JUNE 12, 1959

electronics

A McGRAW-HILL PUBLICATION VOL. 32, No. 24 PRICE SEVENTY-FIVE CENTS

Instrumentation For Nuclear Power

Hidden Dangers ... tion

NEW METERED Variacs

for every work bench

- ★ Indicate the exact amount of load voltage and either load current** or power† drawn.
- ★ Ideal for measuring power consumption.
- ★ Provide a convenient means for determining the effects of reduced or increased line voltage on a-c operated equipment; for example, cutoff points of voltage-regulator circuits are readily determined.
- ★ Useful for tracking down circuit troubles that are intermittent with normal line voltage, but which can be made to occur more frequently or fail altogether at either low or high line-voltage.

▲ **Type W5MT3A** Metered Variac, $85**
. . . reads load volts and amperes

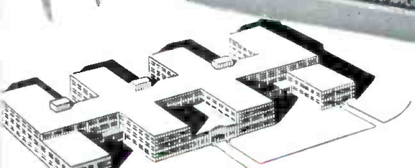
▲ **Type W5MT3W† Metered Variac, $110**
. . . reads load volts and watts

The new General Radio Metered Variac® autotransformers are everyday tools needed in laboratory test setups and engineering work areas. These continuously adjustable a-c supplies are available in two types. Each model consists of a W5 Variac with Duratrak* brush contact surface, a current transformer, the necessary switches, a voltmeter, and either an ammeter (W5MT3A) or a wattmeter (W5MT3W).

Output voltage range is from 0 to 135 volts. Dual ranges are provided for maximum accuracy: 0-1 and 0-5 amperes for the volt-ammeter; and 0-150 and 0-750 watts for the volt-wattmeter. Meters are magnetically shielded to yield an overall accuracy of 3% despite the Variac's stray field. A double-pole off-on switch disconnects the instrument from both sides of the line. The output circuit has two fuses mounted on the front panel to protect both the Variac and its meters from overload.

*Patent Applied For

Write For Complete Information



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JUNE 12, 1959

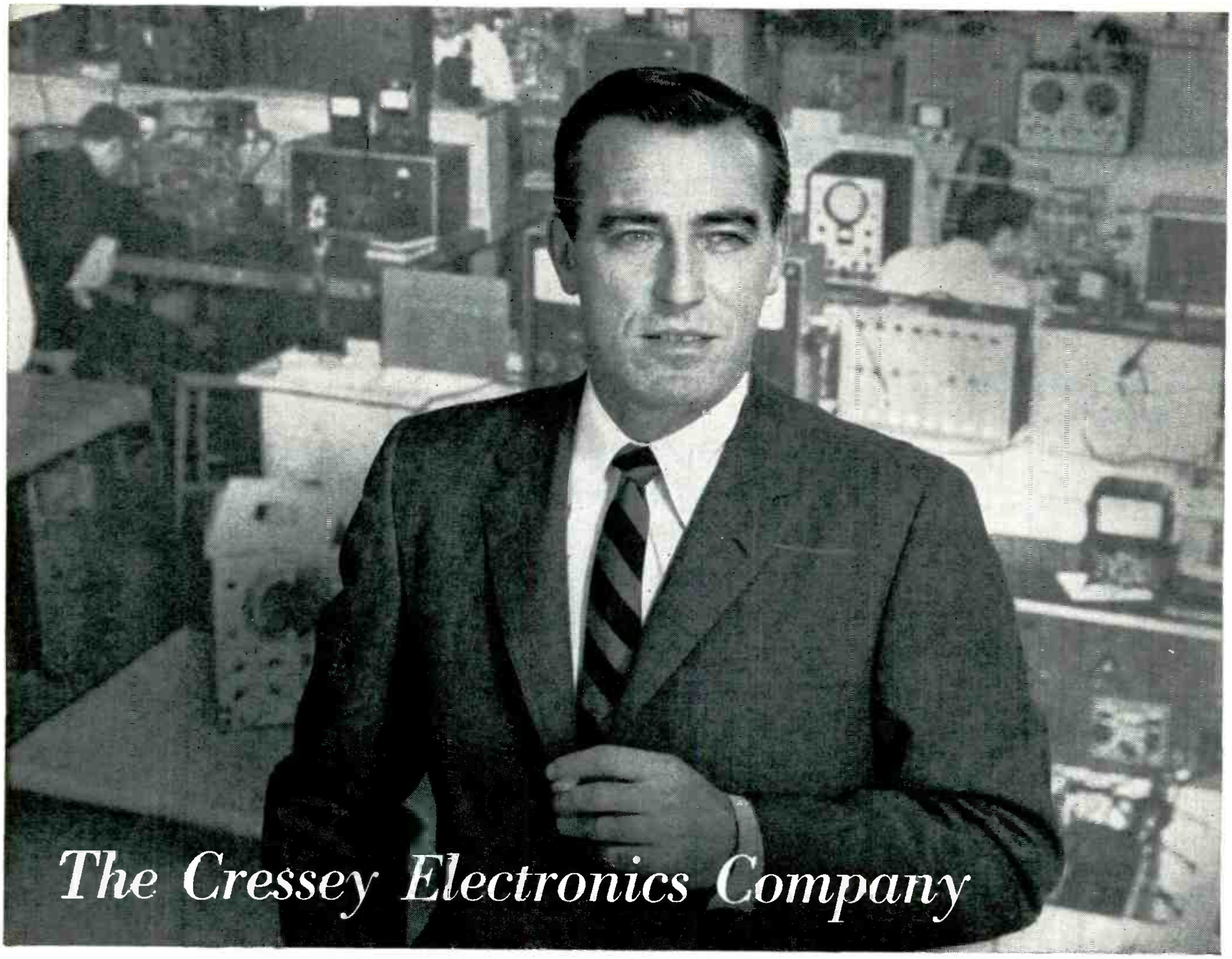
Issue at a Glance

A McGRAW-HILL PUBLICATION
Vol. 32 No. 24

Business

Engineering

Departments



carries on into the future

. . . with the help of the Ætna Life's Business Planning Department

Stanley B. Cressey owns a small, but thriving electronics business. He built this business to a steady year-round volume and looks to the day his son can take it over.

A representative of Ætna Life's Business Planning Department explained what can happen to such a business when its owner-manager dies. With him goes not only the value of his own experience but also the "good will" he has created — leaving more of a problem than a legacy to the heirs!

So Stan's Ætna Life representative, attorney and accountant, worked out a plan to safeguard his family's interest. It will provide money to get them over the rough spots, to maintain profits and stabilize credit until Stan Jr., can take over.

If you own or operate any kind of business, it will pay you to investigate the vital need for a business continuation plan — and no one is better equipped to serve your interests than the Business Planning Department of your local Ætna Life General Agency.

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SHOPTALK . . . editorial

electronics

June 12, 1959 Vol. 32, No. 24

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SAILOR BEWARE. Reflecting on several recent collisions between radar-equipped ships, one experienced skipper declared last week: "A radar set is no license to disregard the International Rules of the Road, to run headlong through a fog."

Sometimes a radar set on the bridge can provoke an accident looking for a place to happen. It can infuse a kind of electronic courage into the watch officer, making him put aside ordinary caution.

Then too, there are operating errors that can be fatal in a tight spot.

In his article "Radar: Its Hidden Dangers", Associate Editor Leary takes a close look at a series of recent marine disasters and assesses what part the use or misuse of navigational radar played. For a story that may give the key to saving lives, see p 30.

AS FREE AS AIR. But how free is the air? Specifically, how free is a broadcaster's signal once it leaves the transmitting antenna? That's what a federal court out in Idaho will have to rule on soon.

The hassle developed when a broadcaster sued a community antenna television operator for using his signal without permission. But it brings to light a host of other knotty problems:

What about vhf television boosters, 1,000 of which operate today in the half world between legality and illegality? What about vhf-to-uhf translators? How long can they continue to collect fees from viewers who just tune in their signal and have no legal obligation to shell out?

These are just a few of the new problems in tv broadcasting we tackle in "Growth in a Troubled Field" on p 35.

THE FEELING IS MUTUAL. Mutual Investment companies now control some $14.5 billion and are heavily involved in the securities of about 2,000 corporations. A financial operation of this size is bound to have great effect on a growth industry like electronics.

To learn what this effect is, Associate Editor Emma contacted mutual investment firms across the nation.

One fact emerges. Interest is growing steadily. More mutual fund groups hold electronics securities than ever before. Another evident fact rising from the research is seen by replies to question "Why have you dropped certain corporations from your portfolio?" Comments on this contain a warning worth heeding. For details turn to p 38.

Coming In Our June 19 Issue . . .

SPACE PROBE. One day last October, a highly instrumented rocket left the launching pad at Cape Canaveral, nosed up with gathering speed and disappeared into space. This was Pioneer I, whose mission was to break free of earth's gravitational bonds and head for the moon. It never reached that goal. But Pioneer I did travel over 70,000 miles into space, blazing a brilliant path for future missions.

The Pioneer program of the National Aeronautics and Space Administration was under the technical direction of Space Technology Laboratories, Inc., of Los Angeles. Its success was a tribute to the vast array of industrial, academic and governmental groups who cooperated in the venture. Next week, ELECTRONICS adds to its long list of feature stories on the electronic details of satellites. Five members of the technical staff of STL have contributed to a fascinating technical description.

High Stability

OHMITE®

RITEOHM® PRECISION

Metal Film Resistors

A new kind of precision resistor with these important features

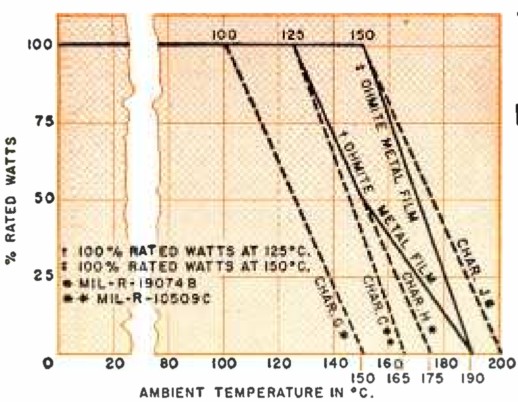
- Long-term load and shelf stability
- Low temperature coefficient of resistance
- Low noise level
- 125°C and 150°C ambient ratings
- Exceeds military specifications
- Excellent high frequency characteristics

Developed to meet tough new military and industrial demands, Ohmite Metal Film Resistors represent a radical departure in construction from wire-wound precision resistors. They employ no wire for the resistance element, yet feature stability and noise level comparable to wire-wound units. In addition, they have a low temperature coefficient of resistance, and excellent high frequency characteristics. Thus they are ideal for high-gain electronic circuits.

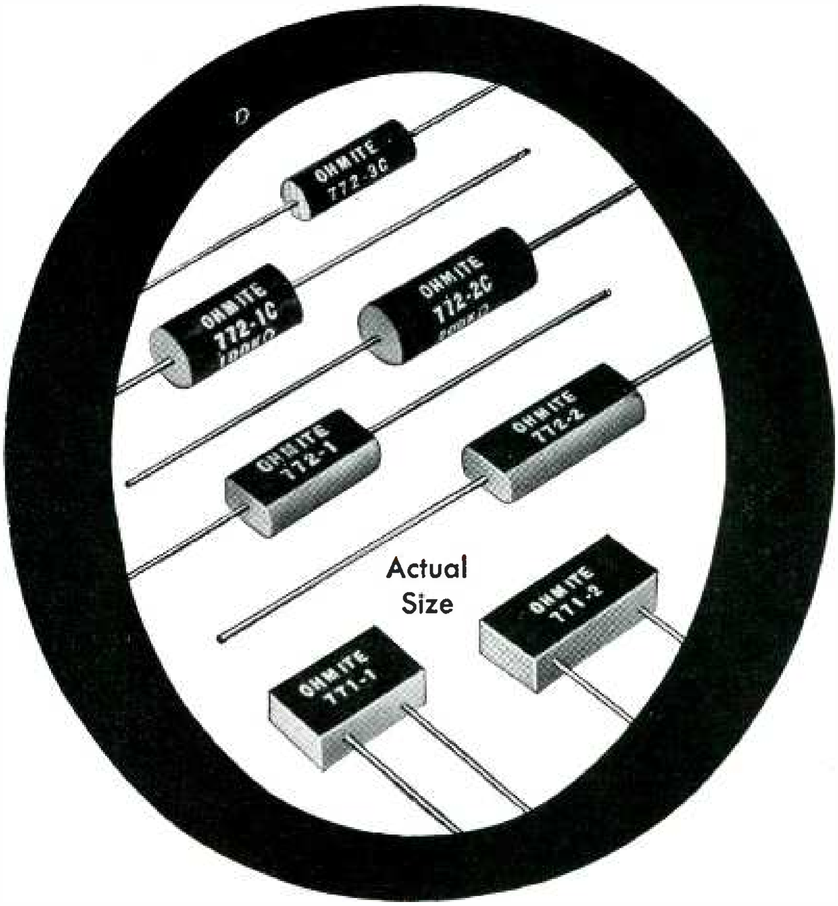
The expanded line of Ohmite Metal Film Resistors now consists of 5 sizes, and a total of 3 styles —full cylindrical, semi-cylindrical, and rectangular. With the new and existing sizes, Ohmite can now supply metal film units to meet various styles of MIL-R-10509C and MIL-R-19074B (Ships).

These new Metal Film Resistors may be used at full rated wattage in higher ambients than other types of precision film resistors. Wattage ratings range from ⅛ watt to 1 watt, depending on the resistor size and the ambient temperature. Ratings are based on two ambients—125°C and 150°C.

Temperature Coefficient of Resistance: Standard temperature coefficient is 0 ± 25ppm/°C (0 ± .0025% /°C) over a wide temperature range of −55°C to +190°C (25°C reference ambient) regardless of resistance value! Temperature coefficients of 0 ± 50 ppm/°C and 0 ± 100 ppm/°C are also available at lower cost. A temperature coefficient spread of 30 ppm/°C can be supplied at additional cost.



Watt rating chart. These curves indicate percentage of rated wattage that can be applied at temperatures higher than 125°C and 150°C. However, at no time shall the applied voltage exceed the maximum for each style.



Write for Bulletin 155

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18

17

RAYTHEON "FIRSTS" IN THE FIELD include:

First to produce Junction Transistors in commercial quantities 16

First to insure reliable Transistor performance by developing the Raytheon Fusion-Alloy process 15

First to make low-noise Junction Transistors commercially available 14

First to develop and introduce High Frequency Fusion-Alloy Transistors 13

First to offer Fusion-Alloy Transistors specially designed, manufactured and tested for computer (switching) applications 12

First to manufacture Computer Transistors meeting military specifications 11

First to design and produce "Submin" Transistors 10

First to produce PNP Silicon Transistors for standard industrial applications 9

First to make available both PNP and NPN Silicon Transistors 8

First to mass produce diffused junction Silicon Rectifiers 7

First to introduce Ultra-High Frequency Germanium Mixer Diodes 6

First to engineer and build automatic test equipments for quality control of Transistors and to use them on a full production scale. 5

RAYTHEON qualifies as your No. 1 source of Transistors and Rectifiers that meet MILITARY requirements as specified by MIL-T-19500A and MIL-E-1D. 4

RAYTHEON keeps pace with fast-changing, fast growing demands. Raytheon's production facilities are steadily expanding in order to back up and still further enhance the Raytheon reputation as the most reliable source of reliable Semiconductors. 3

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RAYTHEON enjoys a world-wide reputation for product quality and reliability. 1

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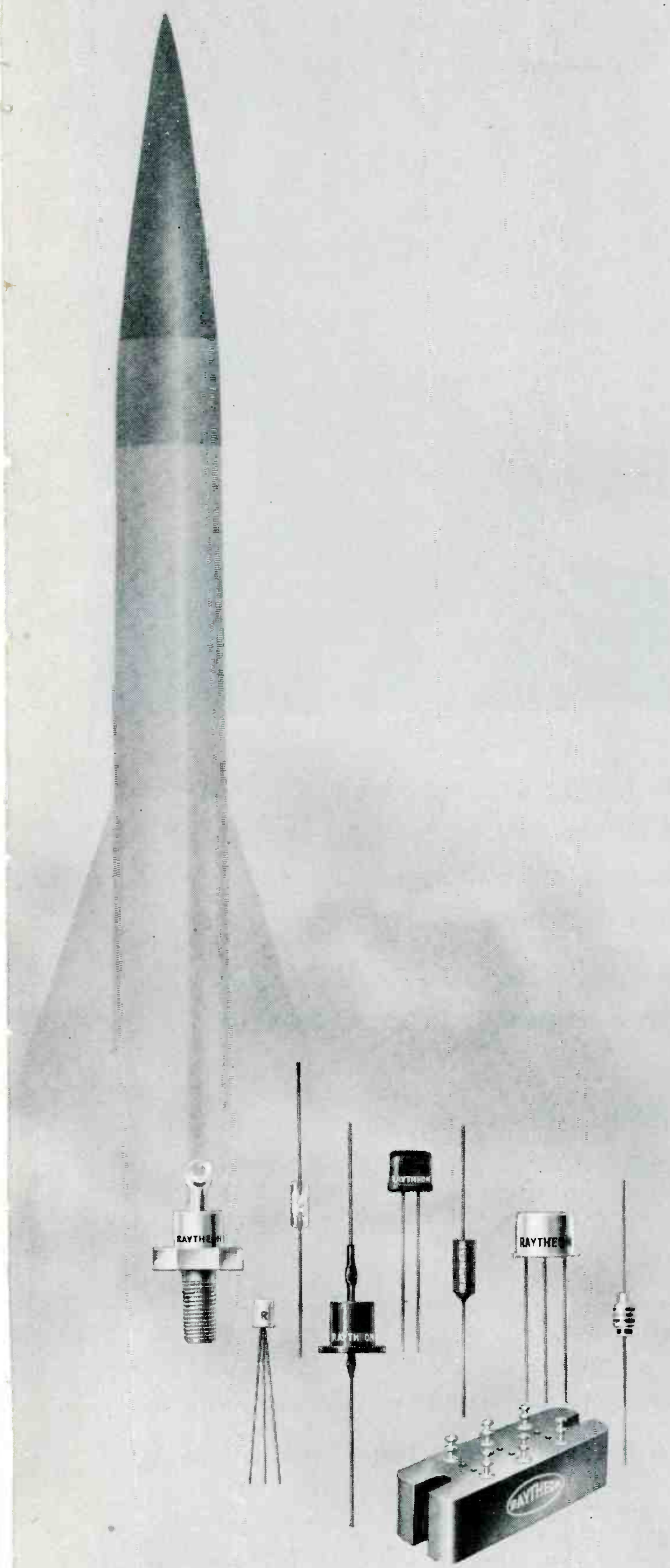

COUNT ON:

Raytheon PNP and NPN Fusion-Alloy Silicon Transistors for large signal, small signal, and low-noise applications. Advantages include low saturation voltage; 20 volt BVEBO; minimum change in characteristics with temperature, current and voltage; welded, hermetically sealed TO-5 package.

Raytheon Germanium Computer Transistors meet the stringent requirements of Military specifications including electrical, mechanical, and environmental tests. Switching currents to 1 ampere; high frequency, high gain; low saturation resistance; H_{FE} control at high current. Available in both TO-5 and SUBMIN packages.

Raytheon General Purpose Germanium Transistors including high frequency, audio frequency, low noise and radio receiver types. Available in TO-5 and SUBMIN packages.

Raytheon Diffused Junction Silicon Rectifiers in both wire-in and stud types, welded, hermetically sealed. Noted for their high forward conductance, exceptional reverse recovery.

Raytheon Silicon Diodes, featuring low reverse current, high forward conductance and excellent stability in high temperature applications. All subject to environmental quality control. Available in a wide range of characteristics.

Raytheon Germanium Diodes in a wide variety of both popular and special types — point contact and gold bonded. Available in standard and small glass packages.

Raytheon Circuit-Paks of Transistors, Diodes, Rectifiers and other components offer better utilization of space, ease of assembly and extreme reliability. These compact, encapsulated, complete, subassemblies, such as Phase Comparators, Bridges, Choppers, and Flip-Flops are available from stock or to your specifications.

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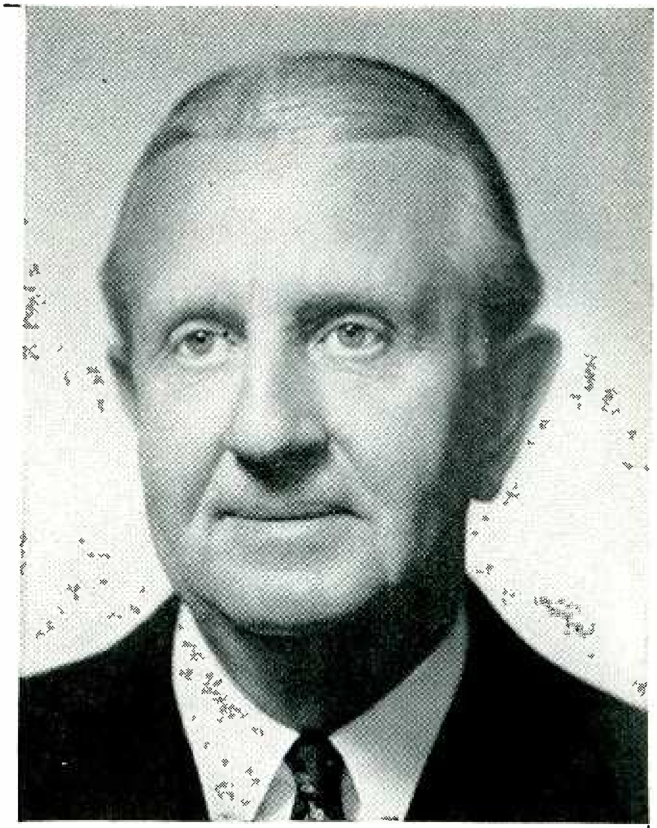
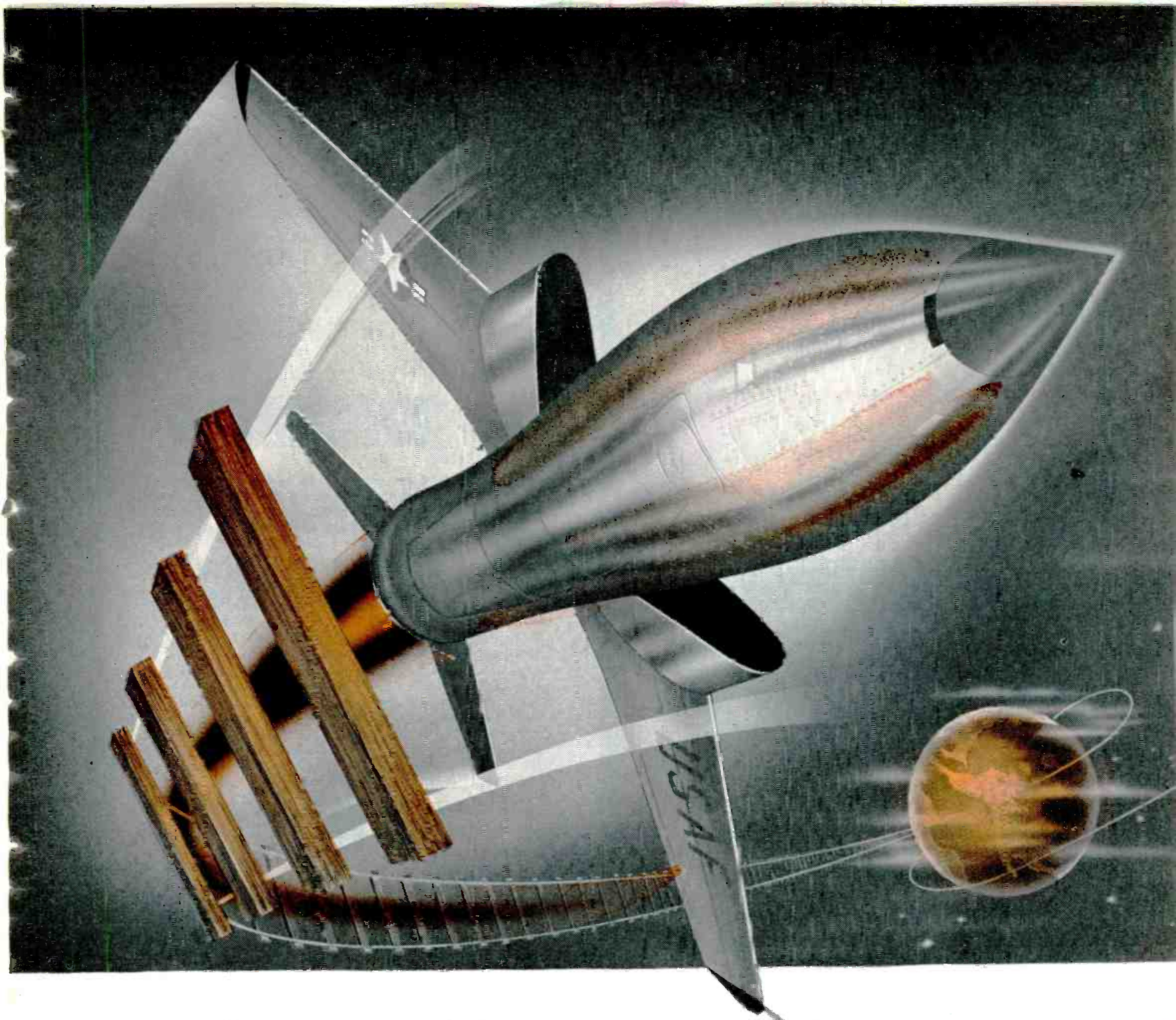
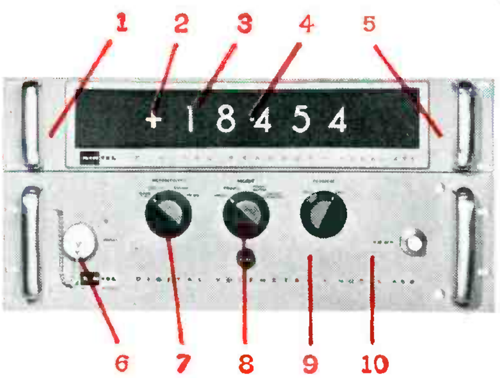




HERE'S WHY CALCULATING ENGINEERS USE KIN TEL DIGITAL VOLTMETERS



MODEL 501

1. Single-Plane Readout...no superimposed outlines of "off" digits...readout lamps have ten times longer life.

2. Automatic Polarity Indication...no lead switching.

3. Ten Times Greater Resolution at decade voltage points than other 4-digit voltmeters. A unique extra fifth digit in the left decade indicates "0" or "1" to provide 100% over-ranging.

