a position of being unduly restricted.

Some developers counter this argument by offering a lease that allows maximum freedom of movement. It includes:

1. An overlay for expansion. If the company outgrows the plant, it can make additions, using its own capital, or have the developer build it to its specifications.
2. The right to sublet, with the industry that has the facility built remaining primarily liable.
3. Option to cancel at any time should the company find the plant unsuited to its needs. A penalty is charged for cancelation, but this is not prohibitive.

Another argument in favor of purchasing the plant outright is that the company, by putting its money in real estate, can avoid amassing a surplus the government may determine excessive. But then, few companies are in a position to worry about having too much money.

G-T-C Continues Expansion

LEASE of an additional 16,000-sq ft building (picture) at 87-11 130th St., Richmond Hill, N. Y., is announced by General Transistor Corp. Full production of tran-

SYNCHRONOUS MOTOR COMMUTATOR

COAXIAL CABLE SPLICER

PLUG-IN COIL BOBBIN

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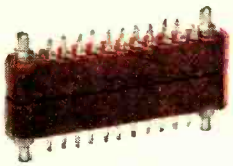
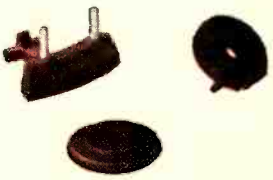


CONNECTOR PLUG

ELECTRIC MOTOR THERMOSTAT HOUSING



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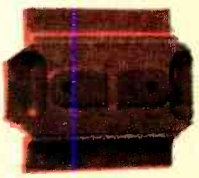
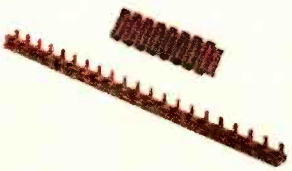


AIRCRAFT BRAKE SHOE HEAT BARRIER

TERMINAL CAP



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Dissipation factor @ 1 megacycle	dry 0.005 wet 0.05
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Tensile strength, psi	4,500
Impact strength, ft-lb/in	15

*Cured 2 hours at 390 F. For operation at 1500 F, an additional afterbake at 800 F is recommended.

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MIDLAND, MICHIGAN

sistors in this one-story plant will move early in 1958. This brings to five, the number of G-T factories located in the New York metropolitan area. The new plant will be devoted almost exclusively to a number of semiconductor products planned for introduction early this year.

Fill New Post at Du Mont

ASSIGNMENT of Samuel B. Fishbein (picture) to assistant general sales manager of the military operations department is announced by Allen B. Du Mont Laboratories, Inc. He assumes his duties at the newly created post after serving as manager of Du Mont's New England military operations office, Wellesley, Mass., since September, 1956. At that regional post, he was responsible for the company's military sales endeavor in an area encompassing all territory north of a line from Boston, Mass., to Buffalo, N. Y. This included Toronto and eastern Canada.

Granger Ups Hennies

APPOINTMENT of Stuart R. Hennies as manager of applications engineering for Granger Associates has been announced by John V. N. Granger, president of the Palo Alto firm specializing in electronic systems.

Since joining Granger last spring

Hennies has been a senior member of the engineering staff. His widened responsibilities place him in charge of coordinating customer requirements with the development and application of the firm's electronic devices.

From 1951 through 1956 Hennies was with Varian Associates, Palo Alto. His first assignment with Varian was as a microwave tube design engineer specializing in reflex klystrons. Later, as an applications engineer, he was concerned with the utilization of klystrons in radar and microwave relay systems.

Bolz Takes New Position

In Tenafly, N. J., Automation Dynamics Corp. names Richard A. Bolz (picture) director of research. He will direct the research phases of the company's activity in the fields of automatic control, communications and computing devices.

Bolz was previously senior project director at Production Research Corp. where he contributed to microwave communications systems development, specialized antennas and related devices.

Scudder Is New ISE President

Recently elected president of International Standard Electric Corp., overseas manufacturing, research,

sales and licensing subsidiary of IT&T, is Henry H. Scudder. He was formerly executive v-p of ISE, has been with the IT&T System since 1919, and has served in various executive capacities in the U.S., Europe and South America.