4. Automatic Ranging...decimal point is automatically positioned for maximum resolution and accuracy.

5. Remote Readout Mounting...no electronic circuitry in readout allows easy remote mounting.

6. Floating Input...input may be floated above or below chassis ground...10 megohms input impedance...input connectors on front and rear.

7. Adjustable Sensitivity...control permits decreasing sensitivity to allow reading of noisy signals...greatly increases instrument usefulness.

8. Built-in Printer Drive for parallel input printers...control permits either automatic operation when voltmeter reaches null, or remote operation by external contact closure.

9. Reliability...transistor drive circuits provide "cushioned" DC drive for stepping switches for long, trouble-free operation.

10. Accuracy...measures DC from ±0.0001 to ±1000.0 volts...continuous, automatic calibration against internal standard cell provides 0.01% ±1 digit (of reading) DC accuracy.

Price: $2995

These let you measure AC, increase sensitivity, measure ratios, scan multiple inputs

AC CONVERTER Price: $850

The Model 452 AC converter can be added to the basic 501 DC digital voltmeter to permit 4-digit measurement of 0.001 to 999.9 volts AC, RMS, 30 to 10,000 cps. Accuracy is 0.2% of full scale and ranging is manual (auto-ranging models are available).

DC PREAMPLIFIER Price: $1475

The Model 459 differential DC preamplifier has a gain of −100 which extends the DC sensitivity of KIN TEL digital voltmeters to 1 microvolt. Overall system accuracy when the 459 is used with a digital voltmeter is 0.15% ±5 microvolts. Input resistance is greater than 5 megohms, and input and output circuits are completely floating and isolated from each other and chassis ground. Common mode rejection is 180 db for DC and 130 db for 60 cps with up to 1000 ohms input unbalance. Input can be floated up to ±250 volts.

AC-DC PREAMPLIFIER Price: $1225

The Model 458 is a single-ended preamplifier with a gain of −100 which extends the sensitivity of KIN TEL digital voltmeters to 1 microvolt DC, and 10 microvolts AC from 30 to 2000 cps. Overall system accuracy when the 458 is used with a digital voltmeter is 0.1% ±2 microvolts for DC, and 0.25% of full scale for AC.

DVM & RATIOMETER Price: $3835

The Model 507A measures both DC voltages from ±0.0001 to ±1000.0 volts and DC/DC ratios from .0001:1 to 999.9:1. Ranging is automatic and accuracy is 0.01% ±1 digit both for ratios and voltage. Any external reference between 1 and 100 volts may be used for ratio measurements.

INPUT SCANNER

The Model 453M master scanner automatically or manually scans up to 400 1-wire, 200 2-wire, or 100 4-wire inputs. Addition of a slave scanner (453S) permits scanning up to 1000 data points.

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ELECTRONICS NEWSLETTER

FUEL CELL just announced generates electricity by means of hydrogen and oxygen divided by an ion exchange membrane as an electrolyte. GE Research Laboratory describes the cell as a round plastic disk about one-half inch thick and three inches in diameter. Membrane, with an electrode in contact with each of its sides, divides the hollow interior into separate chambers for hydrogen and oxygen. Hydrogen ion is the charge carrier; water forms at the oxidant electrode and can be disposed of by evaporation. Firm says a number of cells have been operating for 75 to 100 days, with tests not yet concluded. Some tests were conducted at current densities of 30 ma/cm^2 but most were at lower densities. Power densities of about one to two kw per cu ft have been calculated.

Automatic celestial navigation system for Hound Dog air-to-ground missile, Kollsman Instrument Corp.'s Astro Tracker, which was revealed by ELECTRONICS *(p 14, Sept. 26, '58), gets an initial $5 million production contract boost from North American Aviation's Autonetics division.*

MICROWAVE RADIATION MONITOR in the form of a standard NE-51 neon lamp is reported in the May issue of the U. S. Armed Forces Medical Journal. Lamp will glow under stimulus from microwave levels of 5 or 6 mw/cm^2. Danger level from microwave radiation is 10 mw/cm^2 (ELECTRONICS, p 49, Feb. 20). The simple monitor was accidentally discovered by Navy reserve medical officer Lt. Walter Johnson. He was carrying some neon bulbs in his hip pocket while taking intensity measurements aboard the guided missile cruiser Galveston.

NATO TROPO SCATTER CONTRACTS for more than $6 million have been awarded by SHAPE (Supreme Headquarters, Allied Powers in Europe) to the Radio Engineering Laboratories subsidiary of Dynamics Corp. of America. Order, for the Ace High communications system, calls for some 360 transmitting and receiving units for 41 stations in nine countries, plus supporting gear and spares. The equipment, scheduled for delivery in mid-1960, will send and receive static-free f-m signals up to 250 mi away. Gear includes 117 giant 10-kw klystron amplifiers, 161 exciters and 81 diversity receivers.

SATELLITE COMMUNICATIONS techniques are already at hand or can be achieved by straightforward engineering within the next several years. So said Elmer W. Engstrom, RCA senior executive v-p, in a discussion of "Electronics' Role in the Space Age" sponsored by EIA before a missile industry conference last month. Engstrom said apparatus and techniques which relate to transmitter power, large tracking antennas and low noise receiver circuits are unfolding and will ease the practical problems. Wide band signal storage for delayed transmission is also in the near practical stage, he added. Sought, he said, are relays that would be analogous to towers hundreds or thousands of miles high for instantaneous line-of-sight vhf and uhf transmission between continents. Ultimate choice of a passive or active satellite method will be guided by reliability and economics of the application, he said.

SMALL BUSINESS SPACE WORK under NASA contracts will get encouragement from the space administration's new small business adviser. Jacob M. Roey, the newly named adviser, aims to: publicize contract requirements; build an indexed file of small businesses (firms employing under 500 persons); and make big contractors aware of small business potentials.

BRUSHFIRE WAR COMMUNICATIONS LINK of 1,000 to 3,000 mi range that can be carried into action is being produced for the Strategic Army Corps by Adler Electronics. The Signal Corps-developed system, AN/TSC-16, consists of a transmitter van, a receiver-comcenter van, two tractors and two dual, 30-kw power supplies. It all fits into three C-124 transports and can be set up with limited operating capacity in four hours; full capacity takes two days. System, using a 10-kw transmitter, would tie in with U. S. global communications, provide quick contact with top command over two voice and 16 teletypewriter channels. Vans, several miles apart, are linked by uhf.

COMMON ELECTRICAL STANDARDS are expected to aid development of the six Common Market countries, which have a total population equal to that of the U. S. R. C. Sogge, president of the U. S. National Committee of the International Electrotechnical Commission, said the six countries had reported at a recent meeting in Paris that they would follow IEC standards to the maximum extent. Sogge said the IEC group also discussed the possibility of standardization in the field of digital computers and data processing.

Airborne electro-optical tracking device accurate within five seconds of arc is being developed for the Defense Department by Du Mont Laboratories.

PROJECT MERCURY RADAR BEACONS will be produced by the Avion division of ACF Industries under a $434,805 contract from Collins Radio Co. Collins is developing the communications system for the first manned satellite. Two types of transistorized beacons will be used in the NASA satellite. Avion says the beacons will extend the range of tracking radars by responding to and retransmitting a strong signal to ground stations.

One Battle We're Losing —And Why

Lest it seem self-serving, we of McGraw-Hill, as publishers, have hesitated to make the following statement about the "Battle of the Books." However, our reticence has been overcome by our conviction that it is greatly in the national interest to have much wider public understanding of the nature of this battle. This conviction is strengthened by the fact that many, not in the publishing industry, believe in the importance of this battle and, further, by the fact that it is a battle which the United States is losing.

The United States is losing an important battle — a battle of knowledge and ideas, waged with books. It does not have the excitement of competition in scientific achievement, nor the urgency of a diplomatic crisis, nor the obvious economic significance of a struggle for export markets. But our success or failure in this battle of knowledge and ideas may well have a decisive bearing on these more spectacular aspects of international rivalry.

The Russians know this. About a decade ago, they started a program to build up their export of books, the most durable and penetrating way of communicating knowledge and ideas. **By 1957 the Soviet Union was exporting 30 million books, one-and-a half times as many as the United States.** Many of these books are printed in English, and all are in languages of the non-Communist world.

In the languages of the Near East alone, the Russians printed and distributed 413,600 books in 1957, as compared with 166,415 in 1956. In India, Russian textbooks on engineering are to be published in English under a technical aid agreement signed in Moscow last December.

"Trade Follows The Book"

Books are in the advance guard of the Soviet political and economic challenge to the free world. With books go ways of thinking — about government, about education, about management, about science and technology. If these books do their job effectively in the training of those who will become a nation's leaders, they will provide the basis for political and cultural understanding and also, in the future, for trade.

The Russians are not the first to discover this relationship. Britain, which lives by trade, has traditionally exported more of its book production than any other nation. Today it exports one book in every two produced. The British have a favorite dictum: "Trade follows the book." They have proved its accuracy. Now the Russians are trying to make this same principle serve their purposes.

Where does the United States stand in this competition for men's minds? In number of books, it trails far behind the Soviet Union — exporting roughly 20 million books, against the Russians' 30 million. As a proportion of our total output of books, our exports amount to only 10% — against Britain's 50%.

The Russians' Advantage

U.S. book exports have grown in the years since World War II, from approximately $11,000,000 in 1946 to $35,000,000 in 1958 (both figures excluding Canada). But in expanding book exports, the American publishing industry faces two major obstacles:

(1) **The comparatively high cost of producing a book in the United States,** which puts its price well beyond the reach of many students, teachers and businessmen in other countries; and

(2) **The shortage of dollar exchange in many countries,** which means that importers can pay for

books only in currencies that are of little use to American publishers.

The Russians have neither of these problems. Soviet publishing is state-subsidized, and exported books are sold for nominal sums paid in the currencies of the importers. As these books serve the political and economic purposes of the Soviet Union, they are cheerfully sold on giveaway terms.

The American publishing industry, on its own, is making vigorous efforts to increase the distribution of American books in other countries. Leading U.S. publishers and their agents have offices and salesmen in the major countries of Asia, Africa and Latin America. Several publishers have begun to reprint textbooks in Asia at one-half to one-third of their U.S. costs, thus making them available to the students in Asian countries at prices they can more nearly afford. And the American paperback has become a symbol of low cost in popular books. But neither of these devices is practicable for serious cultural, technical, scientific, educational and professional books, which require durable, hard-bound and necessarily expensive editions. Despite their great importance to those who need these books, the demand for them is simply not large enough to warrant low-cost publishing methods.

Government agencies also have increased the availability of American books. The United States Information Agency and the International Cooperation Administration have placed American books in libraries overseas, donated them to educational institutions and presented them to key individuals in the industries and governments of the developing countries of the world. But these programs are small in relation to the need.

A Modest Program

An unusual and little-publicized Government program has helped American publishers overcome the other major obstacle to the export of books — the shortage of dollar exchange. This is the Informational Media Guaranty (IMG) program, administered by the United States Information Agency. It enables publishers of books judged to be worthy of the American way of life to sell their books, for local currency, in countries such as the Philippines, Formosa, Vietnam, Burma, Indonesia, Pakistan, Turkey, Israel, Poland, Yugoslavia, Spain and Chile, which would otherwise be unable to buy these books because of their shortage of U.S. dollar exchange.

The IMG program is not a giveaway. Publishers have to **sell** their books, and customers overseas have to want them enough to **buy** them at full prices. IMG merely guarantees that the exporting publisher receives in dollars the payments he collects from his customers in their currency. The program costs very little in terms of our total foreign aid program, or in terms of what it accomplishes. In ten years it has made possible the sale of $150 million worth of books, magazines and films to countries of key economic and strategic importance at a cost of only $10 million.

The IMG functions through a revolving fund. Foreign currencies are exchanged for dollars, and the foreign currencies in turn are resold to replenish the supply of dollars. The net cost is the small but unavoidable loss on resale of these foreign currencies. Over the ten years of this program, the IMG revolving fund has shrunk from its original $28 million to $18 million, $10 million of which is in unconverted foreign currencies.

If this modest but vitally important program is to be continued, Congress must appropriate the money necessary to rebuild the revolving fund. This would ensure that any country approved by the State Department and willing to sign an agreement to buy American books, at their full price, with its own currency, could do so. Last August, Congress reduced a requested appropriation for this purpose from $7 million to $2½ million. To continue even at its present reduced level, an appropriation of $3½ million is needed. To realize the full potential of IMG, the revolving fund must be restored to its original level.

If the IMG program is not continued, with adequate financial support, some countries whose friendship and understanding we seek today and with whom we hope to build a trading partnership in the future will have to reduce their purchases of American books to a trickle. These are countries where school teachers, college professors, students, engineers, doctors and businessmen need and want to buy American books. The loss will be not only theirs, but ours as well. For it will deprive the U.S. of one of its most effective, and least costly, means of communicating knowledge and ideas and understanding of the American way of life.

This message is presented by the McGraw-Hill Publishing Company to help increase public knowledge and understanding of an important national problem. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

WASHINGTON OUTLOOK

WASHINGTON—SOME MISSILES UP, OTHERS DOWN.

That's the word on the Pentagon's 1960 buying plans. The House Appropriations Committee did the reshuffling—slashed Mace and Bomarc missiles, beefed up Nike-Zeus, Atlas and the antisubmarine program.

The net result is a $399.9-million over-all decrease in the administration's defense appropriations request—which comes as something of a surprise. Just a few weeks back, Rep. Mahon, (D., Texas) head of the committee's Defense Subcommittee, was talking up a $750-million hike.

These are the electronics-related projects given a boost:

The Army's Nike-Zeus antimissile missile system gets a big chunk of extra funds for accelerated development work and advance procurement of components—on top of the $300-million basic request for R&D. The project stands out as the chief beneficiary in a $200-million appropriation boost for general Army hardware procurement.

An extra fund of $85 million is earmarked as a "down payment" to expand production of the Atlas ICBM from the nine squadrons now planned to 17. American Bosch Arma is the major electronics contractor here. The Minuteman ICBM (North American Aviation's Autonetics division) gets $87 million extra to speed development. Antisubmarine warfare operations are accelerated with an additional $255.3 million. But no precise allocations for electronic gear are spelled out.

On the other side of the ledger, the committee cut Bomarc procurement by about one-third (a $162.7-million cut in the appropriation request). Westinghouse is the major electronics contractor. A $127-million request to continue production of Mace (General Motors' AC division) is killed.

The Air Force's "radar improvement" program suffered a $50-million reduction. Reason: to stretch out production "to allow for maximum implementation of technical improvements occurring in this field."

Finally, there's a one-percent across-the-board procurement cut to "enforce competition in military contracting and improved procurement practices generally".

- **A new House Antitrust Subcommittee report** says the 1956 consent decree signed by the Dept. of Justice with American Telephone & Telegraph Co. is a "blot on the enforcement history of the antitrust laws."

  The report—signed by four Democrats, but blasted by three Republican members as a "smear"—calls for the government to re-open the antitrust case. In addition, the report charges that AT&T and its wholly-owned manufacturing subsidiary, Western Electric Co., are not living up to the patent licensing terms which are in the decree.

  The Democrats have never let the AT&T case rest since former Atty. Gen. Herbert Brownell negotiated the out-of-court settlement, which ended suit brought under the Truman administration in 1949. The original suit charged AT&T and WE with a monopoly in manufacture and sale of telephones and telegraph equipment, called for a split-off of WE as the sole supplier of AT&T's Bell operating companies. Brownell is blistered in the new report.

- **They're trying to jack up radar** to levels it won't reach—so says Sir Robert Watson-Watt, Britain's "father of radar". He spoke at EIA's well-attended national missile industry conference here. Sir Robert set Washington tongues wagging with his claim that radar will play only a "minor role" in space exploration and communications. He said "direct signals" are needed for missile defenses, that too much is being spent on Sage and Nike-Zeus.

Swift, sure
DISTORTION READINGS

-hp- 330B/C/D Distortion Analyzer

20 cps to 20 KC

Measure distortions as low as 0.1%
Measure noise on voltages as small as 100 µv
High sensitivity, high stability
Wide band 20 db gain amplifier
Oscilloscope terminals; built-in VTVM

-hp- 330B Distortion Analyzer is a basic instrument universally used to measure total audio distortion, voltage level, power output, gain, total AM carrier distortion, noise and hum level and audio signal frequencies.

Model 330B consists of a frequency selective amplifier, a regulated power supply and a VTVM. The amplifier operates with a resistance-tuned circuit to provide almost infinite attenuation of the fundamental while passing harmonic frequencies at normal gain. Negative feedback minimizes distortion and insures uniform response and stability. The VTVM is used to set the load and measure the value of harmonic voltages, thus providing a direct reading of total distortion. The VTVM may also be used separately.

For FM broadcasters, *-hp-* 330C is offered. Similar to 330B, this instrument has a meter with VU ballistic characteristics meeting F.C.C. requirements and a VTVM frequency range of 10 cps to 60 KC.

For FM-AM broadcasters, *-hp-* 330D is available. This instrument is similar to *-hp-* 330C except for addition of an AM detector covering 500 KC to 60 MC.

Details from your -hp- representative, or write direct

HEWLETT-PACKARD COMPANY
4819A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
CABLE "HEWPACK" • DAVENPORT 5-4451
Field Engineers in all Principal Areas

SPECIFICATIONS

Distortion Measurement: 20 cps to 20 KC.
Dial Calibration Accuracy: ±2% full range.
Elimination Characteristics: Reduces fundamental frequency more than 99.9%.
Accuracy: ±3% full scale at distortion levels of 0.5%.
Sensitivity: Distortion levels of 0.3% are measured full scale. Accurate readings on 0.1% levels.
Input Impedance: 200,000 ohms, 40 µµf shunt.
Required Input: 1 v RMS.
Voltmeter: Nine 10 db ranges, 0.03 to 300 v. Full scale sensitivity all ranges.
Noise Measurement: 300 µv full scale. Coverage 10 cps to 20 KC.
Oscilloscope Terminals: 75 db max. gain from AF input to terminals.
Price: -hp- 330B, $410.00 (cabinet), -hp- 330C, $440.00 (cabinet), -hp- 330D, $500.00 (cabinet), (Rack models $15.00 less).

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

hp now has a 200 KC 'scope for $435! Seen it?

DU PONT

ENGINEERING FACTS ABOUT

TEFLON®

FLUOROCARBON RESINS

Number 4
in a series
ELECTRICAL DESIGN
WIRE HANDLING TECHNOLOGY

Typical wire marking operation in harness wiring area of The Martin Company, Baltimore, Md.

Circuit identification now possible by printing on wire and cable insulated with TFE resins

In addition to extreme chemical resistance, TFE resins display non-wettable and anti-stick surfaces of superlative surface resistivity. However, these same properties create problems in adapting ordinary printing techniques to the identification of wire and cable insulated with TEFLON TFE-fluorocarbon resins.

The development, by wire and cable manufacturers, of techniques for pigmenting and spiral-striping this insulation has greatly simplified the design, assembly and maintenance of electronic systems. But for some applications, such as air-frame wiring, identification by printing is often preferred prior to installation of the wire into the unit or system.

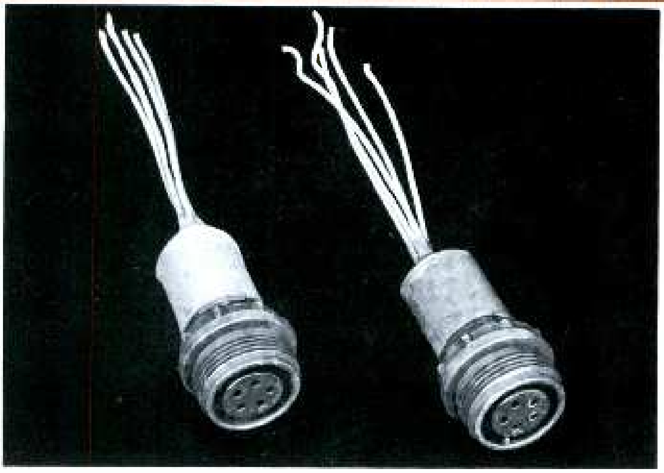
Several methods based on hot-stamping techniques have recently been developed, or are under development, for printing on TFE resins. In one case, the identification is stamped on the wire and then "heat-set" to form adherent markings. By another method, the heat required to insure abrasion-resistant markings is transferred to the insulation surface during the stamping process. In both cases, the markings are legible and can be made without damage to the insulation. These hot-stamping processes are specifically designed to meet the end users' requirements in applying markings in a wire harnessing or assembly area (a typical area is illustrated above).

Thus, design engineers in the aircraft, missile and electronic industries who have taken advantage of the reliability and cost savings made possible by TFE resins are offered an added convenience. Clearly legible printing on wire and cable protected by TFE resins will satisfy an important need in production, assembly and circuit tracing.

If you write to us on your company letterhead, we'll be glad to send you further information and a sample of printed wire. The address is on the next page.

OVER

New techniques produce bondable surfaces on wire and cable insulated with TFE resins...improve potted and encapsulated assemblies



POTTED CONNECTIONS subjected to pressure tests clearly show the superiority of wires which have undergone bonding treatment (see results of tests in table below).

PRIMER is applied to unstripped wire ends preparatory to sintering of coating onto the surface of insulation of TEFLON TFE-fluorocarbon resins.

In many wire and cable applications, as in aircraft and guided missiles, potting of connections is often necessary to protect against moisture, corrosive chemicals and contaminants. Here the need is for a good, strong bond to the surface of the TFE resins used for insulating the conductors. But the almost universal resistance of TFE resins to chemicals and solvents, as well as their anti-stick surface, makes it very difficult to obtain a strong bond by using cements and adhesives.

Lengths of wire insulated with TFE resins and modified to provide a cementable surface have been available for several years and have been used in some cases where potting or encapsulation was desired. Recently, several manufacturers have announced the availability of wire and cable made bondable by entirely new techniques which do not discolor the surface of the insulation. Wire treated by these new techniques demonstrate improved adherence of epoxy resins, silicone rubber and other potting materials. The potted assembly is firmly sealed against moisture and contamination.

In some cases, such as where high surface resistance is required for operation at high humidity, it is often desirable to treat only the ends of the insulation to be potted. One technique for the treatment of wire ends involves the application of a "Ludox" HS colloidal primer to the insulation surface and a short heat treatment at a temperature above 330°C.

Potted connections using wire treated in this manner have excellent resistance to heat aging. In tests, potted connections using a silicone rubber resin and a standard connector were aged for 8 weeks at 175°C. The potted components showed no air leakage, and pull-out strengths were approximately the same as for the unaged control. TFE resins are rated for continuous use at 260°C., so that the maximum rated temperature of the potting compound or the electronic components is usually the limiting factor in high-temperature performance.

Wire and cable protected by TFE resins enable the design engineer to increase the reliability of equipment, conserve weight and space, and reduce costs of assembly and maintenance. A further step toward reliability and cost savings has been taken with the development of these new bonding techniques.

EVALUATION OF BONDABLE WIRE ENDS INSULATED WITH TFE-FLUOROCARBON RESINS*

Insulation treatment	Potting resin	Removal tension (average of 8 samples) (pounds)	Underwater air-pressure test (15 minutes at 20 psig)	
			No. of samples tested	No. of samples leaked
NONE (control)	Epoxy	5	4	4
NONE (control)	Silicone Rubber	2	4	4
NONE (control)	Thiokol Liquid Polymer Rubber	1.5	4	4
"LUDOX" HS (colloidal silica)**	Epoxy	14-15	8	0
"LUDOX" HS (colloidal silica)	Silicone Rubber	4-7	10	0
"LUDOX" HS (colloidal silica)	Thiokol Liquid Polymer Rubber	5-8	8	0

*AWG 22, nominal 10-mil wall, TFE resin over silverplated copper, 7/30 stranding.
**Grasselli Chemicals Dept., E. I. du Pont de Nemours & Co. (Inc.)

SEND FOR INFORMATION . . .

Consult your supplier of wire and cable insulated with TEFLON TFE-fluorocarbon resins with regard to the identification and bonding of these outstanding dielectric materials. You'll find him listed in the Yellow Pages under "Plastics—Du Pont." For any unanswered technical question about these resins, write to: **E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Rm. 2526, Nemours Bldg., Wilmington 98, Delaware.**

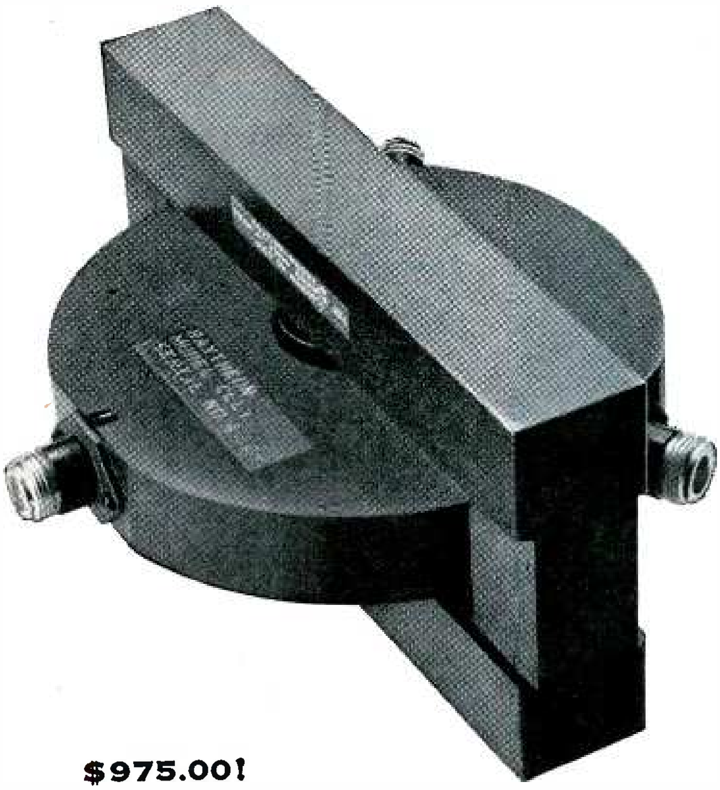
In Canada: *Du Pont of Canada Limited, P.O. Box 660, Montreal, Quebec.*

TEFLON®
FLUOROCARBON RESINS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

NEW MASER CIRCULATOR FOR L-BAND



MINIATURE, THREE-PORT DEVICE WITH COAXIAL FITTINGS MEASURES ONLY 7½ INCHES, WEIGHS 9 POUNDS

An entirely new Raytheon technique has made possible the design of an extremely small low-frequency circulator. The three-port device has Type N coaxial connections and is designed for use with masers and parametric amplifiers at L-band.

The new circulator, designated CLL1, combines an extremely low insertion loss of 0.3 db with 25 db isolation and VSWR of less than 1.1 centered at any frequency from 900 to 1,600 mc. With a permanent magnet, as illustrated, performance is typically 0.4 db and 20 db with a maximum VSWR of 1.25 over any 50 mc band. However, with a tuned magnetic field, the same performance is obtainable over a 100 mc band.

$975.00!

AVAILABLE IMMEDIATELY FOR YOUR APPLICATION.

TYPICAL [illegible]CIFICATIONS

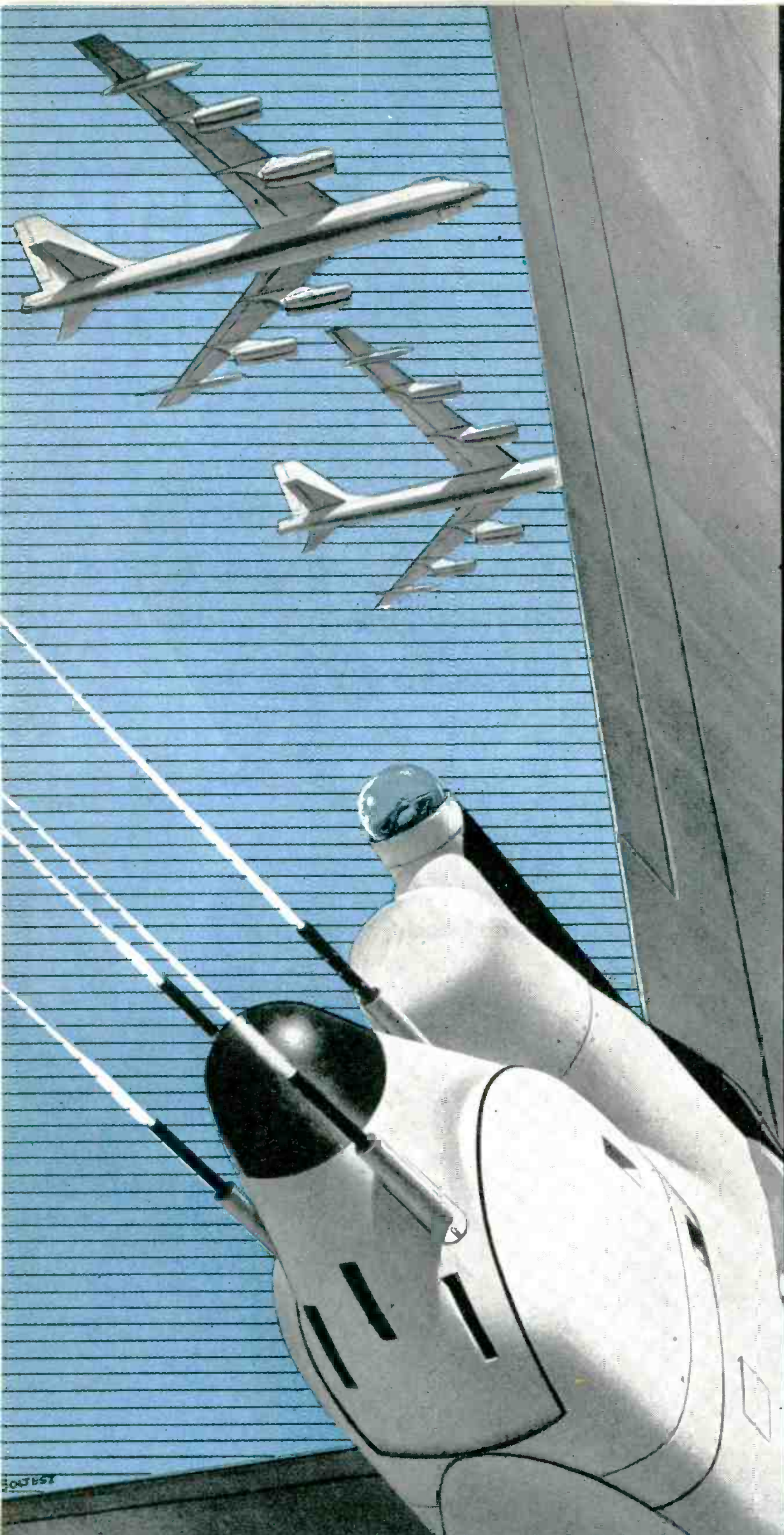
	[illegible]L1	CLL2
Frequency range	*1260 ± 25 mc*	*1400 ± 25 mc*
Isolation		
Minimum	*20 db*	*20 db*
Maximum	*25 db*	*25 db*
Insertion loss		
Minimum	*0.3 db*	*0.3 db*
Maximum	*0.4 db*	*0.4 db*
Power Average	*5 watts*	*5 watts*
VSWR		
Minimum	*1.08*	*1.08*
Maximum	*1.25*	*1.25*
Weight (max.)	*9.0 lbs.*	*9.0 lbs.*
Max. dimension	*7½ in.*	*7½ in.*

To learn more about this significant development or other important Raytheon advances in microwave ferrite devices, please write stating your particular area of interest to the address below.

RAYTHEON MANUFACTURING COMPANY
SPECIAL MICROWAVE DEVICES
WALTHAM 54, MASSACHUSETTS

RAYTHEON

EXCELLENCE IN ELECTRONICS



Crosley

And . . . .

Fire Control Systems for the B-52

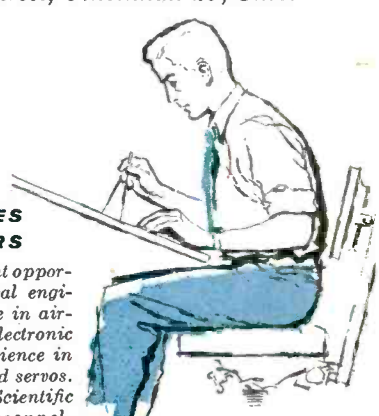
New and greater responsibilities have been given Avco's Crosley Division by the U. S. Air Force. Long a producer of fire control systems for bombers, including the B-47 and B-66, Crosley recently was named prime contractor for the ASG-15 fire control system on B-52 bombers ordered for the Strategic Air Command.

Crosley now has complete responsibility for engineering, production and performance. Two of Crosley's large plants manufacture, assemble and test complete turrets, computers and radar units for the ASG-15 system that both "searches" and "tracks" to aim the guns that defend the B-52.

In the months and years immediately ahead, many new and ingenious improvements will be made in bomber defense. Crosley already is at work on several, and has achieved remarkable results that will be reflected in the bomber defense systems of the future.

Crosley's extensive experience and technical capability have made it the first name in fire control systems.

For further information, write to: Vice-President, Marketing-Defense Products, Crosley Division, Avco Corporation, 1329 Arlington Street, Cincinnati 25, Ohio.

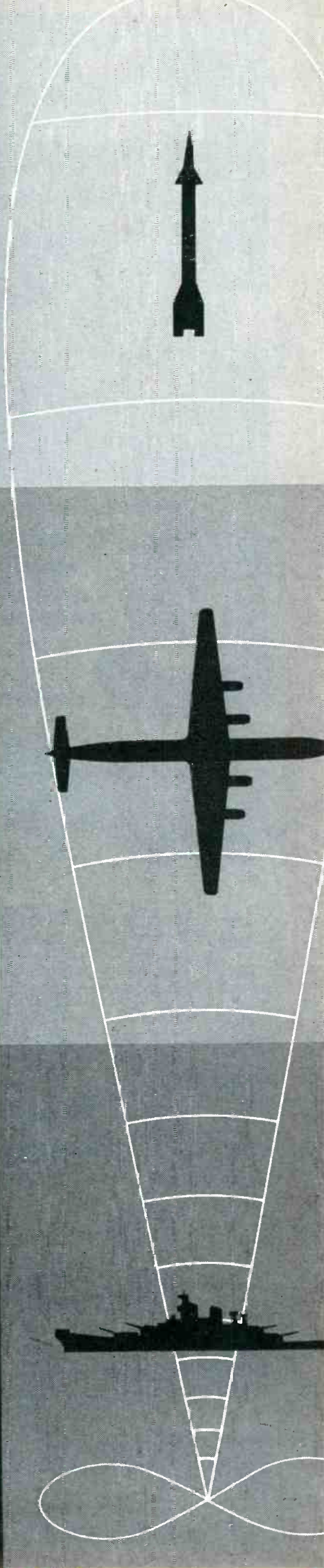


OPPORTUNITIES FOR ENGINEERS

Crosley offers excellent opportunities to mechanical engineers with experience in airborne gunnery, and electronic engineers with experience in fire control, radar and servos. Write to: Director, Scientific and Technical Personnel, Dept. E-69E, Avco/Crosley, 1329 Arlington Street, Cincinnati 25, Ohio.

Avco/Crosley

CIRCLE NO. 20 READER SERVICE CARD



MARKET RESEARCH

Exports Rose 10% in 1958

EXPORTS of electronic components and equipment reached $427 million during 1958, according to latest tabulations released by the Electronic Industries Association. Despite recession's effects, EIA reports last year's total represents a 10-percent rise over export volume of $384.3 million in 1957.

Following table of reported 1958 volume lists radio and television receivers, components and end equipment. Units are recorded whereever information was available.

	UNITS	VALUE
	(Add 000)	
Radio sets	316	$9,215
Television sets	219	25,036
Phonographs, all types, incl. parts and accessories	N.A.	24,000
Recorders, disk, tape and wire	N.A.	12,200
Amplifiers and amplifier systems, all types	N.A.	4,700
Tubes, cathode-ray	N.A.	17,200
Tubes, receiving	22,873	17,859
Other tubes & parts	N.A.	17,000
Semiconductors	5,785	7,778
Capacitors	40,575	5,400
Resistors	43.599	3,840
Inductors	5,734	4,947
Speakers	508	2,171
Unclassified parts	N.A.	31,800
Broadcast transmitters & studio eqpt.	N.A.	12,800
Test & measurement eqpt.	N.A.	27,000
Nuclear radiation detection & measuring eqpt.	N.A.	3,000
Computers & related processing machines and parts	N.A.	17,000
Land mobile, aeronautical, shipborne radio eqpt.	N.A.	123,500
Detection & navigational apparatus	N.A.	44,000
Other eqpt. & apparatus	N.A.	16,554
TOTAL		$427,000

N.A. = Not Available.

Comparison of 1958 and 1957 figures shows:

In 1958 exports of radio and television receivers rose 16 percent and 28 percent respectively over 1957 dollar volume of $7.967 and $19.583 million. Number of radio sets shipped abroad in 1957 totaled 298,368. During same year, 155,817 tv sets were sold to foreign markets.

Among components, semiconductors showed most significant gain in 1958. Exports of these devices in 1957 amounted to $4.230 million, comprising 2,693.737 units. In 1958, the dollar volume shipped rose 84 percent.

Values of other components exported in 1957 were: capacitors, $5.431 million (34,231,000 units); resistors, $3.585 million (36,631,000 units); inductors, $4.947 million (6,096,000 units); speakers, $1.822 million (416,702 units); unclassified parts, $27.6 million.

• **Electronics' key role** in the space age, subject of National Missile Industry Conference held recently in Washington, D. C., will mean more military electronics business in coming years.

Electronics portion of space aircraft-missiles expenditures, estimated by William Long, EIA Marketing Data Department manager, currently amounts to $3 billion, or 27 percent of present dollar outlay.

By mid-1960's, electronics portion will rise to $5 billion, representing 38 percent of total expenditures. By 1970, electronics slice will reach $6 billion, 43 percent of total.

FIGURES OF THE WEEK

LATEST WEEKLY PRODUCTION FIGURES

(Source: EIA)	May 22, 1959	Apr. 24, 1959	Change From One Year Ago
Television sets	115,952	97,485	+57.8%
Radio sets (ex. auto)	274,571	263,434	+69.6%
Auto sets	120,205	108,122	+130.6%

STOCK PRICE AVERAGES

(Standard & Poor's)	May 27, 1959	Apr. 29, 1959	Change From One Year Ago
Electronics mfrs.	91.64	95.79	+75.0%
Radio & tv mfrs.	109.10	106.29	+128.3%
Broadcasters	99.38	100.30	+59.2%

New Capital For Electronics

WASHINGTON, D. C.: Latest word from Small Business Administration is that a license has been issued to the Electronics Capital Corp., San Diego, Calif., to operate as a small business investment company. The firm will operate as a closed-end nondiversified management agency concentrating on the electronics industry.

ECC is the ninth organization to be licensed by SBA, and the first to announce plans to specialize in one particular industry. The company will provide funds, principally through the purchase of convertible debentures from electronics firms in the small business category.

Financial Details

In an exclusive interview with Hal Hood, ELECTRONICS' Pacific Coast Editor, Richard T. Silberman, executive vice president of the new venture, said his firm feels basically that there is no industry that needs long-term capital more than electronics. Due to the management of ECC, his feeling is that in judging an investment situation, it will be seen first in terms of electronics and secondly in terms of banking.

Silberman was president of Kin-Tel, division of Cohu Electronics, prior to joining ECC. He has put approximately $25,000 into the venture with Charles E. Salik, ECC president. The two have operated an electronics mutual fund since 1955. Salik, in company with his father, has invested about $280,000 in the new firm.

Initial capital reserved for investment will amount to $2,500,000, of which approximately $35,000 will be immediately outstanding. No government funds are involved.

Plans To Sell Shares

The company proposes to extend its capital by the sale of 1,800,000 of its authorized shares. The issue is being managed by a group headed by Hayden Stone & Co., New York investment bankers, at $10 a share. Net proceeds will be used for investment in securities of small investment concerns.

Electronics Capital Corp. plans also to make management consultant services available for technical, marketing and manufacturing activities. Goal of the firm will be to make consulting services available at low cost for the benefit of small companies. Corporation officials estimate that of the 4,700 companies engaged in some form of electronics work in the U. S. today, about 4,500 would qualify for aid from ECC.

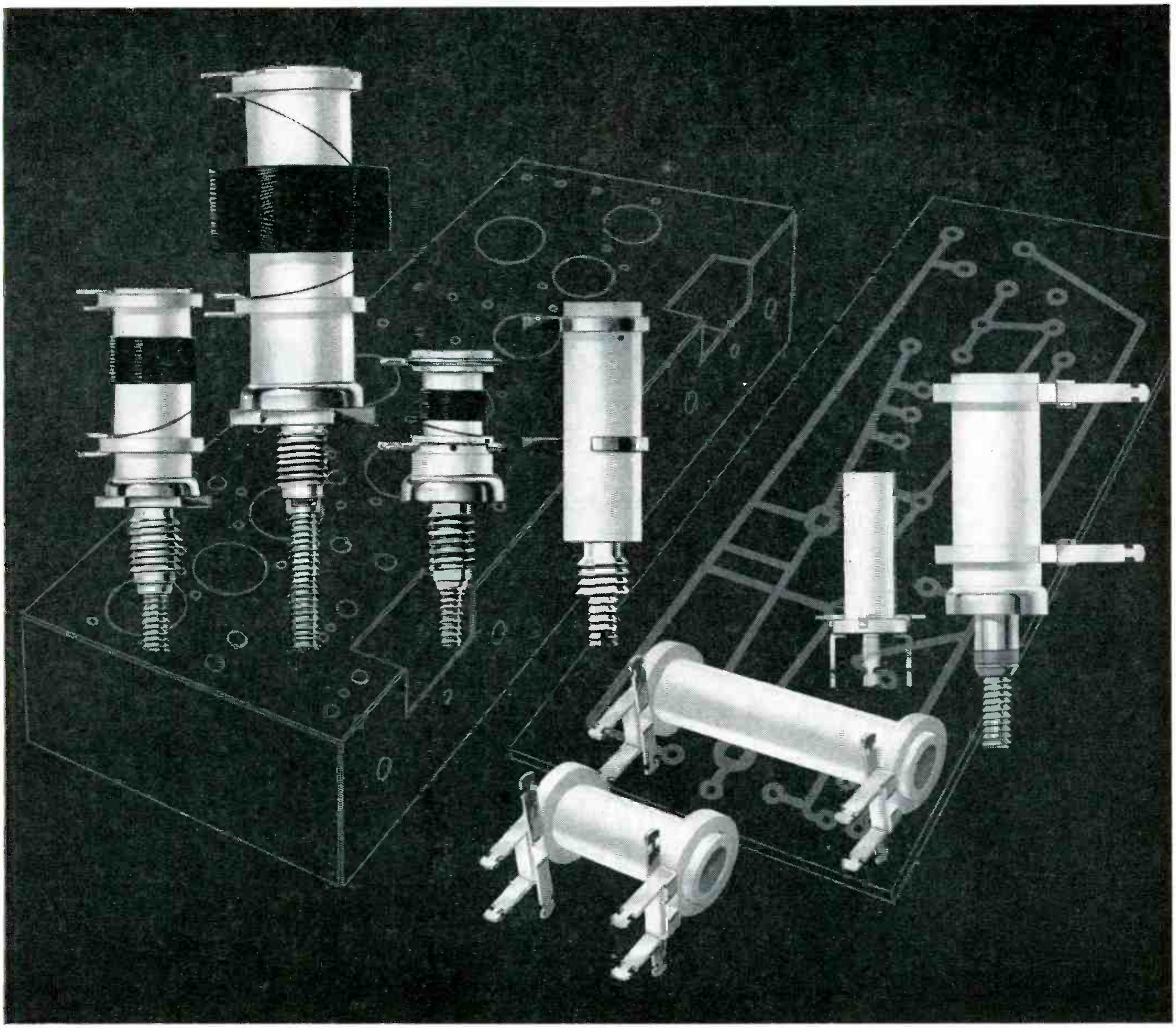
This estimate includes firms in fields closely related to electronics, such as chassis and hardware.

OVER THE COUNTER

1958 BIDS LOW	1958 BIDS HIGH	COMMON STOCKS	WEEK ENDING May 22 BID	WEEK ENDING May 29 BID	May 29 ASKED
3¾	20½	Acoustica Assocs	31	28½	34⅝
1⅝	3	Advance Industries	2¾	2¾	3¼
3⅛	6⅝	Aerovox	10¼	9¾	11¼
5½	15	Appl'd Sci Princet	10¼	9½	11¾
1⅛	8⅞	Avien, A	10¼	10¾	13⅛
6¾	24	Baird-Atomic	32½	30½	36¾
9¾	13⅜	Burndy	17½	17½	19⅛
6¾	9	Cohu Electronics	7⅞	8½	9⅝
11	22½	Collins Radio	33¾	33	37½
32½	49	Cook Electric	42	44	53
4	7	Craig Systems	10½	10¼	12½
17⅝	25⅜	Eastern Industries	18	17⅛	19⅜
1¾	8⅜	Elco Corp	7¼	8	9⅛
10½	21	Electro Instr	28	26½	30⅛
34	49	Electronic Assocs	41	41	47¼
5	11	Electronic Res'rch	18	18	20⅜
8½	12¾	Electronic Spec Co	16	15⅛	18
15¼	49½	Epsco, Inc	39	36	44
5½	9⅜	Erie Resistor	10	10	11¼
10	17½	Fischer & Porter	14¾	14⅜	16
5½	10½	G-L Electronics	11	11¼	13⅝
12	27	Giannini Controls	30¼	29	33
...	...	Haydu Elec Prod	5	4¼	6⅜
30	39½	Hewlett-Packard	44¾	43½	49
23¼	48	High Voltage Eng	65	61	69½
1¾	3	Hycon Mfg	3½	3¼	3⅞
1⅛	5⅛	Industro Trans'tor	6	5¾	6¾
...	...	Internat'l Rec'f'r	27½	27½	31⅛
...	...	Interstate Engin'g	21¼	20¼	23⅞
1½	4¾	Jerrold	6	5½	6½
21	30	D. S. Kennedy	28¾	30	35⅛
3¾	29	Lab For El'tronics	35	32	37
19¼	28	Leeds & Northrup	33¼	32¼	35⅝
2	3⅛	Leetronics	3⅜	3⅜	4
5	18¾	Ling Electronics	28½	26¼	30⅛
3¼	8¼	Magnetic Amplifiers	9⅞	9	10½
2⅞	4½	Magnetics, Inc.	6⅛	5¾	6⅝
4⅝	12	W. L. Maxson	13⅞	13¼	14⅞
10⅝	29	Microwave Assocs	20	22	24⅝
5¼	11¾	Midwestern Instr	11⅜	11	12¼
1⅛	7	Monogram Precis'n	11¼	10¾	12¼
3½	7¼	Narda Microwave	11½	11¼	12¾
...	...	Narda Ultrasonics	11½	11¾	12⅞
9¾	16	National Company	28¼	28½	31¾
14¼	56	Nuclear Chicago	38¼	35	42
4½	7⅜	Pacific Mercury, A	12¼	12	13⅝
10⅛	27½	Packard-Bell	43	42½	45⅝
4¼	9⅜	Panellit, Inc	7⅜	7	8¼
21	53¾	Perkin-Elmer	54½	54	61
11⅜	19½	Radiation, A	21½	20¾	23⅝
2⅛	7⅜	Reeves Soundcraft	7	7	8¼
13	32½	Sanders Associates	34	31½	37¾
...	...	Silicon Transistor	9¾	11¼	14⅝
7	12	SoundScriber	17¾	17	19⅜
22¾	40	Sprague Electric	49½	48¾	53
26	35	Taylor Instruments	36½	34½	39⅞
5½	15	Technical Operat'ns	24	13	18
5½	15¾	Telechrome Mfg	21½	19½	24⅛
3¼	7¾	Telecomputing	13	13⅛	14
1⅛	2¾	Tel-Instrument	2¾	2¾	3⅛
8¾	16¼	Topp Industries	13⅞	14	16
3¾	10¾	Tracerlab	11¼	11	12⅞
1⅛	3⅜	Universal Trans'tor	1¼	1¼	1⅝
14¼	40	Varian Associates	33¼	32	36⅜

The above "bid" and "asked" prices prepared by the NATIONAL ASSOCIATION of SECURITIES DEALERS, INC., do not represent actual transactions. They are a guide to the range within which these securities could have been sold (the "BID" price) or bought (the "ASKED" price) during preceding week.

CIRCLE NO. 23 READER SERVICE CARD→



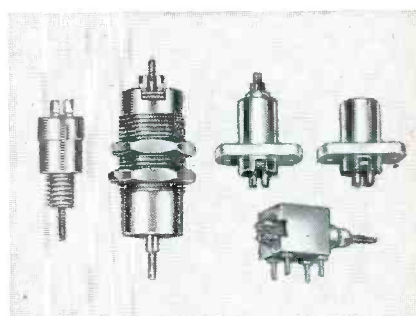
CAMBION standard coil forms cover the widest range of requirements. In addition to types for standard circuits, printed circuit types, designed to eliminate a separate soldering operation, are available in horizontal or vertical mounting styles, the latter including ceramic units with fiberglas collars.

Big variety...big advantages

To the already huge family of CAMBION® coil forms, ceramic and phenolic, new members are constantly added to meet increasing needs. Like the complete CAMBION line, they meet or better government specifications in every detail. CAMBION standard coil forms, designed for use in any type of circuit, can be custom-wound whenever required. Windings can be single layer, close wound or spaced, single or multiple pie. New coil forms are custom-designed to solve new problems.

Standard or custom, most CAMBION coil forms are available with Perma-Torq® tensioning device, which allows locking of tuning cores while still tunable. All are delivered promptly, in any quantity. And all CAMBION components — coils, coil forms, capacitors, solder terminals, insulated terminals, terminal boards, swagers, hardware — are products of top-ranking engineering, workmanship and quality control that make every one of them *guaranteed*.

Available locally through authorized CAMBION Distributors. Or write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Massachusetts. On the West Coast: E. V. Roberts and Associates, Inc., 5068 West Washington Blvd., Los Angeles, California. In Canada: Cambridge Thermionic of Canada, Limited, Montreal, P. Q.



CAMBION shielded coil forms are completely shielded, electromagnetically and electrostatically, for star performance in tight spots. Newcomers include the recognizable "top hat" forms for broad IF and RF applications and the square type, ideal for IF strip work.