As president of ISE, Scudder heads an organization which owns and directs the operations of all of the IT&T System manufacturing and laboratories companies outside the U.S. With 50 principal plant locations in 18 different countries throughout the world, in addition to three major laboratories situated in England, France and Germany, the companies controlled by ISE do a business of well over 300 million dollars a year and employ over 92,000 people.

P&B Elects V-P

Former chief engineer, Zeke R. Smith (picture) has been elected vice president of Potter & Brumfield, Inc., Princeton, Ind. He is assigned the duties and title of director of engineering. He will be in charge of all product and applications engineering for P&B's three plants located in Indiana, Kentucky and New Hampshire.

A member of the executive staff, Smith has been associated with Potter & Brumfield, a subsidiary of American Machine & Foundry Co., for over 3½ years. He joined the company as a sales engineer, with headquarters in Chicago, and later became a member of the engineering department.

Prior to joining P&B, he was as-

sociated with Bendix Aviation Corp., Kansas City division; Vendo, Inc., also of Kansas City; and the Airborne Instrument Laboratory, Mineola, N. Y.

Westinghouse Hires Moss

HILARY Moss (pictured) is now with the advanced development section of the Westinghouse electronic tube division, Elmira, N. Y.

A native of England, during the war years he headed the crt research department of A. C. Cossor Ltd., where he was responsible for the research and development of radar tubes and associated display circuitry.

In 1946 he was named chief engineer and director of research of Electronic Tubes Ltd. Moss moved to the U.S. in 1952 and later joined the Burroughs Corp. as a department manager. Since 1956 he has served as a consulting scientist to that firm.

CEM Expands

APPROXIMATELY 11,000 sq ft of floor space are being added to Central Electronic Manufacturers, Inc., Denville, N. J., a subsidiary of Nuclear Corp. of America, Inc.

Under construction now, the additional space will be used to expand the Electronic Tube Division which makes precision and

special purpose tubes, and the Equipment Division which custom-designs high vacuum, communications, transistorized applications, and laboratory equipment. More space will also be provided for the nuclear research and development operation.

The new building is scheduled for completion in February.

Elect Finke Honeywell V-P

ELECTION of Walter W. Finke (picture), president of the Datamatic division of Minneapolis-Honeywell Regulator Co., Newton Highlands, Mass., to vice president of the corporation is announced. He will continue as head of Datamatic, which is producing large-scale electronic data-processing systems in the $2½-million category for office automation.

Prior to assuming direction of Datamatic's operation in 1955 Finke served with the parent firm in executive positions since 1950.

He successively was head of Honeywell's Ordnance division, head of its Semi-Conductor division and then was assistant to the president.

Cannon Opens New Plant

FASTER delivery of Cannon plug volume lines is said to be assured by the new 106,000-sq ft Cannon

Electric Co., Santa Ana Division. Facilities of the $1¼ million plant are designed for mass production items.

The plant, located on a 30-acre site, is expected to employ 1,500 within three years. It is one of nine world-wide sources of Cannon plugs.

Plant Briefs

Johnson Electronics Inc. moves from Orlando, Fla., to a new 14,000 sq ft building in Casselberry, Fla.

X-Ray Products Corp., Rivera, Calif., will begin construction in about six months of an electronics research center at Grant's Pass, Oregon. The new center will be named Schneeman Electronics.

Executive Moves

Stavid Engineering hires **Edwin S. Hoffman** away from Fada Radio & Electric, makes him contract representative in Washington, D. C.

Harold Mason becomes plant manager for Alpha Wire Corp., will organize the firm's assembly production division.

James H. Peterman becomes sales engineer for Clevite Transistor Products.

Stanley F. Molner leaves Marchant Research to become a product sales supervisor in Beckman Instruments' systems division.

Kieran R. Dunne leaves Filtron Co. to head up the delay-line department of Control Electronics Inc.

Hoffman Electronics' semiconductor division moves **J. R. Madigan** into the post of chief engineer.

Nuclear Corp. of America lends its president and board chairman, **Sam Morris**, to Uncle Sam. Morris is new assistant director of the elec-

tronics division of Business and Defense Services Administration.

Richard D. Evans moves from Sylvania's semiconductor division to become government sales manager for special tube operations.

International Resistance Co. moves J. Burton Henry up to make him sales manager of new products division.

Founders Raymond W. Searle and Lucius E. Packard of Technology Instrument Corp. become respectively president and board chairman of the firm.

A. P. Lancaster, formerly head of Western Electric's eastern area for manufacturing, moves to vice-president in charge of the company's western area manufacturing operations.

News of Reps

Two more instrumentation sales reps are appointed by North Atlantic Industries, Inc., Westbury, N. Y. COL-INS-CO, Jacksonville, Fla., will serve North and South Carolina, Georgia, Alabama, Tennessee and Mississippi. J. P. Brogan Associates, Westbury, will cover the New England States and New York State, with the exception of metropolitan New York City area.

Lawrence C. Freeman resigns as sales engineer at Allen B. DuMont Laboratories, Inc. to establish an independent sales and manufacturer's rep organization. From offices in Montclair, N. J., he will specialize in precision electronic components and instruments.

Los Angeles rep, Conrad R. Strassner Co., takes on the sales of the Pierson receiver for Automation Electronics, Inc. of Burbank, Calif.

In Westbury, L. I., H. L. Hoffman takes on the electronic counters of Northeastern Engineering Inc. Hoffman will serve metropolitan New York and the mid-Atlantic.

NEW BOOKS

Transmission Circuits

By Everard M. Williams and James B. Woodford, Jr.
The Macmillan Company, New York, 1957, 156 p, $4.25.

This book is intended as a textbook for electrical engineering senior students. The material in it, to be covered in a one semester course, deals briefly with distributed parameter circuits but includes a chapter on lumped parameter lines (wave filters).

Topics Covered—The topics covered are organized into six chapters; first, the distributed parameter concept is introduced, then parameter calculation, including skin effect is taken up. Three chapters deal with sinusoidal voltages and currents so that power transmission, signal transmission as analyzed from the frequency response and lossless lines are treated. A short chapter on transients and the above mentioned chapter on lumped constant lines together with appendices on hyberbolic functions and field theory complete the book.

Concise Treatment—The most remarkable fact about this textbook is the length or rather brevity of the work. The bulk of the subject is discussed in 140 pages and discussed completely according to the authors' intention. This is the type of book which the experienced teacher always hopes for—the essentials, the principles, the basic ideas are written down in the book, explained and discussed. The home exercises in the text are not only exercises in the usual sense of the word; they are problems which carry forward the students' understanding of the basic principles and serve as a basis for class discussion. Thus the book furnishes the detailed outline or framework for a course which the teacher using this book must fill in and complete together with his students.

The problems which are such an integral part of this scheme appear to be chosen with skill and foresight and reflect the authors' awareness of the practical aspects of the subject. Thus the authors, who have attempted to write a book that is strong in root content and which will encourage the student towards self-directed activity, have succeeded admirably and deserve the thanks of engineering educators and students for showing the way to this type of textbook.

Subject Choice—The choice of subject matter is somewhat traditional. This reviewer feels that the distributed parameter concept should be more closely integrated with field theory; perhaps transmission lines ought not be taught until after the student has been exposed to Maxwell's equations. The transmission line concept, the lumped parameter content and field theory can then all be deduced from their common root.

The authors have chosen to approach the subject of transmission lines from the sinusoidal steady state viewpoint. The chapter dealing with transients on transmission lines comprises only nine pages. This gives the feeling that an important topic has been slighted and it may well be this feeling is justified, particularly since there are books on transmission lines which approach this topic through the time domain.

The authors have set out to accomplish a specific task. They have succeeded and it is reasonable to expect that their success will fill the needs of many engineering schools.—Egon Brenner, *The City College of New York, New York, N. Y.*

Radio Aids To Air Navigation

By G. H. H. Grover
Philosophical Library, New York, 1957, 138 p., $6.00.