CAMBRIDGE THERMIONIC CORPORATION

CAMBION®

The guaranteed electronic components

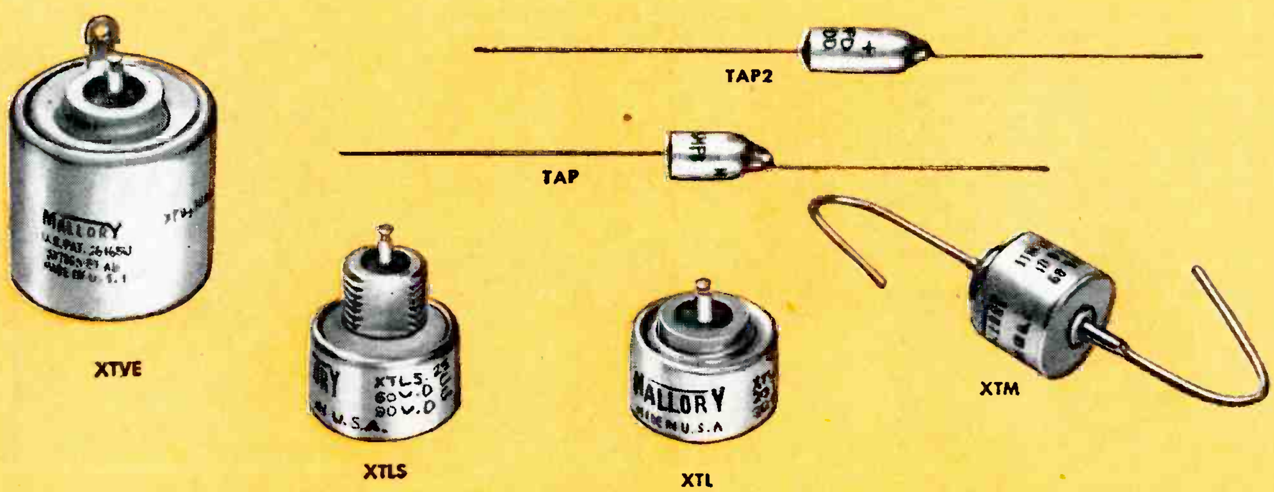
CIRCLE NO. 25 READER SERVICE CARD

Need Tantalum Capacitors?

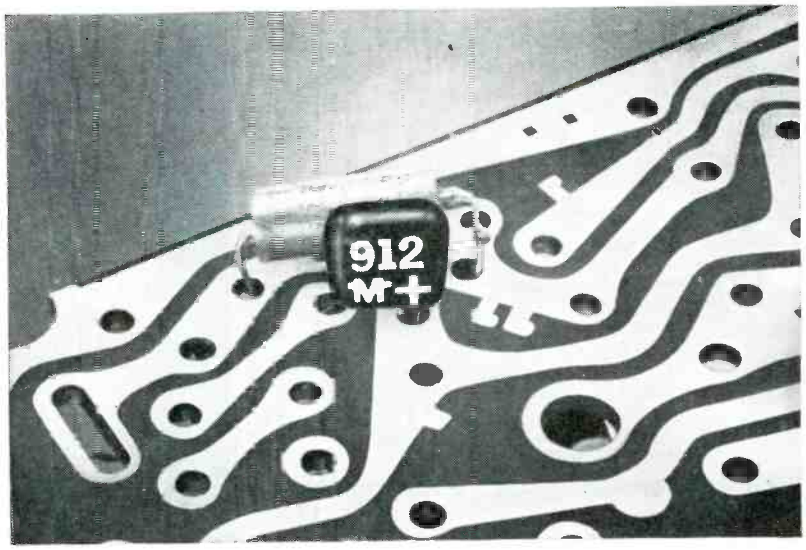
Choose From 15 Mallory Broadest Line on the

Type	Description	Capacity Range	*W. Volts DC Rating at 85°C	Temperature Range	Case Style	Body Length	Body Diameter
HAT	Pellet Anode—Liquid Electrolyte	1-10 mfd.	16-1V.	—20 to +65°C	Metal Case—Axial Leads—Insulated Case	.210″ max.	.070″ max.
TAS	Pellet Anode—Solid Electrolyte	.33-330 mfd.	35-6V.	—80 to +125°C	Metal Case—Axial Leads	.250″ to .625″	.125″ to .313″
TAM	Pellet Anode—Solid Electrolyte	4.7-56 mfd.	25-6V.	—55 to +85°C	Dip Coated Resin—Upright Mounting	.188″	.313″ square
TAF	Foil Anode—Semi-Liquid Electrolyte	.25-440 mfd.	150-3V.	—55 to +85°C	Metal Case—Axial Leads	.688″ to 2.75″	.188″ to .375″
STNT	Pellet Anode—Liquid Electrolyte	4-40 mfd.	50-3V.	—55 to +85°C	Metal Case—Axial Leads	.250″	.145″
TNT	Pellet Anode—Liquid Electrolyte	8-80 mfd.	50-3V.	—55 to +85°C	Metal Case—Axial Leads	.375″	.145″
TAP	Pellet Anode—Liquid Electrolyte	2-30 mfd.	90-6V.	—55 to +100°C	Metal Case—Axial Leads	.500″	.225″
TAP 2	Pellet Anode—Liquid Electrolyte	11-140 mfd.	90-6V.	—55 to +85°C	Metal Case—Axial Leads	.625″	.225″
M 2	Pellet Anode—Liquid Electrolyte	11-140 mfd.	90-6V.	—55 to +150°C	Metal Case—Axial Leads	.500″	.287″ (Body) .484″ (Flange)
XTK	Pellet Anode—Liquid Electrolyte	2-70 mfd.	340-8V.	—55 to +175°C	Metal Case—Axial Leads or Terminal	.438″ to 1.313″	.625″
XTM	Pellet Anode—Liquid Electrolyte	4-140 mfd.	340-8V.	—55 to +175°C	Metal Case—Axial Leads or Terminal	.566″ to 1.800″	.625″
XTL	Pellet Anode—Liquid Electrolyte	3.5-120 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.500″ to 2.595″	.875″
XTH	Pellet Anode—Liquid Electrolyte	7-240 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.688″ to 2.750″	.875″
XTV	Pellet Anode—Liquid Electrolyte	18-1300 mfd.	630-30V.	—55 to +175°C	Metal Case—Axial Terminal	.563″ to 2.750″	1.125″
XTO	Pellet Anode—Liquid Electrolyte	7-240 mfd.	630-18V.	—55 to +200°C	Metal Case—Axial Terminal	.563″ to 2.750″	1.125″

*WVDC at 65°C for HAT.
TAF Capacitors are also supplied in non-Polarized version.



Types... Market



Whenever you need tantalum capacitors for high reliability service in military or commercial electronics, you're sure to find the type you need and the performance you're looking for in the Mallory line.

Leader in tantalum capacitor technology, Mallory has developed models ranging from the microminiature Type HAT, scarcely larger than the head of a match, to the high-capacitance Type XTV, which can replace several conventional capacitors.

200°C ratings, pioneered by Mallory and available only from Mallory, can be obtained in several different capacitor designs.

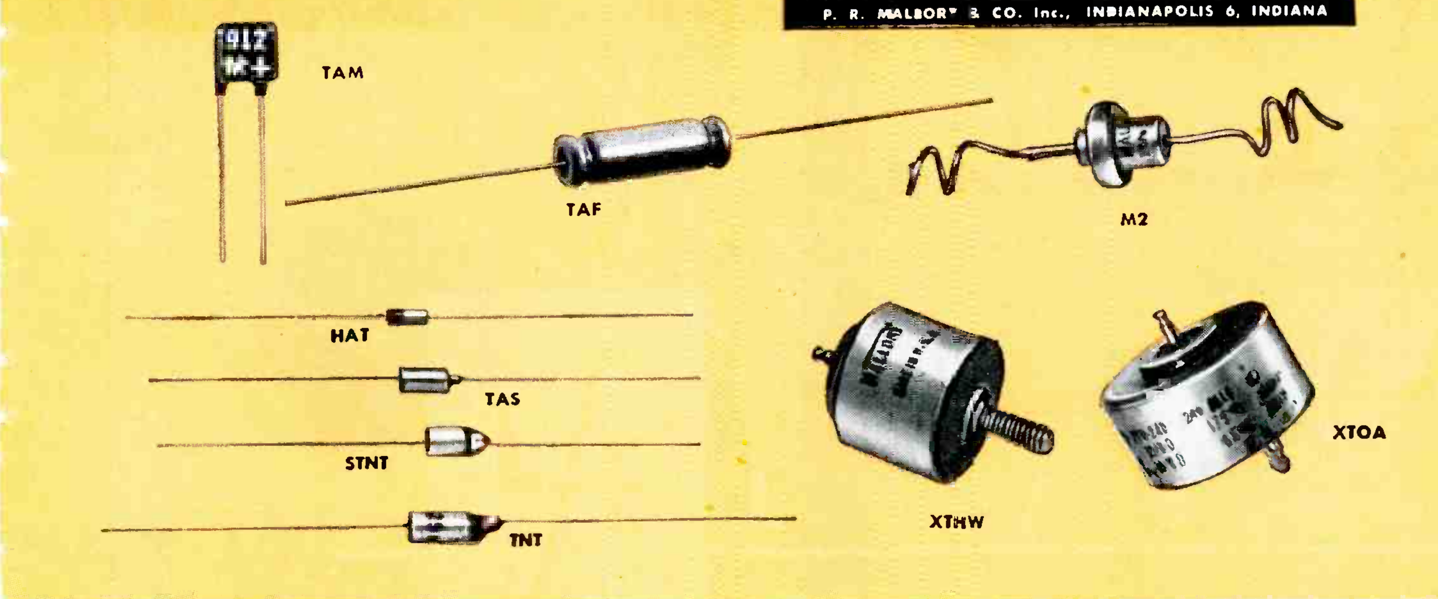
In most of the types shown here, the unique sintered pellet anode construction gives life, stability and electrical properties that are unequaled in the industry. Refinements in hermetic sealing and in design for extreme shock and vibration further expand the utility of the line. Latest additions include a series of new space-saving encapsulated capacitors, and a line of tantalum foil units for applications requiring the special characteristics available from this construction.

New Encapsulated Tantalum Capacitor Saves Space, Weight, Cost.

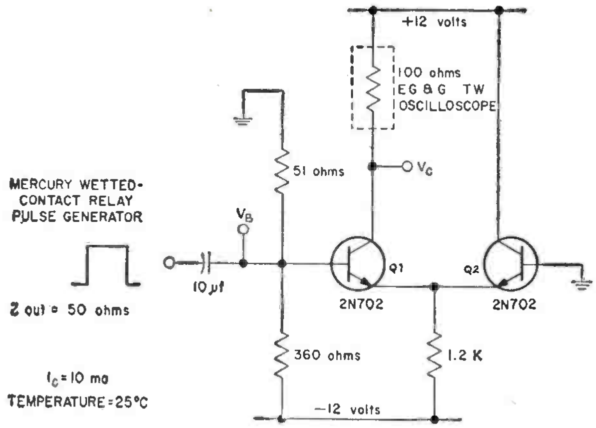
Another Mallory first . . . the new type TAM tantalum capacitor . . . is the first solid electrolyte tantalum capacitor without a metal case. Ideal for printed circuits. Takes only 1/3 the space of its metal counterpart, weighs 30% less; cost is substantially lower. Fully insulated. Grid-spaced leads dimensioned to EIA printed circuit standards. Protected against moisture by a specially developed encapsulation material. Size: 5/16" square, .175" thick. Ratings from 56 mfd., 6VDC to 15 mfd., 25VDC.

All models listed here are available for immediate delivery. Write today for technical data, and for experienced consultation on your circuit requirements by a Mallory capacitor specialist.

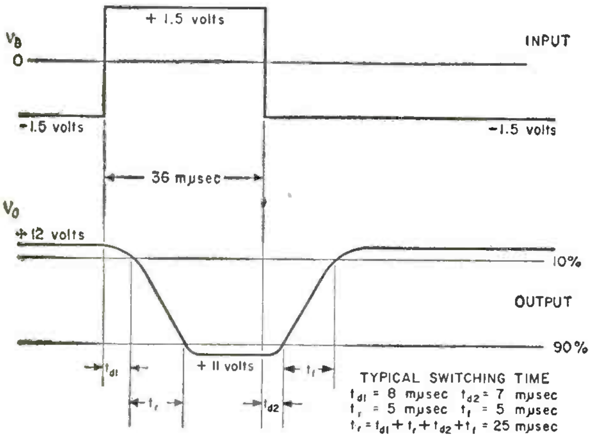
P. R. MALLORY & CO. Inc
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA



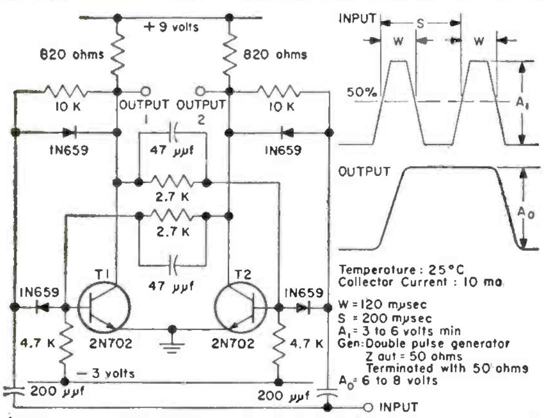
CIRCLE NO. 27 READER SERVICE CARD



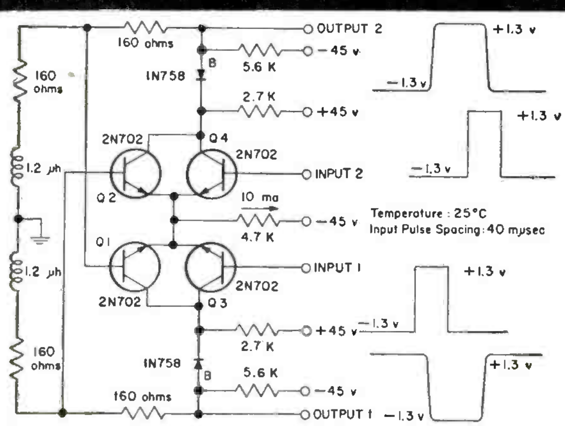
TYPICAL NON-SATURATED LOGIC SWITCHING CIRCUIT



TOTAL SWITCHING TIME NON-SATURATED CIRCUIT



TYPICAL CIRCUITRY FOR OBTAINING 5-MC REP RATE IN SATURATED FLIP-FLOP

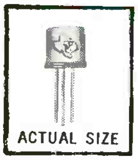


TYPICAL CIRCUITRY FOR OBTAINING 25-MC REP RATE IN NON-SATURATED FLIP-FLOP

NEW

SILICON

TO-18 PACKAGED DIFFUSED-BASE 'MESA' TRANSISTORS

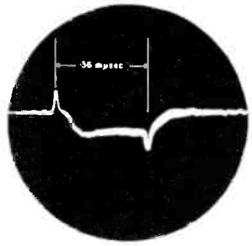


Now available for your evaluation, the subminiature 2N702 is built specifically for your 5-20 ma transistor logic switching applications.

This newest addition to TI's line of diffused-base 'mesa' transistors features . . .

- **Guaranteed dc beta of 15 to 45**
- **50 mc minimum unity beta frequency (f_t)**
- **Maximum 12 μμf output capacitance**
- **Subminiature TO-18 package**

As do all other TI semiconductors, the 2N702 carries a *full-year guarantee* to published specifications. Check the specs at right and contact your nearest authorized TI distributor or your TI sales office for detailed information.

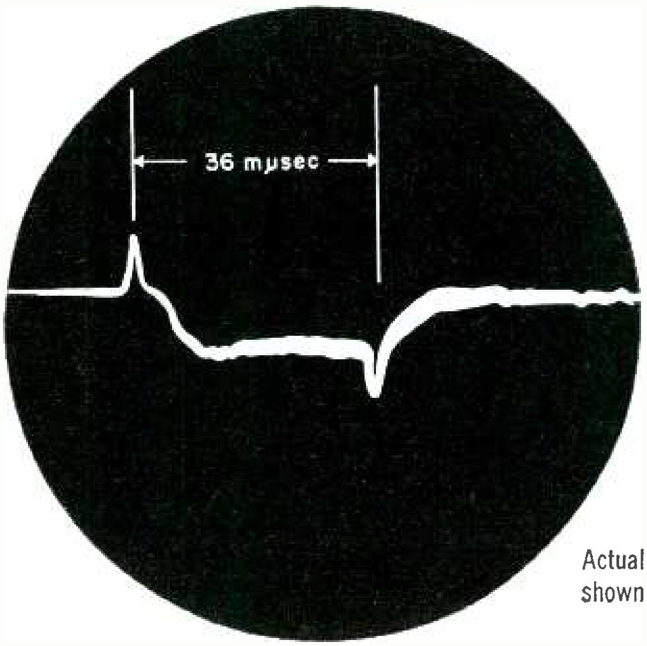


TEXAS

FROM THE WORLD'S LARGEST SEMICONDUCTOR PLANT

25 mμsec

SWITCHERS FROM TI



Actual photo of collector wave form as shown on traveling-wave oscilloscope

absolute maximum ratings (25°C)

Collector Voltage Referred to Base	20 v
Collector Voltage Referred to Emitter	15 v
Emitter Voltage Referred to Base	5 v
Collector Current	50 ma
Dissipation (100°C Free Air, Derate 0.5°C/mw)	150 mw

design characteristics at 25°C (except as indicated)

Symbol	Characteristic	Test Conditions	Min	Typ	Max	U
I_{CBO}	Collector Cutoff Current	$V_{CB} = 10$ v, $I_E = 0$			0.5	
I_{CBO}	@ 150°C	$V_{CB} = 10$ v, $I_E = 0$			50	
BV_{CBO}	Breakdown Voltage	$I_{CBO} = 10$ μa, $I_E = 0$	20			
BV_{CEO}	Breakdown Voltage	$I_{CEO} = 10$ μa, $I_B = 0$	15			
h_{FE}*	DC Beta	$V_{CE} = 5$ v, $I_C = 10$ ma	15		45	
BV_{EBO}	Breakdown Voltage	$I_E = 10$ μa, $I_C = 0$	5			
V_{BE}*	Input Voltage	$V_{CE} = 5$ v, $I_C = 10$ ma	0.7		1.2	
C_{ob}	Output Capacitance	$V_{CB} = 5$ v, $I_E = 0$, f = 1 mc		7	12	
f_t	Frequency at which h_{fe} is unity	$V_{CE} = 5$ v, $I_E = 10$ ma	50	100		
V_{CE}* (Sat)	Saturation Voltage	$I_C = 10$ ma, $I_B = 2$ ma			0.6	

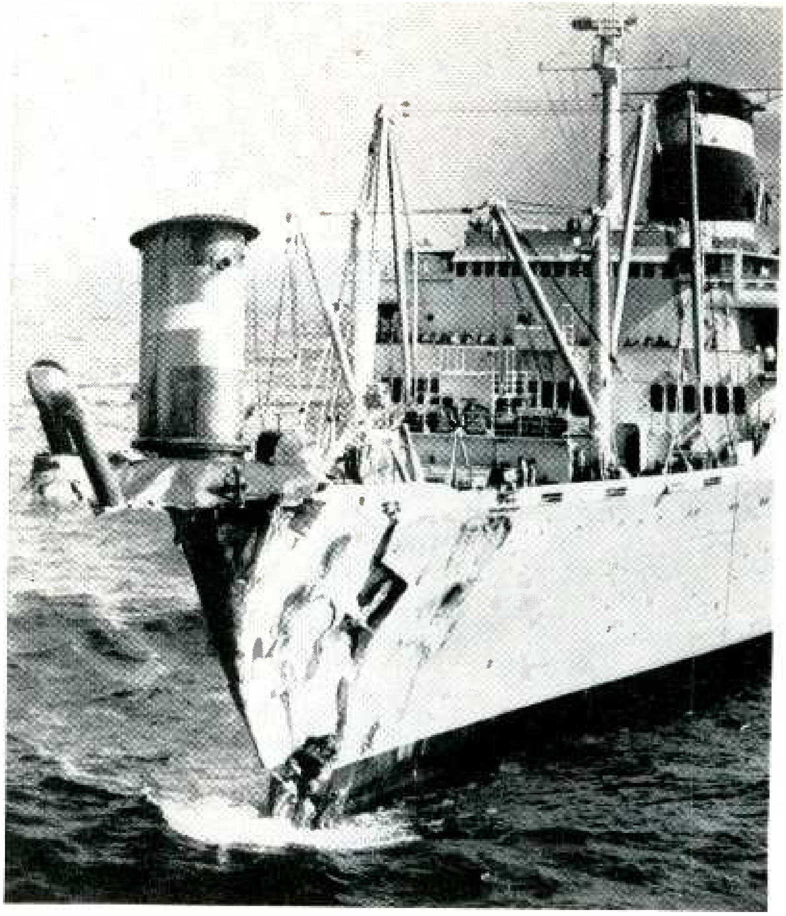
* Tested using pulse measurement.

NOTE: These units meet JEDEC outline TO-18 dimensions. A drawing of this package is attac

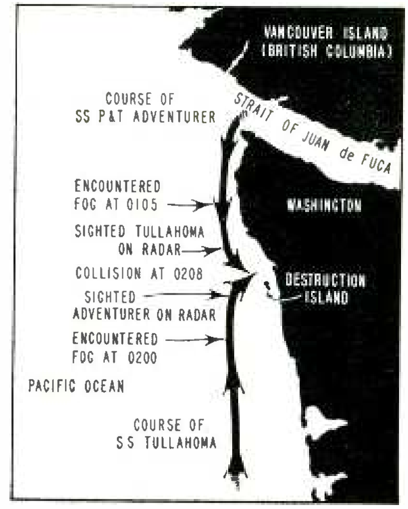
TEXAS INSTRUMENTS INCORPORATED
SEMICONDUCTOR - COMPONENTS DIVISION
13500 N. CENTRAL EXPRESSWAY
POST OFFICE BOX 312 • DALLAS, TEXAS

Write on your company letterhe
describing your application ,
specific details on TI produc

CIRCLE NO. 29 READER SERVICE CARD



Stack and funnels of tanker Valchem perch on bow of the liner Santa Rosa after collision last March. Both ships were navigating by radar in fog



Misreading radar data resulted in collision of cargoship P & T Adventurer with tanker Tullahoma in August 1951. In this typical case, both vessels were attempting to open up distance between them, actually closed on collision course

Radar: Its Hidden Dangers

Misreading scopes, misinterpreting blips, misuse of controls contribute to increasing ship collisions. Better training, human engineering could prevent them

EARLY in the morning of July 26, 1956, the Swedish liner *Stockholm* rammed the starboard beam of the Italian luxury cruiseship *Andrea Doria* off Nantucket. Late in the evening of Oct. 2, 1950, the American tanker *E. J. Henry* struck the port quarter of the Norwegian freighter *Fernland* near Winter Quarter Light Vessel off the Delmarva Peninsula. Just before dawn on April 20, 1951, the tanker *Esso Suez* rammed the port side of the tanker *Esso Greensboro* in the Gulf of Mexico. On March 26, 1959, the liner *Santa Rosa* (picture) rammed the port side of the tanker *Valchem* off Atlantic City.

All of these collisions occurred in limited visibility caused by fog, rain or mist. In each case—and in many other cases investigated by the Coast Guard—the ships were being navigated by radar, and the ships saw each other on the radar.

Radar is one of the most valuable and efficient electronic aids to ship navigation, and is admitted to be so by ship masters and maritime officials. But inadvertently, it is contributing to the alarming increase in frequency of ship collisions at sea.

Official Coast Guard investigations of these collisions constantly reiterate the admonition that radar "in no way relieves the master of a ship from his obligation" to observe the rules of the road. The fact remains, however, that many masters short-cut these rules when they feel they can get away with it.

Spokesmen for radarmakers and maritime officials alike agree that the collisions are not caused by technical limitations of the radar equipment, nor even, strictly speaking, by misuse. Economic pressures to make port with cargo push ship's masters into proceeding at excessive speed through fog and mist. In situations where ordinary mariner's caution would usually slow them or hold them up, the radar gives them a kind of false sense of security, with occasionally catastrophic results.

As one radarmaker puts it, "it's not radar, but blind reliance on radar, that's at fault. Radar is no substitute for common sense."

Radar at Sea

Shipboard radars are commonly made to provide plan-position data in either relative-bearing or true-bearing form. True-bearing radar keeps track of ship's bearing and holds north always at the top of the scope. Relative-bearing radar provides a ppi picture relative to the ship's heading.

True-movement radar (ELECTRONICS, July 20, '57) keeps track of both course and speed, and adjusts the starting point of the scope sweep to compensate. Thus it draws on the scope a fixed map of the area, on which the ship itself appears as a moving blip.

True-movement and true-bearing radar are valuable for navigating by landfalls, or on river channels, where radar presentations can be compared with charts. But in these cases, radar is merely an aid to navigation: the mariner uses it to check actual course and speed against plans. True-movement radar is also used for piloting in river channels, where traffic movement and landmarks are easier to grasp in a roughly rectilinear projection.

Relative-bearing radar is most useful for open-sea navigation. Since mariners are accustomed to looking at the outside world with reference to their own ship and its heading, the relative presentation is most easily translated to their customary frame of reference. But even so, it can give rise to error.

Since the radar gives only range and bearing to targets, the movement of the base from moment to moment must be vectored out of the data before it can be used. One ship's master told ELECTRONICS "radar belongs in the chartroom, not on the bridge or in the wheelhouse." The Coast Guard constantly emphasizes that course and speed of a target can be validly estimated only after plotting radar data on a chart.

Misinterpretation

The dozen or so case histories made available by the Coast Guard for study by ELECTRONICS clearly show the commonest ways in which radar data can be misinterpreted.

A true-bearing radar on a southeast-bound ship, for example, will show a northbound ship on a collision course as a target at the bottom right of the scope, closing toward center. A ship's master may not think to translate the data to relative bearing and may assume that the ship is overtaking him from his starboard quarter. To increase his margin of safety, he may order a course change to port. The northing vessel will be more likely

(Continued on p 35)

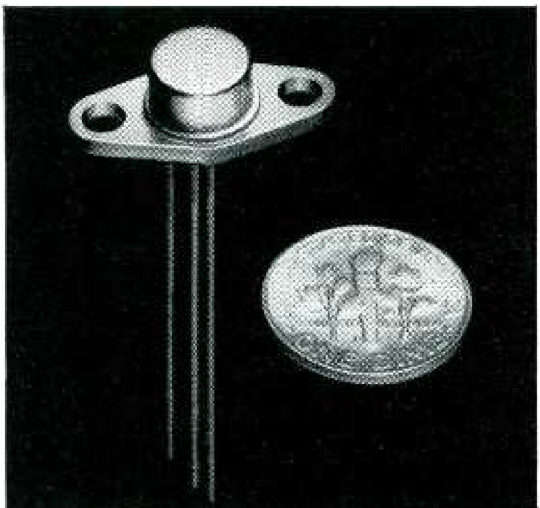

MEMO TO
MANAGEMENT MEN
IN THE MAKING:

NEW!

SMALL!

DELCO POWER TRANSISTOR

Designed for use where space and weight are restricting factors



MAXIMUM RATINGS	2N1172
Collector Diode Voltage	40 volts
Emitter Diode Voltage	20 volts
Collector Current	1.5 Amperes
Junction Temperature	95°C
TYPICAL CHARACTERISTICS (25°C)	
Typ. Collector Diode Current I_{co} $V_{cb}=40$ volts	50μ
Current Gain ($V_{ec}=-2$ volts, $I_c=100$ Ma)	70
Current Gain ($V_{ec}=-2$ volts, $I_c=\frac{1}{2}$A)	30
Saturation Resistance	0.3 ohms
Cutoff Frequency (Common Emitter)	17 kc
Thermal Resistance	12° C/Watt

The 2N1172 is a medium power transistor offering dependable operation in a new range of applications where space and weight have been a problem.

It's a mighty mite with more punch in a smaller package. The 2N1172, excellent for output use or as a driver for a very high power transistor, has already proved especially effective in DC amplifiers, voltage regulators, and as a driver for a high power stage in servo or other amplifiers.

This PNP germanium transistor is housed in a modified version of the JEDEC 30 package with a diamond shaped base for improved thermal conduction. It dissipates up to 2 watts at a mounting base temperature of 70 degrees centigrade. Available now in volume production—write today for complete engineering data.

DELCO RADIO

Division of General Motors

Kokomo, Indiana

BRANCH OFFICES

Newark, New Jersey
1180 Raymond Boulevard
Tel: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel: Exbrook 3-1465

Radar: Its Hidden Dangers . . .

(Continued from p 31)

to interpret the radar correctly, and will order a course change to starboard. The vessels will inevitably cross courses, and may collide.

Rules of the road for an inland waterway or channel require a master to keep vessels to starboard when overtaking, to port when meeting. In other words, the rules say keep to right, pass on left. These rules do not hold so strictly on the open sea, but in close maneuvering they are usually obeyed unless the masters agree by exchange of signals to do otherwise.

Errors of Judgment

In more than half the cases involving collisions by radar-equipped ships in fog, the southing ship made a course change to port in a situation in which a change to starboard would have been more reasonable. Since the official investigations concentrate more on the initial violation—proceeding at excessive speed in conditions of limited visibility—this error in judgment is not usually mentioned. But when the northbound coast steamer *Baranoff* rammed the southbound Greek freighter *Triton* in July 1952 off the coast of British Columbia, the investigating board record officially noted the judgment error. The record says: "The seamen's eye method of analysis of the movement of another vessel appearing in the radar scope is dangerously apt to lead to a false conclusion that the line of relative motion shown in the radar scope represents the actual course line of the other vessel."

Misuse of controls can also cause misinterpretations. In one case, the tanker *Atlantic Dealer*, proceeding northward in the Delaware River, rammed the *Atlantic Engineer*, which was lying at anchor in midchannel. About twenty minutes before the collision, the *Dealer's* second mate reported a target dead ahead at eight miles. He had previously shifted the radar to four-mile scale, but had forgotten having done so. By the time the error was discovered, the *Dealer* was closing on the *Engineer* and collision was inevitable.

Translators (above), boosters and community antennas help television spread out, bringing . . .

Growth In Troubled Field

THE QUESTION of who owns a tv signal once it leaves the station is being examined on several fronts these days.

Interested parties in addition to the viewing public are: broadcasters, community antenna, booster and tv translator services.

The status of the more than 1,000 booster operators now in business has been a matter of debate for more than four years. Plans this year were for the Federal Communications Commission to ban booster operations in their present form entirely by March 31. Comment against this by public officials and operators resulted in an extension to the end of this September.

FCC says Congress must amend the Radio Act before boosters can be made subject to Commission regulation. Once this is done, technical demands can be made and enforced by present FCC methods. Meanwhile, boosters continue to be the only source of tv in many regions of the country.

The job facing the FCC is more than just one of deciding the fate of booster operators. Also slated for attention are community antenna (CATV) groups.

Broadcaster Sues

One broadcaster in Idaho is bringing suit against a CATV organization on the grounds that his signal is being used without permission.

A 42-page document now before FCC asks that all CATV's be required to obtain the broadcaster's permission before using a program signal, and to guarantee that no signal degradation will occur.

Another way of attempting to regulate CATV activity has been proposed in a request to the Commission asking that arrangements between CATV's and common carriers be regulated. So far FCC says it won't consider either practice.

Case Against Boosters

Community antenna groups are seeking to prevent passage of one proposal—that of legalizing boosters. Legalization is being fought on the grounds that the booster system, which rebroadcasts the signal on the same frequency, results in a ghosted signal in areas between the station and the booster. Booster opponents also claim that booster signals can adversely affect radio gear in planes flying over the area.

Translators now number close to 300 in the U. S., as compared to about 135 in mid-1957, according to Adler Electronics Inc., New Rochelle, N. Y. Translators are now legally required by FCC to obtain permission from stations whose signals they use.

Translators operate by "trans-

(Continued on p 38)

**Norman Allen is account supervisor, Mohr & Eicoff, Inc., advertising agency for Burnell & Co., Inc.*

Norman Allen* takes the stand for electronics

One day last week in a discussion of engineering techniques with Norman Burnell, President of Burnell & Co., pioneer manufacturer of toroids, filters and related networks, I commented that the chain of production was no stronger than its weakest link. Mr. Burnell thought a moment and gave this highly meaningful reply. "I believe," he said, "you mean the chain of production is no stronger than its weakest *think*."

There's a lot of significance to that sentence when it comes to publications as well as people. It's one of the reasons why **electronics** has been on Burnell's advertising schedule since the company's inception—a schedule which today includes seventeen full pages.

I regard **electronics** as an indispensable medium of advertising—because it represents one of the strong 'thinks' in Burnell's production plans. Advertising in **electronics** informs industry of Burnell's product development, new designs, new circuit components, new production methods and advances in miniaturization. Moreover, **electronics'** advertising, news and feature columns have been an endless source of ideas and information. They help the Burnell engineering staff keep abreast of developments and anticipate the electronics industry's needs. In summing up, I'd say advertising in **electronics** has been of considerable help in establishing Burnell & Co. as a leader in the field of toroids, filters and related networks.

If it's about electronics, it's advertised and read in **electronics.**

electronics

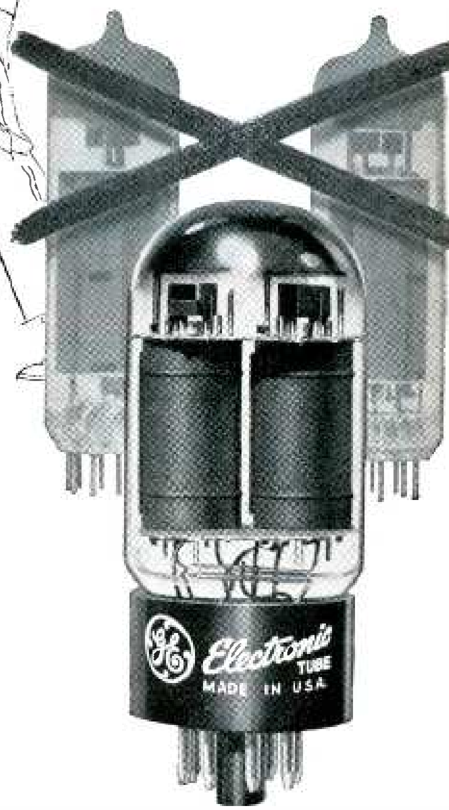
Published WEEKLY plus the mid-year electronics BUYERS' GUIDE

A McGraw-Hill Publication • 330 West 42nd Street, New York 36, N. Y.

ABC ABP

CIRCLE NO. 37 READER SERVICE CARD→

PLAY UP SPACE SAVING
PLAY DOWN
CIRCUIT COSTS!



Now *one* hi-fi amplifier tube-- General Electric's new 6DZ7 --does the work of *two!*

Every inch counts in designing trim, compact hi-fi equipment. That's one reason why a single new G-E 6DZ7 in place of two 6BQ5's is headline news. Now you can have push-pull amplification in one tube envelope!

And your circuit costs drop! You save a socket, you save other components. Helps you sharpen your cost pencil, to meet stiff price competition.

With stereo, your savings mount still further. Here two 6DZ7's, powered by one heavy-duty General Electric 5AR4, will take the place of four 6BQ5's. Speaker volume and tone quality are fully maintained...see ratings at right.

Go modern in amplifier design, go one-tube, go G-E 6DZ7! Any General Electric tube office listed below will be glad to give you further information.

200 Main Ave., Clifton, N. J.
(In Clifton) GRegory 3-6387
(In New York City)
WIsconsin 7-4065, 6, 7, 8

3800 North Milwaukee Ave.
Chicago 41, Illinois
SPring 7-1600

11840 West Olympic Blvd.
Los Angeles 64, Calif.
Phones: GRanite 9-7765
BRadshaw 2-8566

Progress Is Our Most Important Product

GENERAL ELECTRIC

2-211-102

TWIN POWER PENTODE TYPE 6DZ7

Max plate dissipation, per plate	13.2 w
Max total screen dissipation	4.0 w
Power output (Under following conditions: $E_b = 400$ v; $E_{c2} = 250$ v; $E_{c1} = -11$ v; $E_{sig} = 22$ v peak grid-to-grid voltage)	18 w, with only 2.5% harmonic distortion *without* feedback

OTHER G-E QUALITY TUBES FOR HI-FI AND STEREO

5AR4 6BQ5 6CA4 6L6-GC
7025 7189-A 7247

Why Funds Pick

Exclusive survey reveals more than 80% of mutual fund groups invest in our industry

A SURVEY concluded this week by ELECTRONICS indicates a growing interest in our industry by mutual investment companies. This opens new avenues to money needed by electronics firms to grow.

Mutual investment organizations now handle more than $14½ billion a year, according to the National Association of Investment Companies, which has 156 member firms, and represents the securities of some 2,000 corporations.

To determine the feelings of mutual investment firms in our industry, questionnaires were sent to some 200 companies. Returns indicate that 81 percent have a portion of their holdings in the electronics industry. A year ago this figure was 73 percent, and five years ago it was 64 percent.

Included in the base are some mutual groups which specialize and are therefore unlikely ever to include electronics stocks.

Among the firms now holding electronics securities, two are exclusively concerned with our industry. Nine firms report between 5 and 10 percent of their holdings as electronic, five report ranges from 10 to 20 percent, while the remainder are scattered with electronics holdings as low as 4.6 percent to proportions exceeding 40.

Management capability is considered the most important single factor by 58 percent of the firms. Future earnings and present rate

Growth In a Troubled Field . . .

(Continued from p 35)

lating" vhf signals to uhf before rebroadcasting.

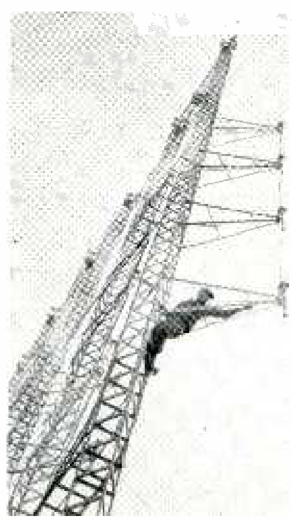
Both translator and booster operators charge an annual fee to support their installations. Initially, equipment is usually brought into the area at the request of a citizen's group which handle the operation.

In recent months there has been talk of establishing vhf translator systems, but some broadcasters see obstacles to this. One fear is that interference problems might result.

There has been talk lately of reducing milage separation between vhf stations (ELECTRONICS, p 30, May 15). If this is done, the problem of interference would grow even greater for vhf translators.

FCC officials have summed up the present growing pains of boosters, translators and community antennas in Commission Docket 12443. In this document, three basic legal questions are posed: What basis exists under present law for FCC to regulate CATV? Would it be legally valid for FCC to deny authorization for common carriers to transmit programs for CATV systems on the grounds of adverse competition to local stations? Is economic injury to a tv station a valid public interest justification for denial of authorization to competing auxiliary services?

Serves the Army



Antennas on this new 96-ft tower at Army Combat Development Experimentation Center's re-transmission station, Fort Ord, Calif., will handle radiophone communications from 300 portable units over 30 channels

Electronics

of growth tied for second place in the opinion of 41 percent. Present financial strength, strong research and development programs and a lead in technology were considered as prime factors by 39 percent.

Thirty percent of the replies indicated much attention is paid to the balance between military and commercial business.

A major portion of the respondents indicated that judging a firm is no easy matter. Energy Fund, Inc., which has 33 percent of its holdings in electronics, says "Investment in electronics is difficult. Our research concentrates primarily on management, technical ability and prospects."

Why They're Bounced

The chief reason mutual groups give for having dropped electronics stocks is that they have become overpriced. Other reasons mentioned are changes in company personnel at the management level, and obsolescence of the product line. A certain amount of shifting results also from sales made to maintain the balance of the mutual fund.

On this subject, Keystone Custodian Funds, whose S4 fund holds 17½ percent in electronics, says:

"During the last six months, we have completely eliminated the stock of only one electronics company. This was done because poor results in 1958 left a question as to the ability of its management."

Knickerbocker Growth Fund holds 6 percent of its assets in electronics. A company spokesman says, "For the future, extreme caution and thorough analytical research is a must to attempt to avoid the many companies which are over-inflated during this period."

Although many respondents indicated a certain amount of caution, there's much enthusiasm.

Securities Fund Inc., for example, comments: "Electronic stocks are still regarded, generally speaking, as speculative, but they are branching out so rapidly and many of them are indicating the attainment of investment stature so that it is possible they will play an increasingly important role in investment portfolios."

3-D Radar Tells... Distance, Altitude

(Pictures on Page 3)

A revolutionary new 3-D radar capable of detecting enemy air attackers at extreme range and revealing their distance, bearing and altitude to missile firing ground units was revealed today by the Army. The new system, called Frescanar and developed by Hughes Aircraft Company...

Army Unveils A Faster Radar System

WASHINGTON — A radar system that is faster, more reliable and more rugged than present equipment was unfolded by the Army here Tuesday.

Nicholas A. Begovich, of Hughes Aircraft Co., said a single antenna does the...

Los Angeles, Tues., Oct. 14, 1958

U.S. Reveals New Radar Instrument

A "3-D" radar that for the first time automatically computes distance, bearing and altitude of far-away targets was unveiled today by the Army in Washington.

Army Unveils Revolutionary Radar De...

BY VERNON ...

Hughes D...

THE WALL STREET JOURNAL, Wednesday, October 15, 1958

Army Tests Improved Radar Device Originally Developed for Navy

By a WALL STREET JOURNAL Staff Reporter
WASHINGTON—The Army said a radar device that spots airborne ... "extreme range" and simultaneously ... bearing and altitude ... Fullerton ...

NEW YORK, WEDNESDAY, OCTOBER ...

Army Shows Radar With 3d Dimension

By JACK RAYMOND
Special to The New York Times.

WASHINGTON, Oct. 14—The Army demonstrated a new "three-dimensional" radar device today and called it "one of the most important advances made in electronic detection."

The new radar gives simultaneous readings of bearing, distance and altitude; it is designed to be hauled on truck trailers.

...alled Great Advance

Army Unveils Hughes Radar

Electronically, 'Frescanar' Can ... 50% Further Than Previous D...

WASHINGTON, Oct. 14 (AP)—The Army Tuesday ... a field radar system that simultaneously ... bearing and altitude.

It employs a single antenna housed in an inflatable ... designed to become the electronic eyes ... defenses.

...l Radar ... by Army

NEW YORK, N. Y. JOURNAL AMERICAN

3-D COMES TO RADAR

WASHINGTON, Oct. 14 — A new "three-dimensional" radar which detects airborne targets at extreme range and for the first time simultaneously computes distance, bearing and altitude, was unveiled here today by the Department of the Army.

Called Frescanar, ...

STAR, Washington, D. C., OCTOBER 15, 1958

ARMY TIMES AGRV ... OCTO...

New Radar Imp... Air Defense for ...

...SHINGTON — Field armies ... have a truly effective missile defense against any kind of attack except that from ballistic missiles within a year, Army ... said last week.

A new field . . . a new future . . . for the forward-looking engineer!

The first radar system capable of simultaneously detecting range, bearing and altitude from a single antenna, transmitter, and receiving channel...Frescanar is a major breakthrough in radar technology.

Developed by Hughes Fullerton, the Frescanar antenna operates on a new electronic principle called *frequency scanning:* The position of the radar beam is changed by varying the frequency of electromagnetic energy applied to the antenna. Thus the beam can move at lightning speed to handle more targets with greater accuracy than with conventional radar.

This unique concept opens entirely new fields for radar... including a great many as yet unexploited. Hughes Fullerton needs creative engineers who can step in and help develop these new military and civilian applications.

While Hughes Fullerton places emphasis on advanced development, it is a completely integrated engineering and manufacturing organization...whose activities cover a wide range of electronic and electromechanical applications.

Now expanding rapidly, Hughes is offering imaginative engineers a number of new positions. If you are interested in stimulating work with solid opportunity for personal and professional growth, we invite your inquiry. Please contact Mr. L. V. Wike at address below.

HUGHES

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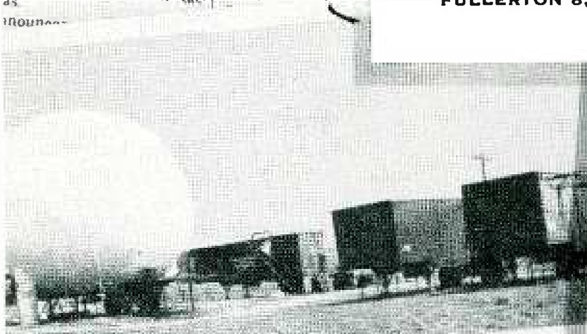
PERSONNEL SELECTION AND PLACEMENT
HUGHES AIRCRAFT COMPANY
FULLERTON 8, ORANGE COUNTY, CALIFORNIA

New Army Radar Can Be Hauled In Three Trucks

By the Associated Press
The Army has a new field radar system that simultaneously computes distance, bearing and altitude.
...employs a single antenna ...ed in an inflatable ...



...DAR ANTENNA—A mobile radar system developed and manufactured for the U. S. Army by the Hughes Aircraft Company, detects targets in three dimensions: height, bearing and distance. On the left is the trailer housing the antenna which obtains the information and transmits ... radar van on its right. Other trailers contain diesel generators which ... in the field. One generator is on a stand by ...

3-D Radar Developed by Hughes

Computes Bearing, Range, Altitude in Single Operation

Three-dimensional, hemispheric radar detection developed by Hughes Aircraft is now in use on Navy ships ...

NEW YORK ... TRIBUNE, WEDNESDAY, OCTOBER 15, 1958

Army Gets Improved Field Radar

WASHINGTON, Oct. 14 (AP)—The Army today ... of a field radar ... simultaneously ...

...adaptation of a Navy model first tested in 1953.

The Marine Corps has a separate field all-purpose radar under advanced testing. It was developed by the Sperry Gyroscope Co., to be small enough and light enough for carrying by aircraft, including helicopters, as well as by trucks and amphibious vehicles.

The Army says its system, which it calls "Frescanar" ...

3-Dimensional Radar Is Displayed by Army

By JAMES W. BRADY

without E-W cooling units, electronic gear in this hut would burn out in minutes!

The Ellis and Watts Model A-9 Unit that keeps this critical electronic gear cool has a cooling capacity of 9000 BTU's per hour. Without this vital cooling capacity the electronic equipment would burn itself out in a matter of minutes!

Wherever electronic gear is used, it creates heat problems. And, in compact airborne huts these problems are especially serious.

Designing and building specialized units to keep electronic gear cool is our business at Ellis and Watts. Units of any capacity, configuration, control requirements or functions can be designed and built to any applicable military or commercial specifications. E-W Units will function perfectly in any climate conditions on earth.

For additional information on Ellis and Watts Model A-9 Unit for cooling electronic gear in airborne huts or similar installations, write for Bulletin #130-E.

Compact, Model A-9 Unit, developed especially to provide cooling in airborne huts, measures only 27¼" x 26⅛" x 16¼" high—leaves maximum space for vital electronic equipment.

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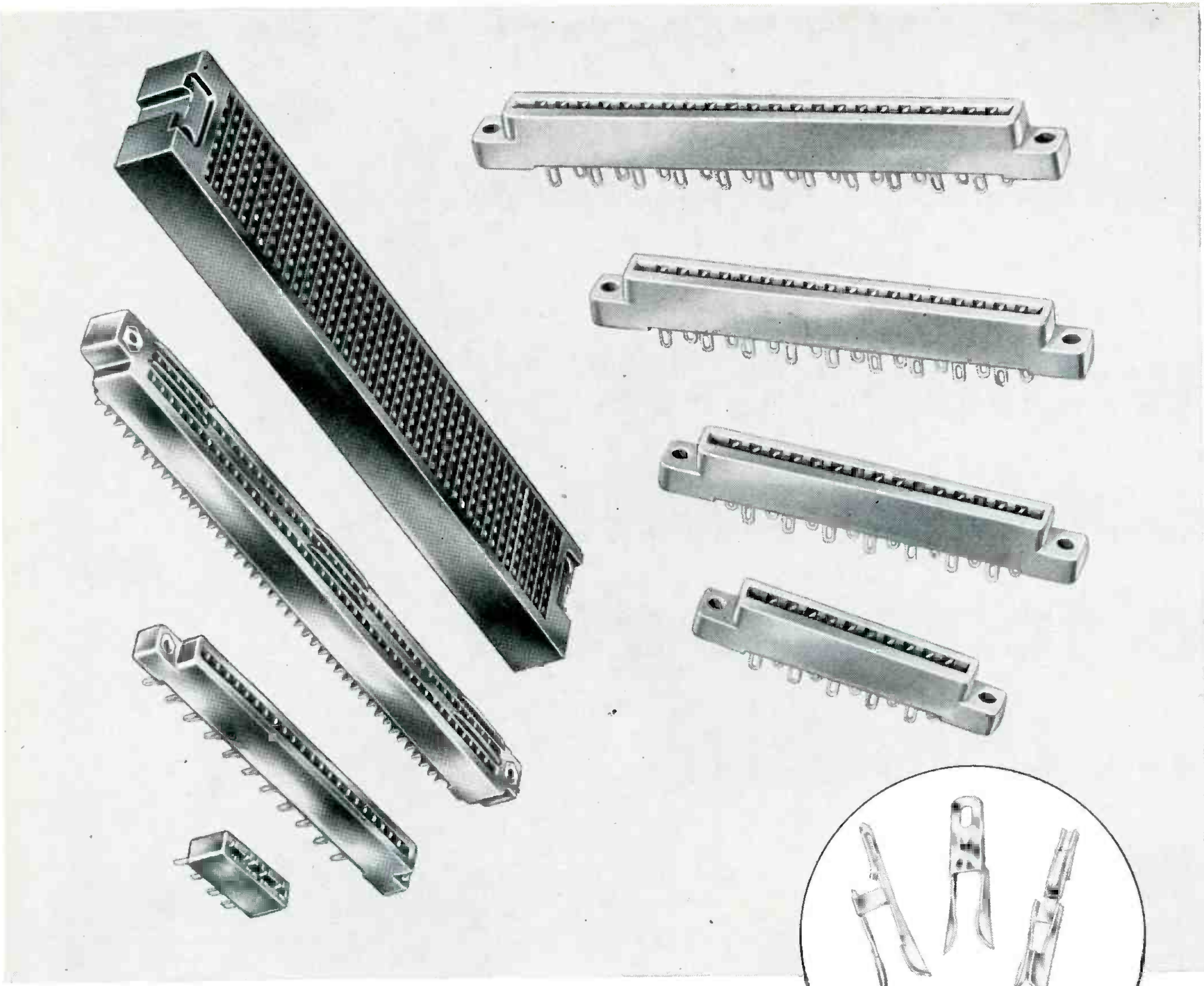

Individual spring contacts are twisted to ensure positive contact.

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Printed Circuit Connectors!

Only DOT printed circuit connectors by Ucinite give you the advantages of Torsion Contact (U. S. and Foreign patents pending). Contact points are precisely twisted so that they apply powerful, continuous and vibration-proof pressure against the printed circuit board. Wiping action during mating ensures a clean connection. Contact edges are rolled after stamping so that high contact pressures do not result in scoring (as is often the case with sheared-edge contacts). Polarizing keys are available. Full engineering details on request.

With an experienced staff of design engineers, plus complete facilities for volume production, Ucinite is capable of supplying practically any need for metal or metal-and-plastics assemblies. Call your nearest Ucinite or United-Carr representative for full information or write directly to us.

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Manufactured by

The UCINITE COMPANY

Division of United-Carr Fastener Corporation, Newtonville, Mass.

New Molecular Electronics

There's a push coming toward greater use of molecular electronics in industry

DAYTON, O.—Scientists at Wright Air Development Center here report a push will be made toward greater industry use of molecular electronics. Work is in progress on growing germanium crystals as flat ribbon type units, and parallel work will be done with silicon.

Crux of the matter is the increasing role of electronics in future airborne weapons. The B-70 plane will carry some 150,000 components, as opposed to a World War II B-17 with only 2,000 electronic components.

Lt. Col. George Watson, WADC Electronic Components Laboratory head, says fundamental research work will continue at his command, with contracts going out to other organizations for continuing research.

Of the many universities and other corporations involved in the research under contract, Burroughs Corp. was reported nearing the possibility of producing end-device units.