This text represents a concise and interesting coverage of the fairly specialized branch of electronics generally considered as radio aids to aerial navigation. The treatment of the subject material is based upon a systems approach to navigational problems with the greatest emphasis being applied to general theory and performance of the various equipments.

Technical detail has been re-

duced to the minimum required for understanding of the design principles and there is no discussion given to the circuit implementation of the theoretical approaches. A good understanding of range and accuracy limitations on each system type and each system class is obtained from this book which, combined with the generous and careful drawings and photographs provided, give the reader a good practical insight into the general field of radio aids to aerial navigation.

Context—Specifically, the book is categorized to describe medium frequency and UHF systems, hyperbolic aids, pulse systems, aids to air traffic control and aids to approach and landing. A chapter on the author's extrapolation of future aids and trends in the field of radio navigation is also included. Continuous reference is made to existing systems and techniques; but although there is mention of TACAN and other aids designed and pioneered in the United States, the major emphasis, as one would expect of a book initially published in Great Britain, is upon European and, in particular, British equipment.

In all, the book is excellent in meeting the author's intended aim of providing students with the data required in preparing for civil license examinations. For the reader whose primary emphasis or interest is radio aids to civil air navigation rather than electronics, the book is highly recommended. —A. E. Nashman, *Executive Engineer, Guided Missile Lab., Federal Telecommunication Lab., Nutley, N. J.*

THUMBNAIL REVIEWS

Transistor Circuits. By Rufus P. Turner, Gernsback Library, Inc., New York, 1957, 160 p, $2.75 (paper). Collection of 150 practical circuits encompassing audio, r-f, i-f and d-c amplifiers, oscillators, power supplies, radio receivers, triggers and switches, control devices, test instruments and amateur devices. Circuits are accompanied by descriptive text.

COMMENT

Christmas Story

We were very glad indeed to have our electronics story in your December 20 edition ("Christmas Story," Dec. 20, p 35), but were considerably disturbed by two errors of fact. We feel that credit should be given where credit is justifiably due.

Bendix Aviation Corp.'s Eclipse-Pioneer division not only helped the Federation of the Handicapped set up its electronics division six years ago, but continues to provide engineering and technical assistance to us.

Also, it is the sales—not the profits, as mentioned in the story—that make up about two-thirds of the Federation's budget.

MILTON COHEN
FEDERATION OF THE HANDICAPPED
NEW YORK

Small Particles

I would like to call your attention to errors in our article "Spot Scanner Counts Micron-Sized Particles" (Dec. 1, p 142).

Both the title and summary indicate that the system counts "micron"-sized particles. The original manuscript made no claim to counting such small particles but mentioned only colonies of 0.5 mm (500 microns) and larger.

The instrument is *not* a moving-target indicator but does use one of the techniques.

Fig. 4 shows the cathode-follower output grounded and omits the ground connection of the last (top) 51K resistor on the voltage divider. Fig. 5 shows a ground connection at the 36K resistor of the 6AL5, which should be at +250V. Fig. 6 shows input 2 grounded and also omits the +250V connection of the 1 mh coil at the 6BJ7 cathode.

On p 145 the text states that the delayed signal is attenuated 100db. This should be 100x or 40db.

H. P. MANSBERG
DUMONT LABORATORIES
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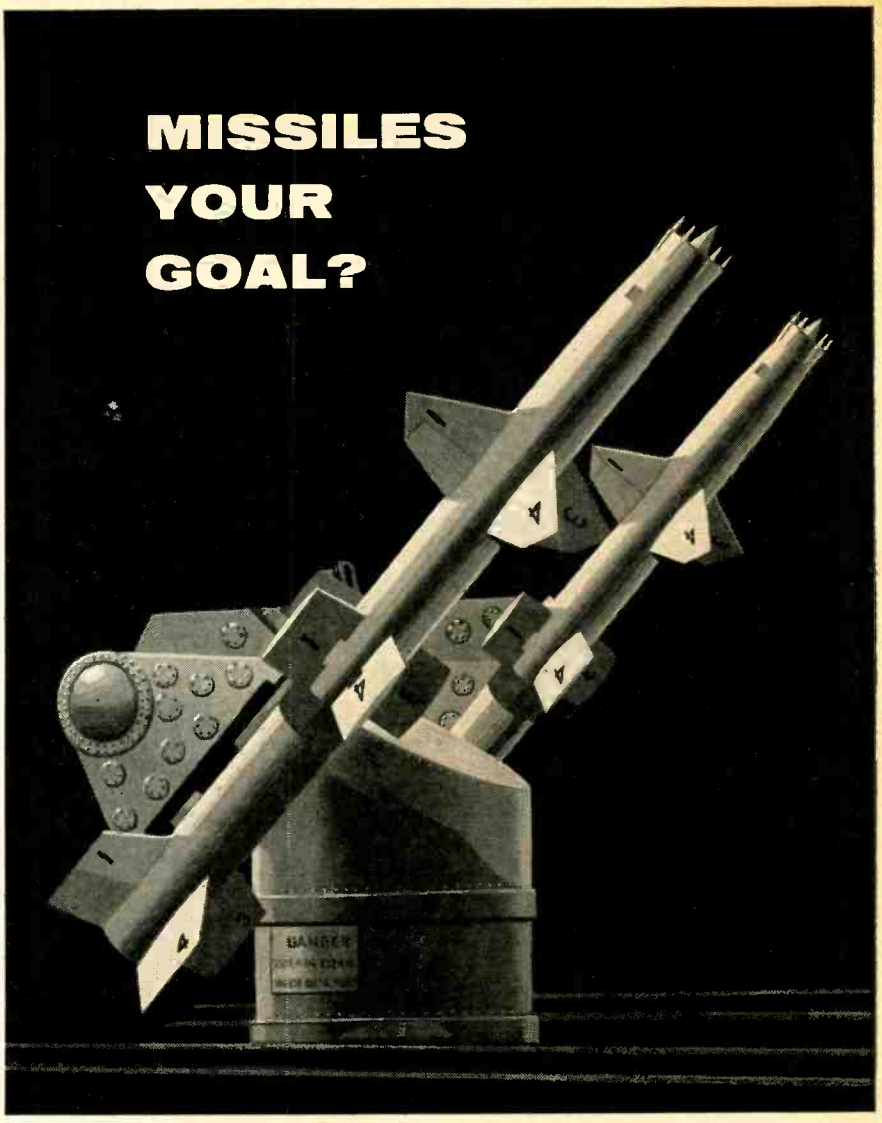

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MAR.	28	APR.	4	APR.	11	APR.	18
APR.	25	MAY	2	MAY	9	MAY	16
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You cut installation and assembly costs. Full mechanical protection allows normal production-line handling . . . close dimensional tolerances (⅛ watt ± 0.010" length; ± 0.015" diameter; ¼ and ½ watt ± 0.008" length; + 0.015" diameter, – 0.005" diameter) allow snug fit in tight circuitry . . . easy readability of markings helps avoid installation and stockroom errors.

T/I

electrical value	CDM⅛ (MIL Type RN60B)	CDM¼ (MIL Type RN65B)	CDM½ (MIL Type RN70B)	Unit
Wattage Rating	⅛	¼	½	Watt
Resistance Range — Low	25	40	25	Ohm
High	1	1	2	Megohm
Resistance Tolerances (to order)	½, 1, 2, 5	½, 1, 2, 5	½, 1, 2, 5	%
Maximum Rated Voltage	250	300	350	V
Length, Diameter	0.406; 0.140	0.585; 0.200	0.750; 0.250	In.