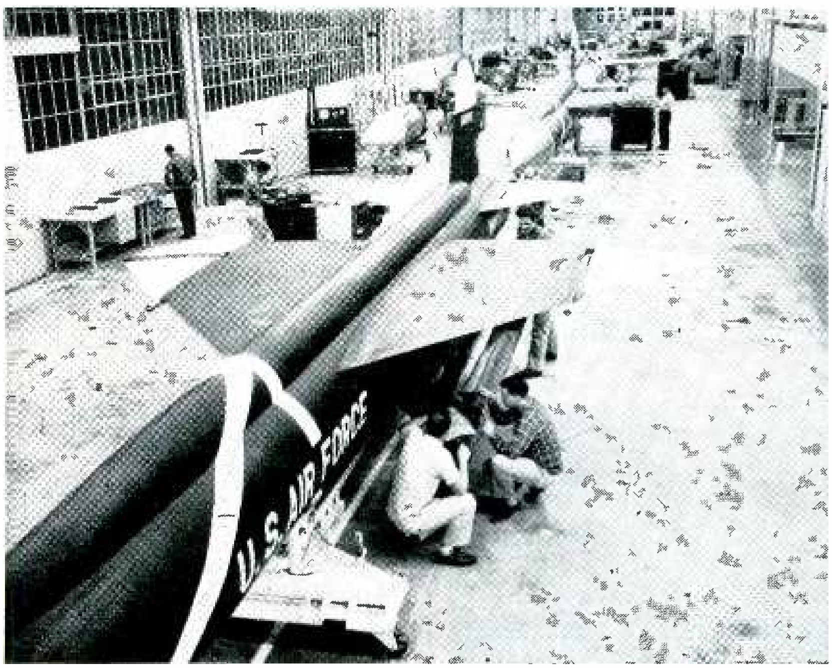
WADC's molecular electronics ideas center around construction of electronic systems by building homogenities in various materials into discrete electronic functions.

Need Reliability

RCA's James B. Gillmore recently told engineers at a conference here that "making something smaller is obviously not enough. Micromodules must be more reliable than present construction permits.

"Initial reliability requirement is for 15,000 hours mean life for a 50-part module within the temperature range of −55 degrees to +85 degrees C. In other words, we want to achieve an average part failure rate of 0.1 percent per 1,000 hours."

Missile Assembly Line



At Boeing's pilotless aircraft division in Seattle, Wash., Bomarc missiles roll down the production line toward their final destination—northeastern air defense bases. Target-seeker system for the 250-mile missile is made by Westinghouse, Baltimore; guidance components come from Lear, Motorola, and Bendix Aviation

MEETINGS AHEAD

June 15-17: American Nuclear Society, Annual Meeting, Gatlinburg, Tenn.

June 15-20: Information Processing, International Conf., UNESCO, PGEC of IRE, AIEE, ACM, UNESCO House & Palais de Exhibition, Paris, France.

June 15-20: Electromagnetic Theory Symposium, USSI, PGAP and PGMTT of IRE, Univ. of Toronto, Ontario, Canada.

June 16-18: Circuit & Information Theory, International Symposium, PGCT & PGIT of IRE, Univ. of Calif., Los Angeles.

June 24-26: Nuclear Instrumentation Symposium, ISA, Idaho Falls, Ida.

June 24-27: Medical Electronics, International Conf., UNESCO, CIOMS, PGME of IRE, Rockefeller Inst., UNESCO House, Paris, France.

June 29-July 1: Military Electronics, National Convention, PGMIL of IRE, Sheraton-Park Hotel, Wash., D. C.

July 1-5: Television Convention, International British Institution of Radio Engineers, Univ. of Cambridge, England.

Aug. 17: Ultrasonics, National Symposium, PGUE of IRE, Stanford Univ., Stanford, Calif.

Aug. 18-21: Western Electronics Show and Convention, WESCON, Cow Palace, San Francisco.

Aug. 23-Sept. 5: British National Radio & Tv Exhibition, British Radio Industry Council, Earls Court, London.

Sept. 14-16: Quantum Electronics, Resonance Phenomenon, Office of Naval Research, Shawanga Lodge, Bloomingburg, N. Y.

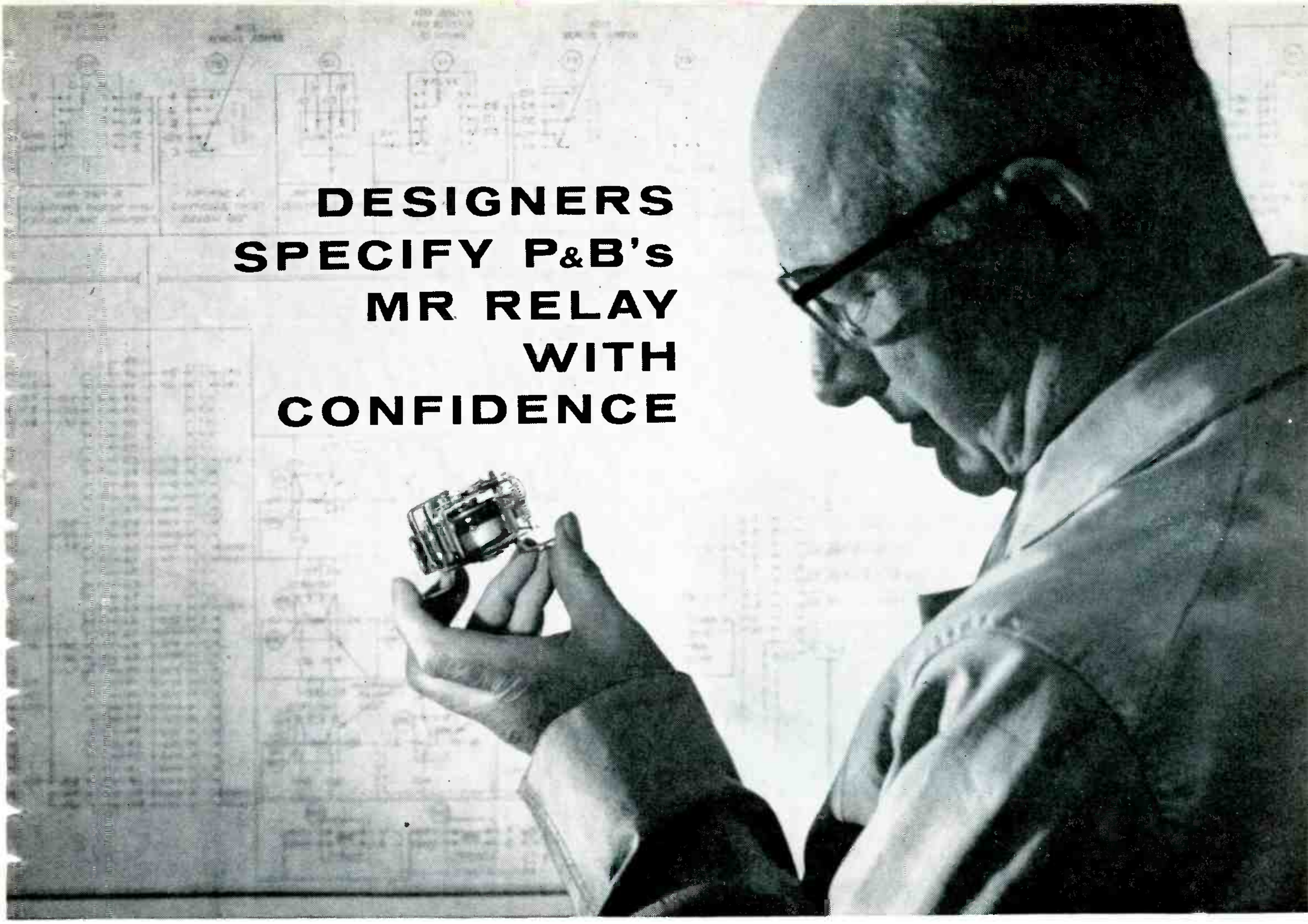
Sept. 15-17: Electronic Exposition, Twin Cities Electronic Wholesalers Assoc., Municipal Auditorium, Minneapolis.

Sept. 17-18: Nuclear Radiation Effects in Semiconductors, Working Group on Semiconductor Devices, USASRDL, Western Union Auditorium, N. Y. C.

Sept. 21-25: Instrument-Automation Conf. & Exhibit, ISA, International Amphitheater, Chicago.

Sept. 23-25: Non-Linear Magnetics and Magnetic Amplifiers, AIEE, ISA, PGIE of IRE, Shoreham Hotel, Wash., D. C.

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 88.



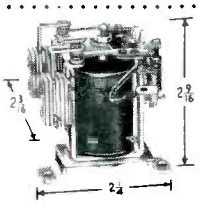
for a host of control applications

RELIABILITY coupled with low cost are two factors which place the MR series relays high on P&B's best seller list. They are being used in a multiplicity of designs . . . transmitters, street lighting equipment and small motor starters, to name but a few.

Both AC and DC models are available, with AC coils ranging up to 440 volts. All are adaptable for printed circuit mounting. The wide variety of contact arrangements include:

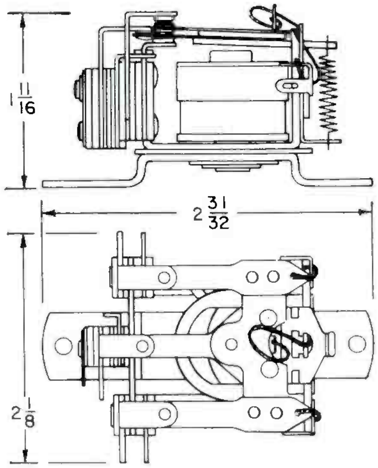
SPST-NO	SPST-NC-DB	DPST-NC	3PST-NC
SPST-NC	SPDT	DPDT	3PDT
SPST-NO-DB	DPST-NO	3PST-NO	

For more information about this medium duty, compact relay, call or write today—or get in touch with the P&B sales engineer nearest you. See our complete catalog in Sweet's Product Design File.



LM SERIES: Plate circuit relays similar to the MR. All sp and dp contact arrangements shown above are available. Coils are wound to specified resistances up to 58,000 ohms max. Sensitivity ranges from 15 mw min. (single pole) to 70 mw min. (double pole).

MR SERIES



GENERAL SPECIFICATIONS:

Breakdown: 1500 volts, 60 cycle rms between all elements.

Temperature Range:
DC −55°C. to +85°C.
AC −55°C. to +75°C.

Pull-in: Approx. 75% of nominal dc voltage; 78% of nominal ac voltage.

Weight: 4 ozs.

Dimensions: 2 31/32" long x 2 3/16" wide x 2" high.

Mounting: Two 5/32" dia. holes. Can be adapted for printed circuits.

CONTACTS:

Arrangements: Up to 3pdt.

Material: 7/32" dia. silver. (Others available).

Load: 8 amps @115 volts, 60 cycle, resistive.

COIL:

Max. Resistance: 34,500 ohms.

Power: 1.5 watts dc; 3.25 volt-amps ac. Will withstand up to 6 watts at 25°C.

Voltages: Up to 110 volts dc; up to 440 volts 60 cycle ac.

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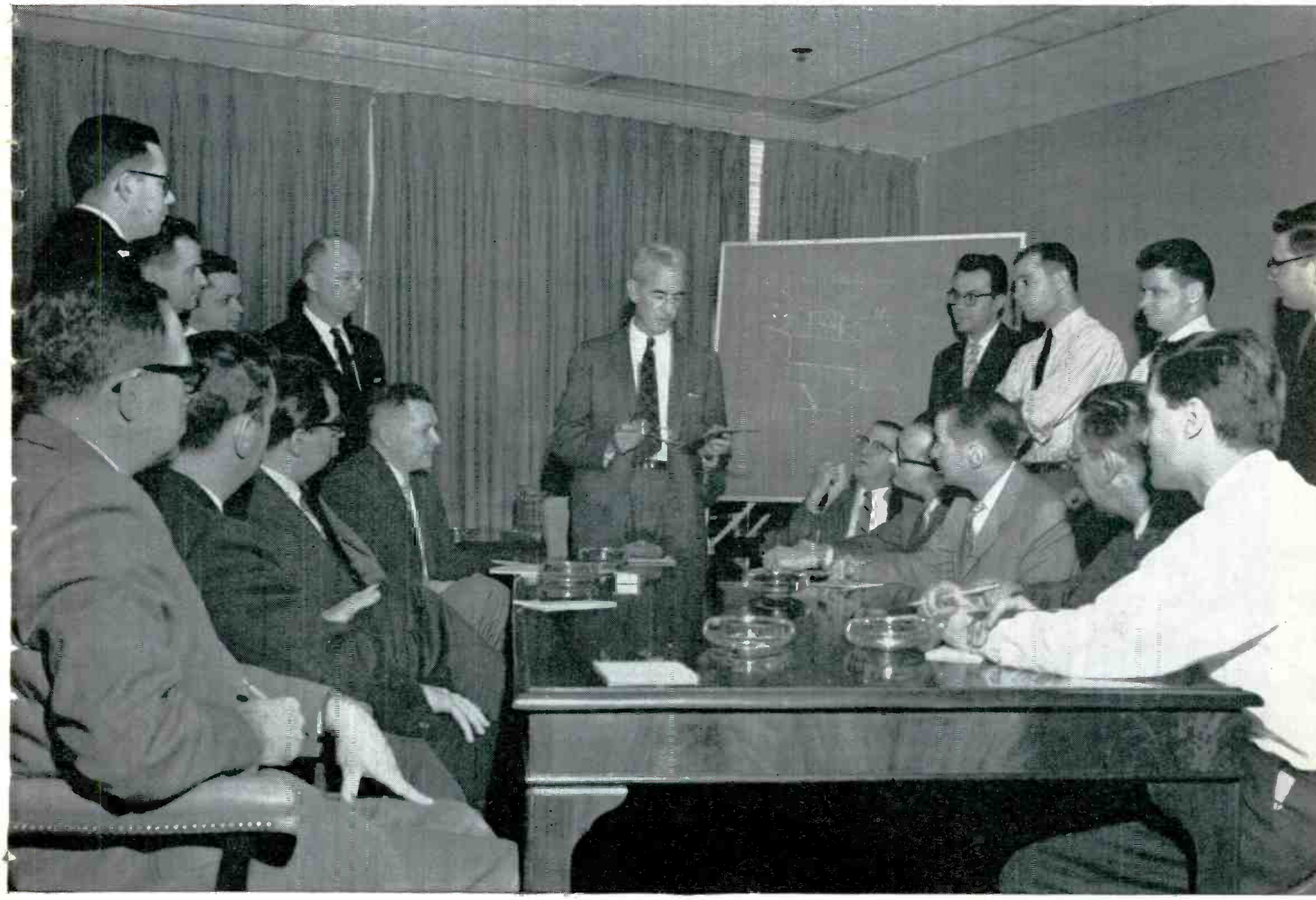
Editorial Conference: Friday 9:30 AM



Bill MacDonald, 33 years an Editor, Feeds a Growing Boy

Electronics, like a growing boy, has a voracious appetite — an appetite for information about technical developments, new markets, business potentials . . .

electronics magazine has the job of feeding information to the industry in a balanced editorial diet so that the quality and quantity of editorial will more than meet industry requirements.

Editor W. W. MacDonald inspires respect from his 26-man editorial staff, and justly so. Mac has been, successively, an Associate Editor, Executive Editor and then Editor of *electronics*. Before joining *electronics* he had been Managing Editor of "Electrical Merchandising" and Editor of "Radio Retailing." A senior member of the Institute of Radio Engineers, he has devoted 33 years to editing McGraw-Hill publications.

Mac is responsible for *electronics* editorial. True, he has far more assistance from his highly trained, professionally mature staff than do most business publication editors. Fifteen members draw upon direct engineering experience in the electronics field. Four editors gained electronics experience in the armed services. Four others came to *electronics* with backgrounds in journalism, finance, and marketing. The balance of the staff comprise the Art Director and his assistants.

But the Editor of *electronics* is a perfectionist and never satisfied. He is constantly raising the standards by researching his readers, going into the field, sounding out his staff.

And what does Mac's editorial contribution mean?

That the reader of *electronics* is kept best informed about his industry, and is therefore most apt to progress in it. If your subscription to *electronics* is expiring, if you're not a subscriber, fill in the box on the Reader Service Card. It's easy to use. Postage is free.

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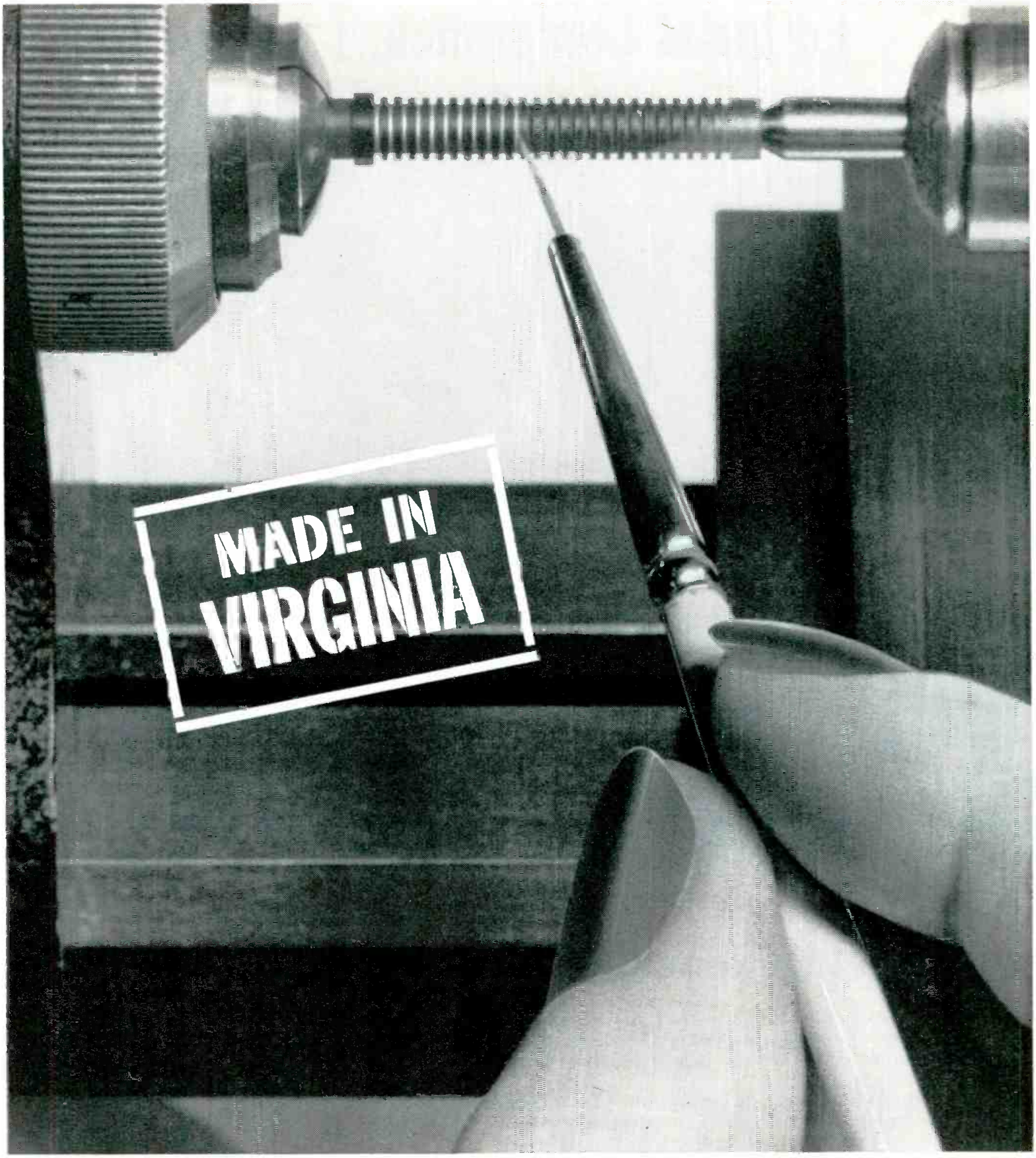

. . . WHERE THERE'S A GROWTH SITE FOR YOUR ELECTRONICS PLANT

This is the hand of a Virginia worker painting an electric circuit 1/10,000 of an inch thick. More than 30,000 such trainable men and women swell Virginia's potential working force each year. Home-rooted, conservative people . . . the kind who've helped make this state's record of labor-management harmony *five times better* than the national average.

That's one reason why the electronics industry is growing far faster in Virginia than in the U. S. as a whole. Your new plant, too, can find a profitable and congenial home in this land of mild climate, pleasant living and thrifty, friendly government.

Write, telegraph or telephone for more facts or confidential site-finding help in Virginia . . . where you'll enjoy southern production advantages as close as you can get them to the great northeast and mid-west markets.

Virginia Dept. of Conservation and Economic Development
DIVISION OF INDUSTRIAL DEVELOPMENT
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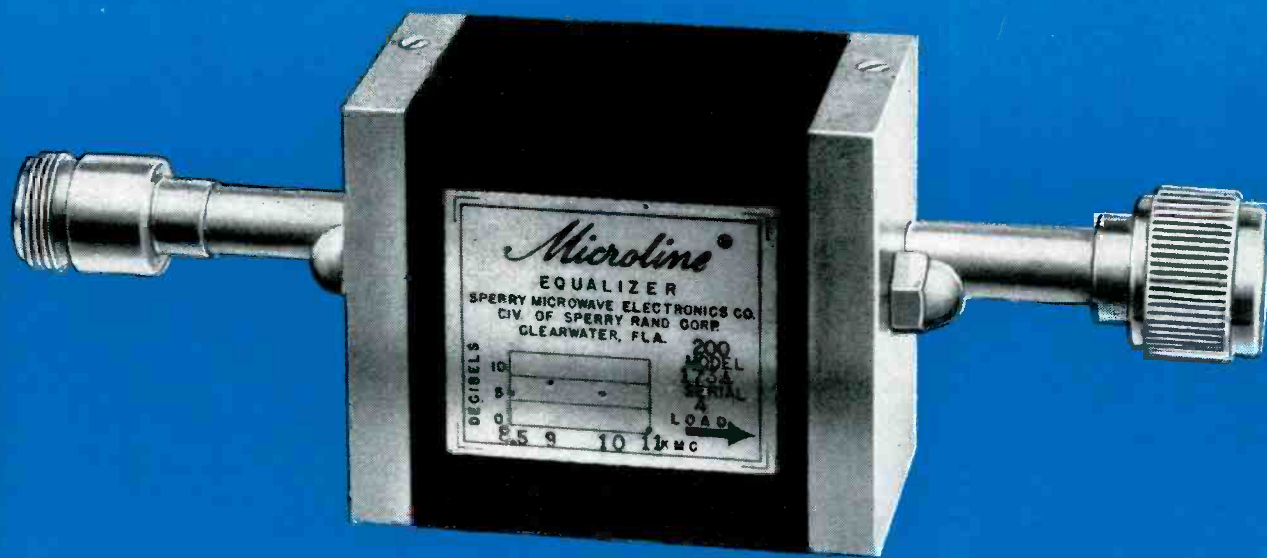
Solid state materials never vary — at **SPERRY**

In its 85,000 sq. ft. plant in Clearwater, Sperry engineers "cook" each batch to precise "recipe."



SPERRY FERRITE EQUALIZER 7000-11,000 MC

Specification..............................minimum attenuation <1 db
maximum attenuation >3-30 db

Other Models 1000-7000 mc

NEW...Sperry FERRITE Equalizers

provide constant power output over full operating frequency range of Microwave Tubes

They're not a "shelf item" — but when tailored to your specific needs, Sperry Ferrite Equalizers give you many exclusive advantages.

They assure *constant* power output over the full operating frequency range of any low-powered microwave or traveling wave tube source. They are light and compact — ideal for all radar, countermeasures, test set and relay applications where small size and light weight are decisive factors. And they are dependable—the result of more than six years of intensive Sperry research and development in the fields of Ferrites and Solid State devices. To learn how Sperry Ferrite Equalizers can be applied to your projects, write today.

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SPERRY MICROWAVE ELECTRONICS COMPANY, *CLEARWATER, FLORIDA · DIVISION OF SPERRY RAND CORPORATION*

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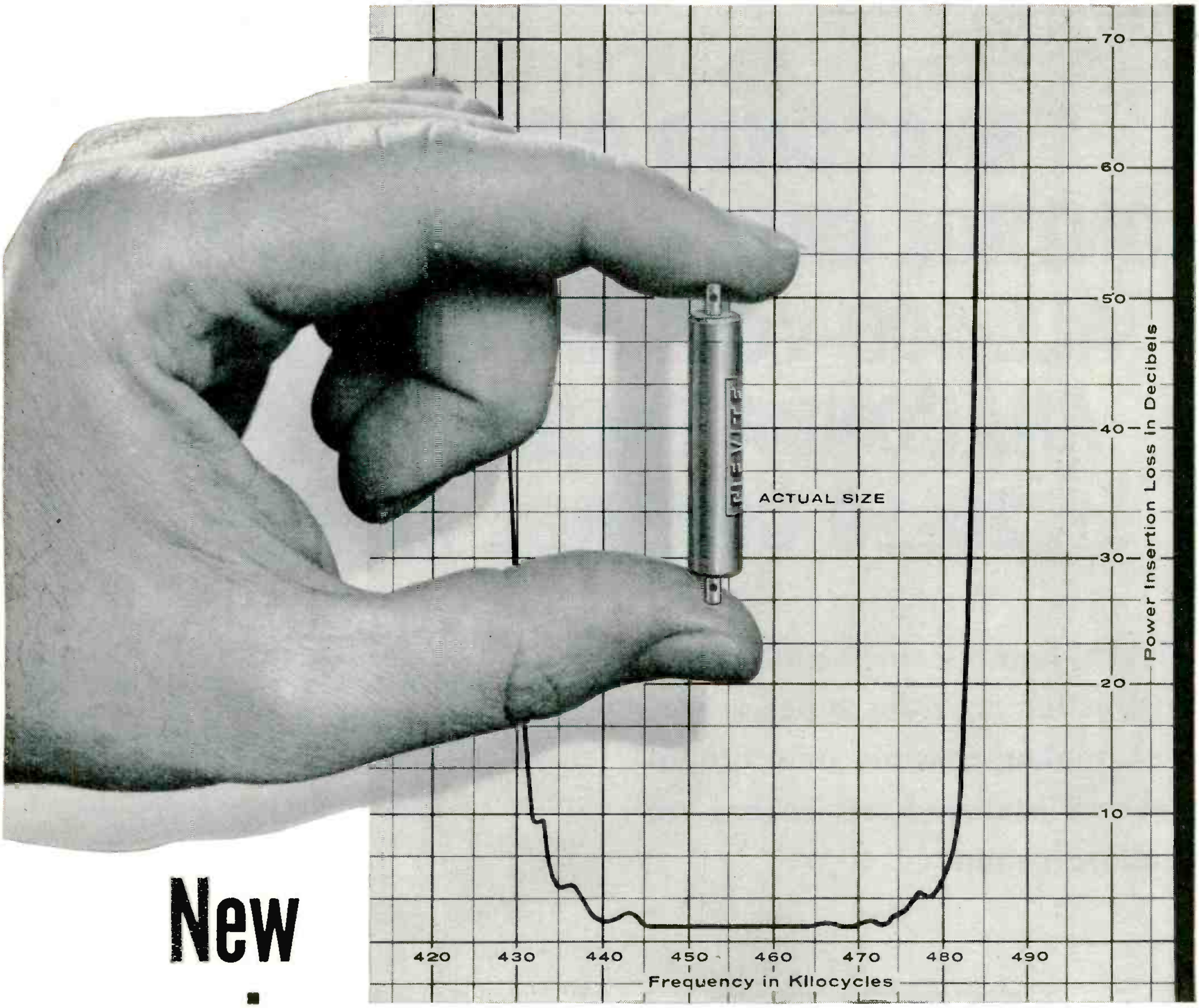

New ceramic ladder filter!