*Specification for Fixed Film High Stability Resistors

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							CLASS A		Classes A and B		LOW-LEVEL			
	VHF Amplifier	HF Amplifier	Mixer	Oscillator	Converter	IF Amplifier	Small-Signal	Driver	Large-Signal	Power	Low-Speed	Medium-Speed	High-Speed	High-Voltage
2N247		✓	✓	✓	✓	✓								
2N274*		✓	✓	✓	✓	✓							✓	
2N370		✓											✓	
2N371			✓											
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2N384*	✓	✓	✓	✓	✓	✓							✓	
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2N140					✓									
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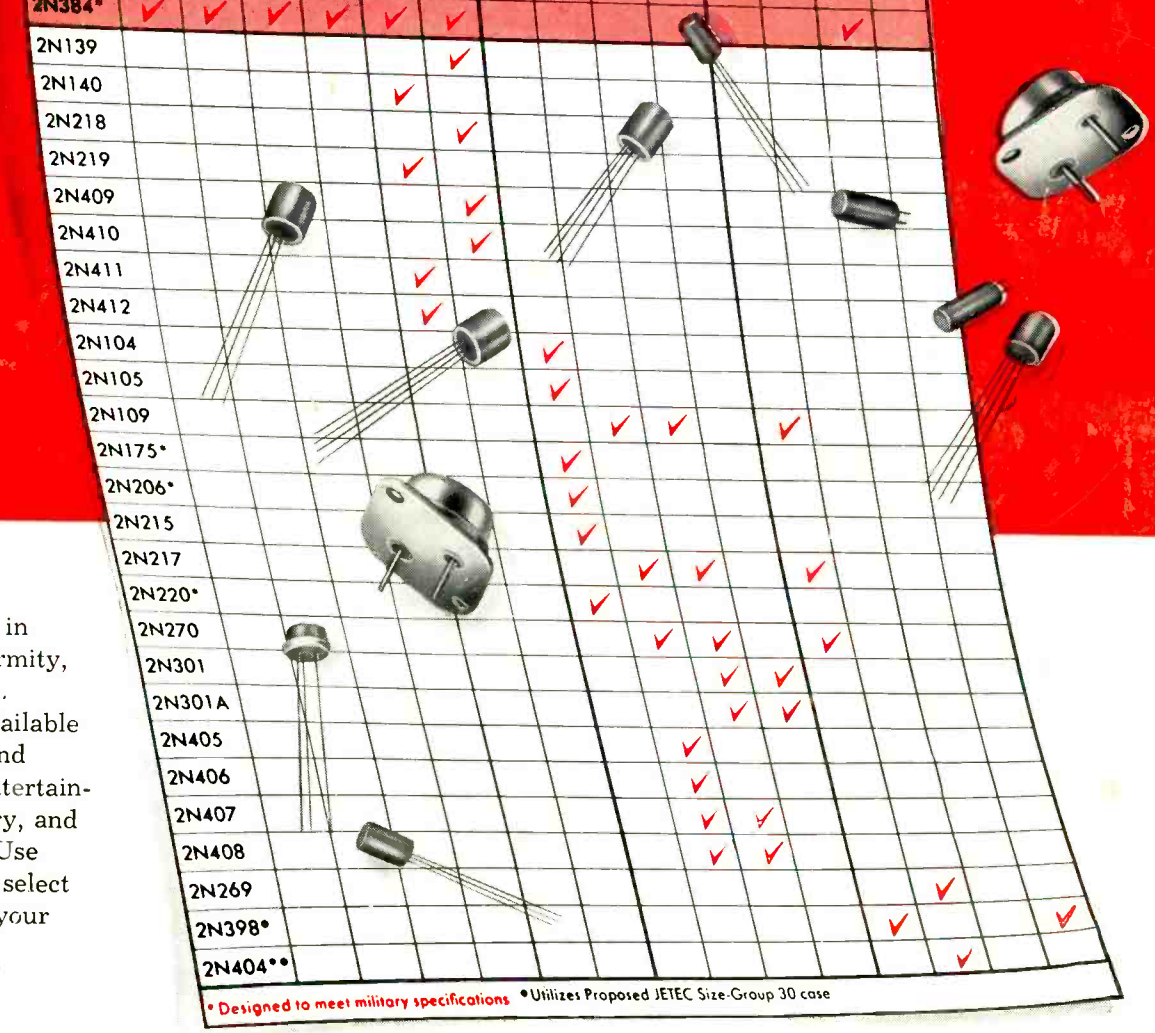

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