. . . increased selectivity—stability—1/2 the size!

The new Clevite Ceramic Ladder Filter, using the highly stable "PZT"® ceramic, answers the need of modern communication systems for increased selectivity and frequency stability in a ladder filter—at one-half the conventional size. The curve above shows a specific filter with a 6 db. bandwidth of 46.7 kc and a 60 db. bandwidth of 55.6 kc.

General specifications are:

Bandwidth Range	4 kc to 50 kc
Center Frequencies	100 kc to 1000 kc
Dimensions	1½ in. long—5/16 in. OD
Nominal input and output impedance	1500 ohms

Meets Mil-Spec 202A for temperature, humidity, vibration and shock.

WRITE FOR BULLETIN 9405 for complete details. Clevite Ceramic Ladder Filters are available now for your application in production quantities. The Clevite engineering staff will assist you with design problems upon request.

Also write for complete information on the miniature Clevite impedance-matching interstage coupler, and emitter by-pass Transfilters®

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DIVISION OF CLEVITE CORPORATION

3311 Perkins Avenue • Cleveland 14, Ohio

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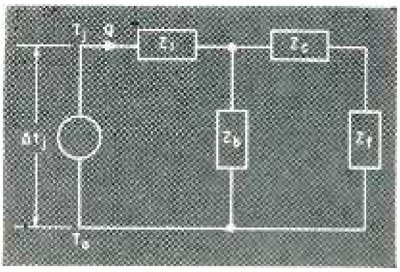
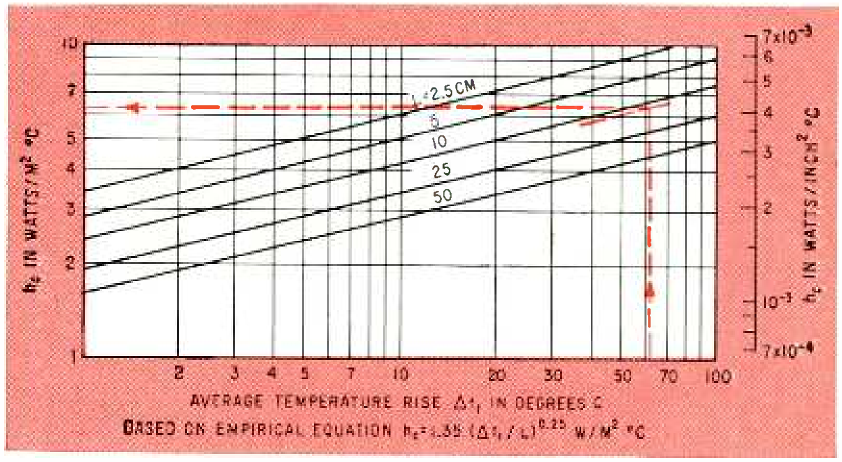


FIG. 1—Equivalent circuit of heat dissipation

FIG. 2—Heat transfer coefficient (h_c) for free convection cooling of vertical plates in air at sea level



Taking the Heat Off Semiconductor Devices

Cooling fins will improve the performance and increase longevity of semiconductor devices. Here are the factors, equations, charts and nomograms needed to tailor a fin to a power transistor or diode without involved math

By **WERNER LUFT**, Product Analyst Engineer, International Rectifier Corp., El Segundo, Calif.

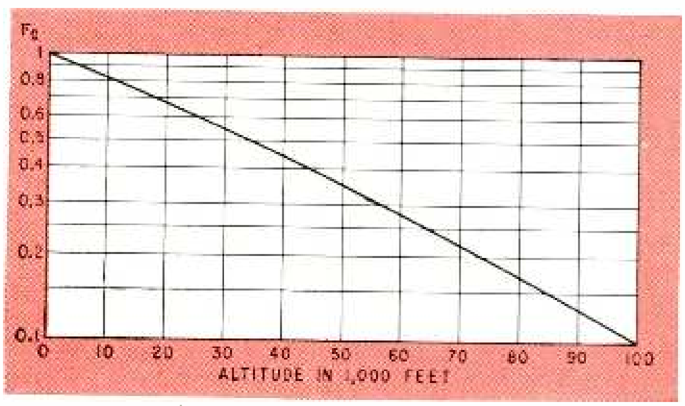


FIG. 3—Altitude correction factor (F_a) for convective heat transfer coefficient

POWER TRANSISTORS, semiconductor diodes and similar devices generate large quantities of heat within a small body. Since their surface areas are too small to dissipate heat without excessive temperature rise, they are mounted on fins, which increase heat dissipation surface.

This article shows how to calculate dimensions of fins cooled by free or forced convection of air at altitudes from sea level to 100,000 feet. Fins must be large enough to dissipate heat without exceeding the device's safe junction temperature, as specified by the manufacturer. Current-carrying capacity of power transistors and diodes is limited by T_j.

HEAT CIRCUIT—Heat flow through a fin-mounted semiconductor device is represented by an equivalent

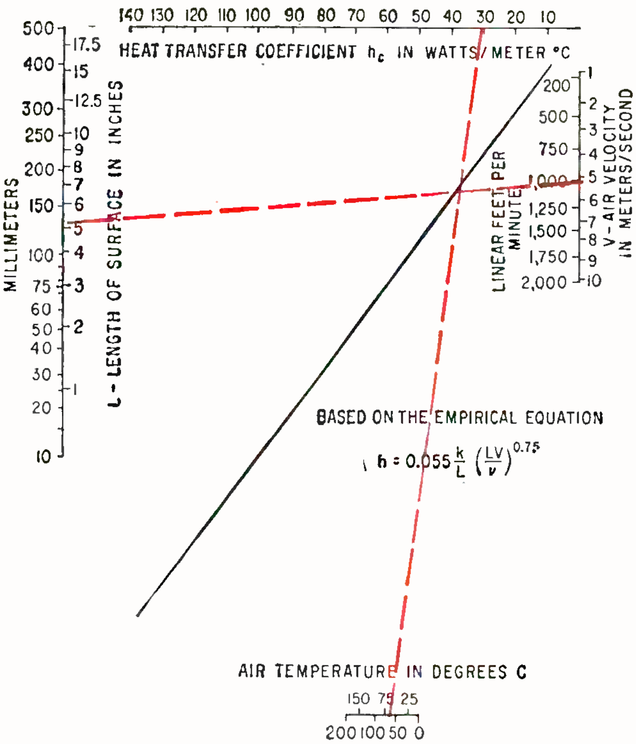


FIG. 4—Nomogram for obtaining heat transfer coefficient for forced convection cooling of plane surfaces in air at sea level with turbulent flow. Dashed lines show sample solution

Glossary of Symbols

Δt_j = temperature rise of junction, in °C
T_j = junction temperature, in °C
T_a = ambient temperature, in °C
Δt_f = average temperature rise of fin, in °C
Q = heat dissipated, in watts
Z_t = total thermal impedance, in °C/w
Z_f = fin impedance (fin to environment), in °C/w
Z_c = contact impedance (device to fin), in °C/w
Z_i = internal impedance (of device), in °C/w
Z_b = external impedance of device without fin (to environment), in °C/w
h = total heat transfer coefficient, in w/m²°C
h_c = convective heat transfer coeff, in w/m²°C
h_r = radiation heat transfer coeff, in w/m²°C
k = thermal conductivity, in w/m°C
ϵ = emissivity
F_1 = correction factor for surface configuration
F_a = correction factor for altitude
F_r = form factor
η = fin efficiency
A = total fin area, in m²
L = length, in m
r_o = heat input radius, in m
r_1 = outer fin radius, in m
D_h = diameter of hole for stud, in m
D_b = base diameter of device, in m
R = natural fin radius, in m
s = fin thickness, in m

circuit of heat dissipation (Fig. 1). The heat flows through a series of impedances, Z_i, Z_c, Z_b and Z_f, on its way from the heat source (the junction) to the final heat sink, the environment.

The temperature potential to maintain the heat flow through these impedances is $\Delta t_j = T_j - T_a$. If T_j is the maximum permissible junction temperature and T_a the maximum ambient temperature, Δt_j becomes the maximum temperature rise allowed. This rise and the amount of heat to be dissipated determine the maximum total thermal impedance from the junction to the ambient air: $Z_t = \Delta t_j / Q$.

Table I—Typical Values of Metal-to-Metal Contact Impedance for Power Diodes

Base Hex Size (in.)	Stud Size	Torque (inch-pounds)	Z_c (°C/w)
7/16	10–32	15	2.6
11/16	1/4–28	25	0.9
1	3/8–24	90	0.4
1 1/8	1/2–20	200	0.2
1 1/4	1/2–20	200	0.18
1 1/4	3/4–16	500	0.18

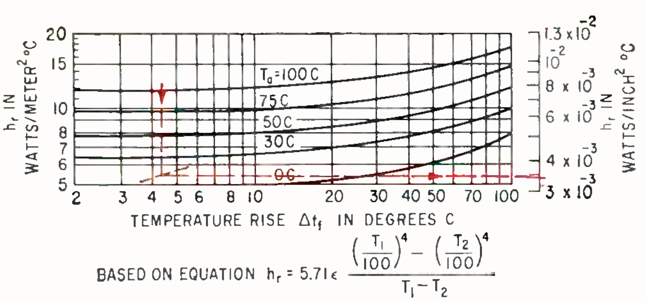


FIG. 5—Radiation heat transfer coefficient (h_r) for unobstructed radiation and an emissivity of 1

HEAT IMPEDANCES — The total impedance is $Z_t = Z_i + Z_b (Z_c + Z_f)/(Z_b + Z_c + Z_f)$ as seen by Fig. 1. Z_b is usually large compared with $Z_c + Z_f$, and can be assumed infinite for a first approximation. Then, $Z_t = Z_i + Z_c + Z_f$.

Z_i depends on the size and internal design of the device and is usually given by the manufacturer. Z_c varies with the area of the device in contact with the fin and with the fin mounting method. Z_c of some semiconductor diodes in standard sizes mounted directly on fins are given in Table I.

If an electrical insulator is placed between the device and its fin, Z_c increases considerably. A 1-mil-thick Mylar washer will triple contact resistance and a 3-mil mica washer will quadruple it. To determine Z_c directly, the temperature difference between the device base and the fin directly below the base is measured with thermocouples.

Having determined Z_t, Z_i and Z_c, the maximum Z_f is obtained from the equation given above.

FIN AREA—Fin dimensions giving a desired Z_f for the cooling method selected can now be established. The total fin area required is $A = 1/Z_f h \eta$. Determination of h and η is described below. The equation for h is $h = F_1 F_a h_c + F_r \epsilon h_r$.

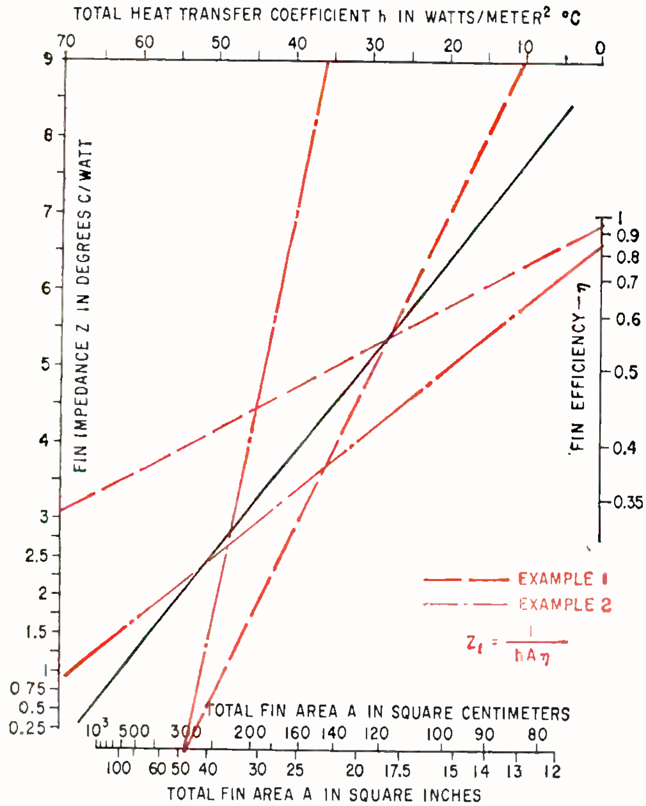


FIG. 6—Nomogram for obtaining total fin area

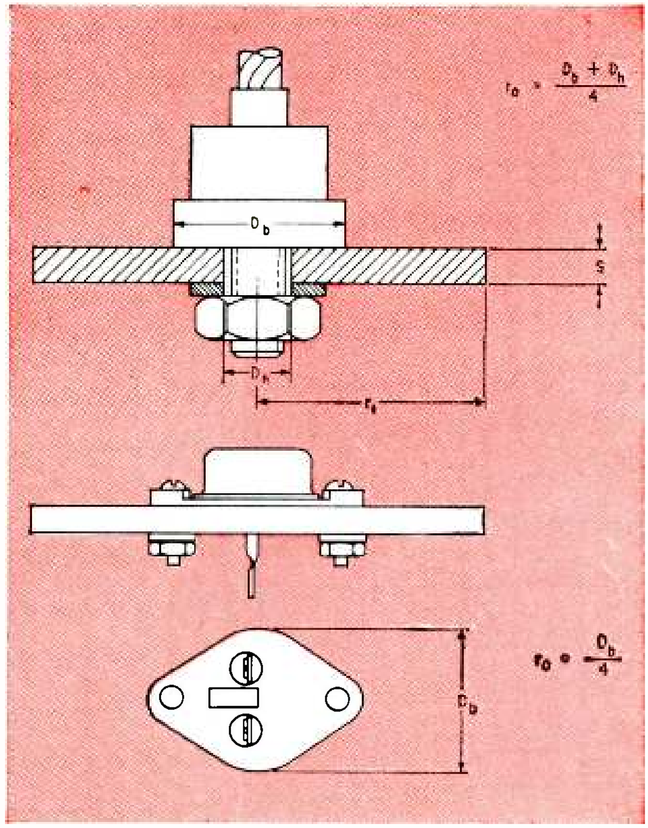


FIG. 7—Relation of device dimensions to heat input radius

HEAT CONVECTION—Heat is transferred from the fin to the environment by convection and radiation. Transfer coefficient h_c for free convection at sea level for vertical fins is obtained from Fig. 2. For other fin geometries or positions, the value obtained from Fig. 2 must be multiplied by F_1 (Table II). The significant fin dimension L (Table II) and Δt_f must be estimated. If the estimation of L proves wrong when the fin area is finally established, the calculation must be made over. Δt_f may be taken as $\Delta t_j/2$.

Forced convection h_c for air cooling at sea level is obtained from Fig. 4. Here also, L must be estimated. Heat transfer by convection decreases as altitude increases. To find h_c at other altitudes, multiply the sea level value obtained from Fig. 2 or Fig. 4 by F_a (Fig. 3).

HEAT RADIATION—Fin emissivity varies with surface finish and fin material. It is always less than 1. Painted fin ϵ is approximately 0.90. Figure 5 gives h_r for $\epsilon = 1$ and unobstructed radiation. The values of Fig. 5 must be multiplied with the actual ϵ.

If radiation from the fin is obstructed by other bodies of the same temperature, h_r must also be multiplied by a form factor smaller than 1. Consider an unobstructed fin's radiation as originating at the center of the fin and being spherical (hemispherical on each side of the fin). An obstruction will interrupt radiation, or subtract a sector from the sphere. F_r is approximately the ratio of the solid angle remaining in the obstructed sphere to the solid angle (4π steradians) of the complete sphere.

The fin should be shielded from bodies of higher temperature. Otherwise, the fin will be heated by

Table II—Significant Dimension L and Correction Factor F_1 for Convective Heat Transfer Coefficient h_c

Significant Dimension L		
Surface	Position	L
Rectangular Plane	vertical	height—max 2 ft
	horizontal	$\frac{\text{length} \times \text{width}}{\text{length} + \text{width}}$
Circular Plane	vertical	$\pi/4 \times$ diameter
Cylinder	horizontal	diameter
	vertical	height—max 2 ft
Correction Factor F_1		
Surface	Position	F_1
Horizontal Plate	facing upward	1.29
	facing downward	0.63
Cylinder	horizontal	0.82
	vertical	0.82 to 1

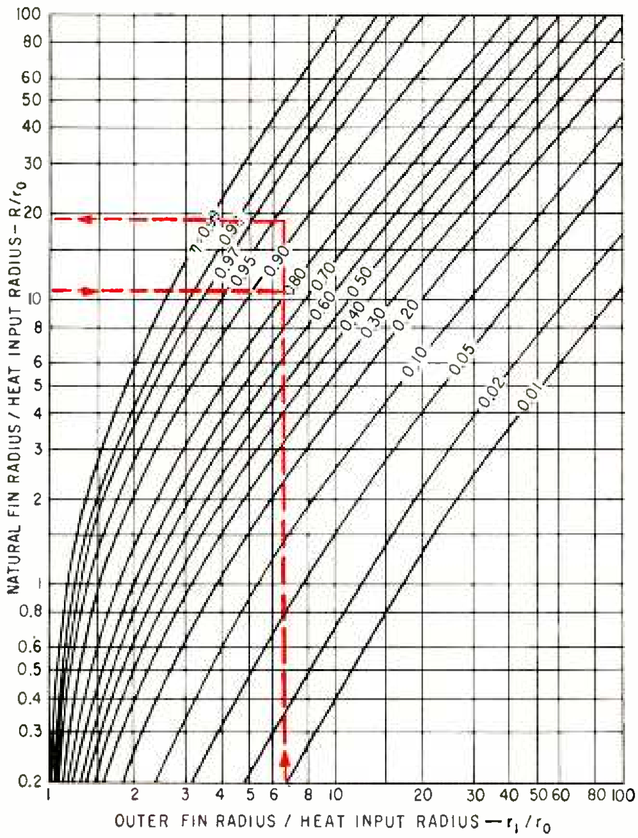


Fig. 8—Fin efficiency η as a function of R/r_0 and r_1r_0

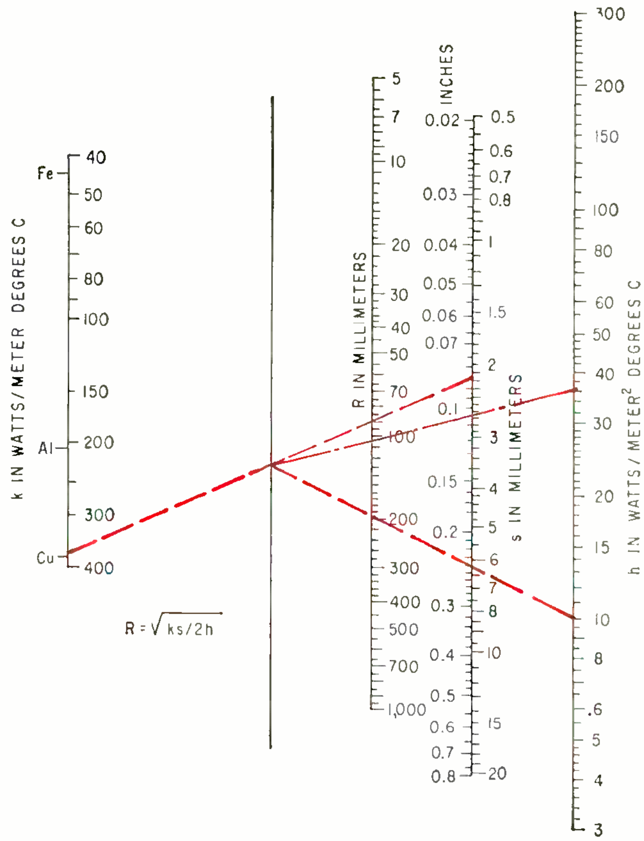


FIG. 9—Nomogram for obtaining fin thickness

EXAMPLE 1: Find fin size required to dissipate 35 w from a power diode, 1⅛-inch hexagonal base, ½-20 stud, cooled by free convection in air at sea level. $T_j = 190$ C; $T_a = 65$ C; $Z_c = 0.2$; $Z_i = 0.25$.

SOLUTION: $\Delta t_j = T_j - T_a = 190\text{-}65 = 125$C
$Z_t = \Delta t_j / Q = 125/35 = 3.57$°C/w
$Z_f = Z_t - Z_c - Z_i = 3.57 - 0.2 - 0.25 = 3.12$°C/w
assume $\Delta t_f = 125/2 = 62$
and $L = 5$ inches = 12.5 cm
For vertical fin $h_c = 6.1$ w/m²°C (Fig. 2)
$h_r = 11.3$ w/m²°C for $\epsilon = 1$ (Fig. 5)
assume $\epsilon = 0.9$ and $F_r = 0.39$
h_r is then (0.9) (0.39) (11.3) = 4 w/m²°C
$h = h_c + h_r = 6.1 + 4.0 = 10.1$ w/m²°C
Desired fin efficiency $\eta = 0.95$
$A = 334$ cm² = 51.7 in.² (Fig. 6)
corresponds to a 5.09 × 5.09-in. fin, close enough to the assumed L
$r_o = (1.125 + 0.515)/4 = 0.41$ in. = 10.5 mm
$r_1 = 5.09/2 = 2.55$ in.
$r_1/r_o = 2.55/0.41 = 6.22$ in.
$R/r_o = 19$ (Fig. 8)
$R = (19)(10.5) = 200$ mm
assume the fin to be of copper.
$s = 0.086$ in. (Fig. 9)
thus, a 5.1 × 5.1 × .086-inch vertical copper fin is required.

EXAMPLE 2: Find how much heat the diode and fin of Example 1 will dissipate if cooled by forced air at 1,000 linear feet per minute, other conditions equal.

SOLUTION: $h_c = 32$ w/m²°C (Fig. 4)
$h = h_c + h_r = 32 + 4 = 36$ w/m²°C
$R = 108$ mm (Fig. 9)
$R/r_o = 108/10.5 = 10.3$
$\eta = 0.83$ (Fig. 8)
$Z_f = 1.0$° C/w (Fig. 6)
$Z_t = Z_f + Z_c + Z_i = 1 + 0.2 + 0.25 = 1.45$°C/w
$Q = \Delta t_j / Z_t = 125/1.45 = 86$ watts n be dissipated from the diode.

radiation instead of being cooled.

FIN DIMENSIONS—When the desired fin efficiency is chosen, required fin area can be found with Fig. 6. Reasonable values of η, when fins are copper or aluminum, are 0.95 for free convection and 0.75 to 0.85 forced convection. Higher values of η make the fins too thick and uneconomical.

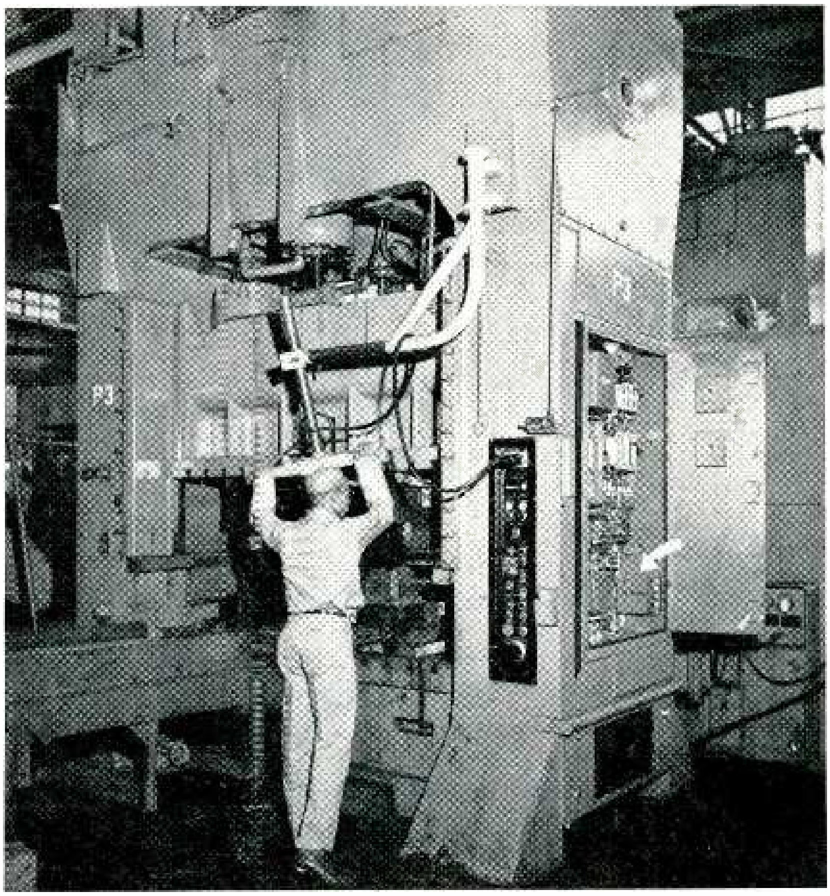
Fin dimensions are calculated from the area of the fin's two sides. Length of one side of a square fin, for example, is $L = \sqrt{A/2}$. The calculated dimension should compare satisfactorily with the value of L assumed while using Fig. 2.

FIN THICKNESS—Fin thickness is determined by the assumed efficiency η. The mathematical relationship between these quantities is complicated; however, fin thickness can be easily determined from Figs. 7, 8 and 9.

Fig. 7 defines r_o according to device mounting. It equals $D_h/4$ for a transistor without a stud and $(D_h + D_s)/4$ for a stud-mounted transistor or diode. Radius of the fin for circular fins is r_1. Rectangular fins with sides a and b have $r_1 = \sqrt{ab/\pi}$.

R is determined from Fig. 8. Fin thickness s is found in the equation $R = \sqrt{ks/2h}$ and Fig. 9.

EXAMPLES—The nomographs, curves and equations can be used equally well to determine the amount of heat a fin-mounted device can dissipate for a given temperature rise. Sample problem calculations are traced above, and by dashed lines on the figures.



Operator, who is standing before the work, makes an adjustment before starting a cycle. Doors at the right are open to show the power, latch, hold and supply units, which are in the lower right-hand corner of the enclosure (see arrow)

Static Switching Techniques For Machine-Tool Safety

Static switching control enables operator to work a machine press safely and reliably. Control circuits prevent the operator from being in the danger area

By S. A. ZARLENG, Development Engineer, Clark Controller Co., Cleveland, Ohio

PRESS SAFETY requires a high degree of reliability. An ordinary machine tool whose control malfunctions only once every six months doesn't represent a serious problem. However, if a press control permitted its descending ram to crush an operator's arm every six months the situation would be intolerable.

The basic cycle of the press consists of a working, or down, stroke of the ram and a return, or up, stroke. The down stroke is started by depressing the *run* pushbuttons. After the down stroke is completed, the operators must remove the workpiece, insert a new blank, and get their hands out of the way before another down stroke can safely begin. Therefore, the press control is arranged so that the press stops at the end of each cycle and cannot begin another cycle until the operators have signaled that they are ready by depressing the *run* pushbuttons again.

The most satisfactory way to make sure the operators' hands are not in the danger zone as the ram

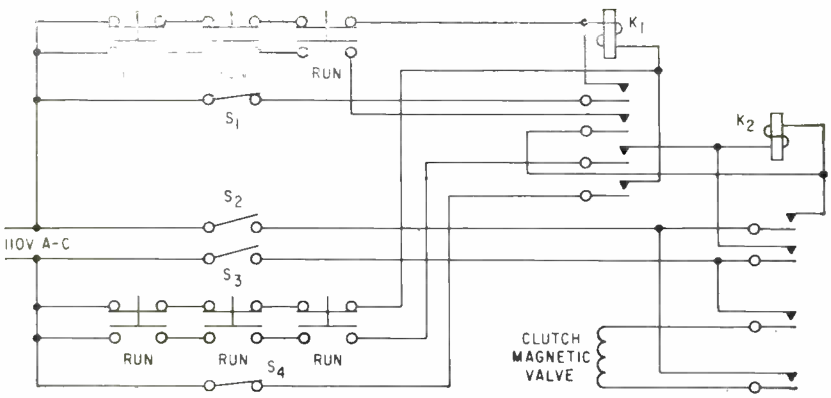


FIG. 1—Relay-circuit start conditions shown assume that 110 v is not present

descends is to make it necessary for them to be somewhere else. To do this, the circuit has two *run* pushbuttons for each operator and is arranged so that the ram cannot descend unless all *run* pushbuttons are depressed and held. After the downstroke is nearly completed,

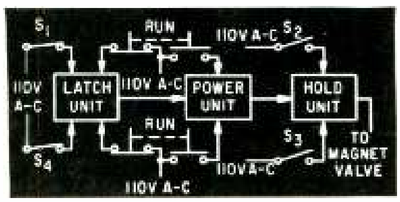


FIG. 2—When run pushbuttons are depressed, power unit energizes magnetic valve. Hold unit takes over from power unit later on

limit switches operated by the moving ram close, continuing the press cycle so that the operators can prepare for the next cycle.

Workmen often find such safety restrictions annoying. To remove the temptation for them to jam or tape one or more of the *run* pushbuttons closed, the control stops the press at the end of a cycle whether or not the *run* pushbuttons are depressed at this time. The pushbuttons must be released and depressed again before the press will begin a new cycle.

These are the basic requirements of an antirepeat control. Refinements such as provisions for inching, bypassing some of the *run* pushbuttons for some types of press, or protection against bypassing all of the *run* pushbuttons are incidental to the basic problem and will not be covered in this discussion.

Conventional Relay Control

Before discussing the static switching control, the relay control circuit shown in Fig. 1 will be described for comparison.

At the start of a cycle, limit switches S_1 and S_4 are closed and limit switches S_2 and S_3 are open. A circuit through the *run* pushbutton switches energizes control relay K_1. This circuit pulls in the normally open contacts of relay K_1, completing a circuit through S_1 and S_4 that will keep relay K_1 energized after the *run* switches are depressed.

Closing all *run* pushbuttons energizes relay K_2. When the contacts of K_2 close, the clutch magnetic valve is energized. This valve controls the air that actuates the press clutch and brake, and now makes the press begin a down stroke.

During most of the down stroke, the *run* pushbuttons must be held down or the contacts of relay K_2 will drop out and stop the press. Near the bottom of the stroke, however, switches S_2 and S_3 close. These switches complete another circuit to the valve so that now the *run* pushbuttons may be released without stopping the press.

During the up stroke, switches S_1 and S_4 open briefly. If, during this period, the *run* pushbuttons are still depressed, relay K_1 will be deenergized. Then, when switches S_2 and S_3 open at the top of the stroke, relay K_2 will be deenergized, stopping the press. To start another cycle the *run* pushbuttons will first have to be released to energize relay K_1 and then depressed to energize relay K_2.

Static-Devices Control

In the static switching control there are no elements that are exactly comparable to the relays in the relay control, so it is not possible to simply substitute a static device for each relay, and to utilize the same circuits. The three operational sections of the new control, *latch*, *power* and *hold*, are shown in Fig. 2.

Figure 3 shows the operating characteristic of the power unit, which is a magnetic amplifier. The characteristic of the hold-unit magnetic amplifier is shown in Fig. 4. This magnetic amplifier acts somewhat like a snap switch because it is self exciting.

Circuit Details

Figure 5 shows a simplified schematic of the static switching control. The secondary of transformer T_1 and diode rectifiers D_1 and D_2 comprise a center-tapped rectifier power supply. The center tap of the secondary winding is positive; the negative connection is at the center tap of the primary winding of current-transformer T_2. Power supply output is applied to the signal winding F_5-F_6 of the power unit through the emitter-collector circuit of transistor Q_1. Even though switches S_1 and S_4 are closed when the press is at its topmost position, no current flows in the power unit because transistor Q_1 has no base current.

Rectifier D_3 and transformer T_1

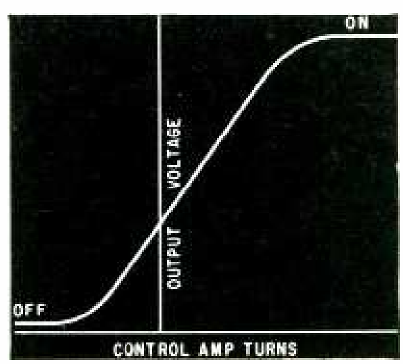


FIG. 3—Transfer characteristic of power-unit magnetic amplifier

constitute a half-wave rectifier supply which provides permanent excitation for winding F_3-F_4 of pulse-transformer T_3. Winding F_1-F_2 of transformer T_3 is excited with half-wave d-c through rectifier D_4 and the normally-closed contacts of the *run* pushbutton switches. Depressing the *run* pushbuttons breaks this circuit, suddenly reversing the flux in pulse transformer T_3. This flux reversal momentarily induces a voltage in winding F_5-F_6, swinging F_6 positive with respect to F_5. A small current now flows in the base of transistor Q_1 and switches on its collector current.

Collector current flows through winding F_5-F_6 of the power unit magnetic amplifier and through the primary winding of transformer T_2. Since this current flows alternately in each half of the winding of T_2, it induces a voltage in the secondary of T_2. Rectifiers D_5 and D_6 rectify this secondary voltage, which appears across the emitter-base of Q_1 as pulsating d-c. Thus transistor Q_1 acts like a closed switch that is kept closed by the feedback current from the secondary of transformer T_2.

Any interruption of the base current switches off transistor Q_1 because the feedback current stops when the collector current stops. Releasing the *run* pushbuttons energizes winding F_1-F_2 of pulse transformer T_3, inducing a voltage in winding F_5-F_6. This voltage is opposed to the feedback voltage and is large enough to stop all current flow in the base circuit of the transistor.

Suppose the operator were to tape the *run* pushbuttons in their depressed position. When switches S_1 and S_4 open briefly during the press up stroke, the latch unit would reset to the off state despite the locked pushbuttons. Before another cycle could be started, the *run* pushbuttons would have been released to energize winding F_1-F_2.

The power unit obtains a-c power from the 115-v line through the normally open contacts of the *run* pushbuttons. With the *run* pushbuttons depressed, the power unit supplies d-c power to the air valve magnet if the power unit also receives a signal from the latch unit. The power unit furnishes power to the valve as long as the *run* pushbuttons are depressed or until the latch unit is turned off during the up stroke by the opening of switches S_1 and S_4.

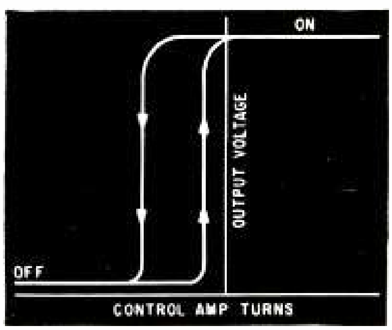


FIG. 4—Transfer characteristic of hold-unit magnetic amplifier

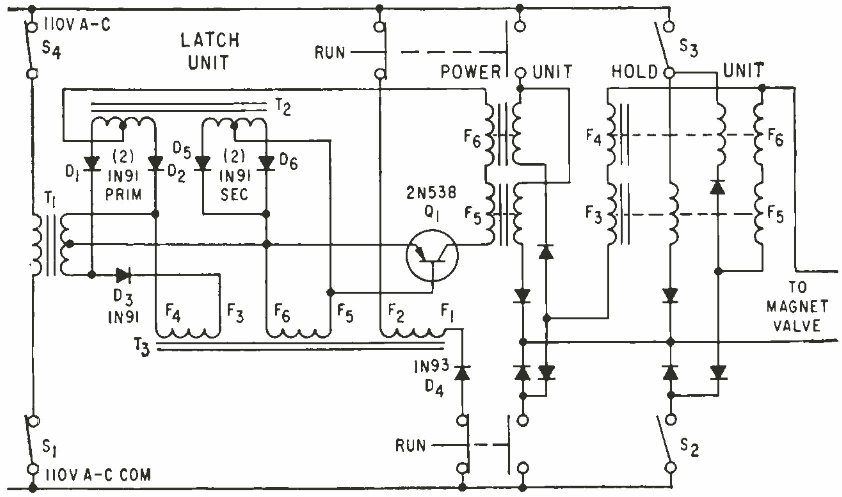


FIG. 5—Bias connections of static switching control are not shown. Control switches are in positions they occupy before start of cycle. Operators begin cycle by depressing both run pushbuttons

Valve Magnets

When the air valve magnets are energized by the power unit, the air valve current flows through winding F_3-F_4 in the hold unit. Thus, when the hold unit receives power from the line by the closing of switches S_2 and S_3 as the press nears the bottom of its stroke, the hold unit also furnishes power to the air-valve magnets.

When the *run* pushbuttons are released, the power unit shuts off and the hold unit supplies all power to the air valve. Although the hold unit output is not enough to pull the air valve magnet into its operated state, it is large enough to maintain magnet operation. Thus, the air valve cannot operate if the power unit should fail.

When the power unit shuts off, the hold unit remains on because the load current passes through winding F_5-F_6 in the hold unit. At the top of the press stroke all units are off and the press stops. Depressing the *run* pushbuttons begins a new cycle.

Performance

This press control is typical of a class of circuit designs which incorporate static devices. These designs are simplified by not requiring specialized power supplies.

Both sides of the power line are broken as an added precaution for press control, which must be safe. The control method of interrupting the power to the magnetic amplifiers does not hurt the amplifiers.

Speed of operation is comparable to that of relays in being primarily dependent on the line frequency. Typical operating time is one-half cycle. By proper component design, the effects of line voltage and frequency changes encountered in industrial service can be effectively eliminated.

Although this discussion speaks of the press stopping at the end of each cycle, it does not necessarily do so. On some presses with experienced operators and work that permits, it is possible to run the press continuously.

Designing High-Quality

Completely transistorized audio amplifier uses junction transistors to deliver 25 watts output power. Frequency response is within ±1 db between 20 and 25,000 cps with low harmonic and intermodulation distortion

By **ROBERT MINTON,** Semiconductor and Materials Division, Radio Corporation of America, Somerville, N. J.

THIS TRANSISTORIZED AUDIO AMPLIFIER was designed to investigate the feasibility of using junction transistors in a high-quality audio amplifier. The seven-stage amplifier can deliver 25 watts when driven by a variable reluctance cartridge. It has low harmonic and intermodulation distortion and good frequency response, and may be used at ambient temperatures up to 55 C. Table I lists the amplifier characteristics.

Preamplifier

The preamplifier shown in Fig. 1 uses four alloy junction transistors and was designed to accept a signal from a variable reluctance cartridge having an output of approximately 10 millivolts at 1,000 cps with an inductance of 0.52 henries and a d-c resistance of 600 ohms. The preamplifier provides a frequency-corrective network for RIAA recording characteristics, variable bass and treble compensation, volume control and loudness control.

The recording frequency corrective network is composed of R_1, C_1 and C_2 connected as a feedback network between the collector of Q_2 and the emitter of Q_1. The feedback causes the overall frequency response of the first two stages to be the inverse of the recording characteristics and raises the effective input impedance of the input stage so that at any frequency the input impedance is much higher than the impedance of the inductive pickup. As a result, the equalization circuit provides flat response independent of the source impedance.

The treble control circuit consists of R_2, R_3, R_4, C_3, and C_4 and provides approximately + 12-db boost and −17-db cut at the higher frequencies. The bass control circuit consists of R_5, R_6, C_5, C_6 and the input resistance of Q_3. This circuit provides approximately +15-db boost and −12-db cut at the lower frequencies.

Volume control R_7 is a current divider controlling the current fed to the loudness control and the input to Q_4. The loudness control circuit consists of R_8, R_9, R_{10}, C_7, C_8 and the input resistance of Q_4. Variable resistors R_8 and R_9 are ganged to form a dual control. The loudness control is a frequency selective current divider providing substantial boost to the low frequencies and slight boost to the higher frequencies while attenuating the mid-frequencies as the intensity level is decreased.

The power amplifier input stage Q_5 shown in Fig. 2 is a class-A, common-emitter power amplifier. Application of balanced negative feedback from the collectors of output stage Q_7 and Q_8 to the base and emitter of input stage Q_5 reduces the harmonic distortion and extends the overall frequency response of the power amplifier. The use of balanced feedback also effectively minimizes any residual hum appearing in the feedback loops because the voltages are opposite in phase and are cancelled.

Driver stage Q_6 operates class-A in a common-emitter circuit. The output is transformer-coupled to to the class-B output stage. The secondary of driver transformer T_1 is bifilar wound to provide tight coupling, thus minimizing transient voltages when the current shifts from the base of one output transistor to the base of the other. The source impedance to the input of the class-B output stage has a pronounced effect on the total harmonic distortion in the output stage. As

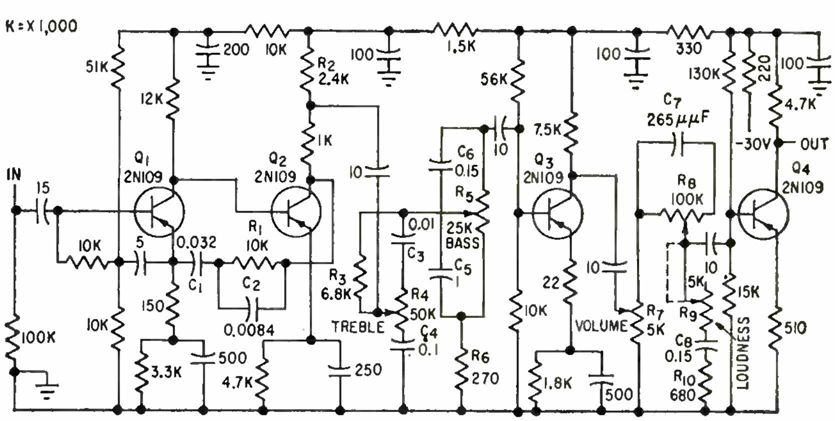


FIG. 1—Preamplifier accepts variable reluctance cartridge signal and contains bass, treble, volume and loudness controls. Four alloy junction transistors are used

A-F Transistor Amplifiers

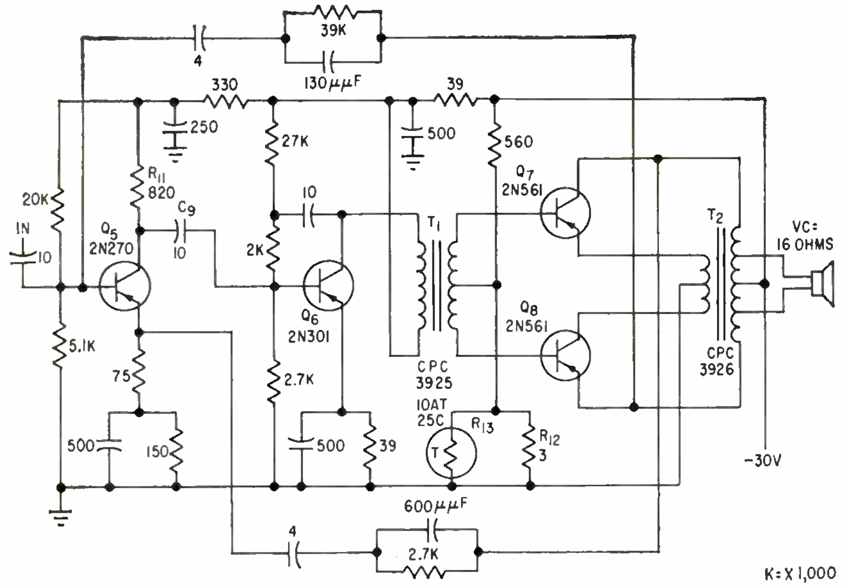


FIG. 2--Power amplifier uses balanced negative feedback and operates class-B. Output stage has emitter degeneration as further improvement

Table I—Amplifier Characteristics

Frequency Response	Within 1 db from 20 to 25,000 cps. 3 db down at 25-watt level
Power Output	25 watts
Harmonic Distortion	1.25 percent at 25 watts and 400 cps
Intermodulation Distortion	3.5 percent at 25 watts, 60/3,000 cps at 1:1
Hum Level	−75 db below 25-watt level
Maximum Ambient Temp.	55 C

the output impedance of the driver stage is too high, it is reduced by shunt feedback from the collector to the base. This also causes a reduction in the effective input impedance of the driving device and requires that the transistor used in the input stage operate as a power amplifier.

The power amplifier output stage consists of two pnp germanium alloy junction transistors operated in a class-B, push-pull circuit. Class-B operation is used because it provides maximum efficiency. The stage can be biased essentially at cutoff thus reducing standby power and minimizing zero-signal dissipation. A common-emitter type circuit provides the highest power gain but suffers from total harmonic distortion which is usually higher than acceptable; a common-collector circuit has lower distortion due to its inherent feedback but requires a considerable amount of driving power. The output stage used is a combination of both circuit types and has a power gain intermediate between the two.

Output transformer T_2 has a winding connected in the output stage emitter circuit to provide emitter degeneration and low harmonic distortion. Because the transformer d-c resistance is low, d-c power loss is minimized and higher operating efficiency results than would be obtained if resistors were inserted in the emitter circuit to provide the same amount of a-c degeneration. The output transformer has bifilar windings to reduce leakage inductance and winding capacitance. This method of winding provides nearly unity coupling between both halves of the windings reducing transient voltages.

Temperature stabilization of the output stage is provided by R_{12} and thermistor R_{13} in the bias circuit. The network provides a compensating shift in bias voltage with temperature variations which causes the d-c collector current to remain essentially constant.

The collector junctions of the power transistors in the driver and output stages are connected to the mounting flange and must be electrically insulated from the chassis which is at ground potential. At the same time, the mounting flange must make good thermal contact with the chassis. Mica insulating washers having a thickness of 0.002 in., are used to insulate the mounting flange electrically from the chassis. The mica washers have high thermal conductance and do not increase the total thermal resistance of the circuit appreciably.

Power Supply

The power supply consists of a transformer, two silicon diodes and a choke-input filter. The power supply should deliver 30 v d-c. The power transformer should deliver a maximum load current of 2 amps. Because the power supply works into a varying load impedance, a choke-input filter is used in conjunction with silicon diodes to provide good regulation. The choke has an inductance of 0.075 H at a current of 2 amps and a d-c resistance of approximately 1 ohm.

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Electronic Instruments in

Table outlines characteristics of radiation detection instruments, their use in reactors and their associated electronic equipment

NUCLEAR REACTOR instrumentation has two major functions: detecting and measuring radiation and controlling, measuring and indicating operation of the reactor's control rods.

Radiation particles may or may not carry an electrical charge, affecting choice of instruments. Detectors, their characteristics and associated equipment are outlined in Table I.

Ionization chambers, proportional counters and Geiger counters operate in fairly discrete voltage ranges. Best stability is obtained normally by operating each in mid-range. A Geiger counter, for example, has a plateau of 1,000 to 1,600 v. This plateau means the same output for a variation of 50 to 300 v in applied potential.

Circuit reliability and stability considerations require at least two safety channels on each reactor. Both must detect an event at the same time to avoid false shutdowns of the reactor.

Transistors and chopper-stabilized power supplies and amplifiers are expected to expand the use of electronics in reactor control. Pulse height analyzers and electronic data processing should find more use in the future for rapid, automatic programming and control. Ideally, controls will be all electronic with operating speed as fast as nuclear events and control time limited only by the inertia of the nuclear system.

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Table Footnotes

(a) Neutrons/cm^2/sec (b) Photons/sec (varies with scintillator, limits given based on 6.66 sq cm of NaI) (c) Operates on voltage plateau; range is for 50 cps to 50,000 cps (d) α—alpha, β—beta, γ—gamma

(e) Key for types of equipment; A—amplifiers; PHD—pulse height discriminators; PHA—pulse height analyzers (for analytical work unless otherwise specified); RR—register or recorder (all basic instruments also use mechanical, digital or decimal types); S—binary or decimal scaler (up to 10,000 cps); CRM—count rate meters

(f) Estimated for application and type of reactor. All instrumentation is not used on all reactors. Instrumentation costs for research and test reactors may be higher

(g) Reactor types: T—thermal including pressurized water, boiling water, heavy water, homogeneous, swimming pool, graphite and sodium graphite; I—intermediate, basically liquid metal cooled; F—fast, basically fast breeders

(h) Specialized instruments. Fundamental purpose is to look for fuel ruptures

Table I—Control, Survey and Coolant Monitoring

Instrument	Range	Response (sec)	Type of Radiation[d], Operating Principle
CONTROL INSTRUMENTS			
BF_3 Proportional Chamber	10^{-1} to 5×10^4 [a]	10^{-4}	Neutrons; gas amplification n, α reaction
Fission Chamber	5 to 5×10^6 [a]	10^{-5}	Neutrons; fission fragments
Compensated Ion Chamber	10^2 to 5×10^{10} [a]	10^{-5} to 10^{-6}	Neutrons; n, α reaction
Uncompensated Ion Chamber	10^6 to 5×10^{10} and up[a]	10^{-5} to 10^{-6}	Neutrons; n, α reaction
SURVEY INSTRUMENTS			
Scintillation Counter	10^{-4} to 10^4 [b]	10^{-4} to 10^{-9}	α, β, or γ; photo conversion to counts per minute
Geiger Counter	900 to 1,800v [c]	10^{-4} to 10^{-5}	β or γ; gas amplification nonlinear d-c pulses
Proportional Counter	100 to 700v potential	10^{-3} to 10^{-6}	α, β, γ; linear gas amplification d-c pulse
Ionization Chambers	100 to 350v potential	10^{-3} to 10^{-5}	α, γ; linear no gas amp d-c pulse
COOLANT MONITORS[h]			
Fission Product Water		10^{-3} to 10^{-5}	β, γ; ion exchange
Matrix Sampling System		10^{-3} to 10^{-6}	β, γ; fission product leakage
Precipitation Fission Product		10^{-3} to 10^{-5}	β, γ
Delayed Neutron Emitter		10^{-4}	Neutrons

Nuclear Power Reactors

By HAROLD SOISSON, Knolls Atomic Power Laboratory, Schenectady, N. Y. (Operated for the Atomic Energy Commission by the General Electric Company)

Instruments for Nuclear Power Reactors

Associated Equipment*	Number Used Per Reactor and Position Where Used	Approx. Cost/ $1,000	Applications: Reactor Types°; Advantages and Disadvantages
A—d-c, preamp, nonoverload; PHD—1 for α and Li pulses; S; RR; CRM—linear; PHA	1 or 2, startup; reactor compartment startup channel	3–5 + PHA up to 10	Reactors-TIF: good in low flux region for use with sources, saturates at high flux levels
A—preamp, nonoverload, d-c, linear, period; PHD—1/chan; PHA; RR-log count; S; CRM—log	1, period meas and control; health monitor log ct rate chan safety circuits	3–5	Reactors-TIF: sensitive to γ non-compensated, good at intermediate flux, sat at high flux
A—preamp, magnetic, d-c, log N, sigma, period, servo; PHD—1: PHA; RR—log N, period; S; CRM—log	1, period meas; 1, rod control; log N period chan, linear flux chan, safety	4–10 per chan	Reactors-TIF; compensated for γ in the intermediate power region
A—nonoverload, d-c, log, preamp, sigma, servo; PHD—1; PHA; RR; S; CRM—log	1, power meas; 2 or more, safety opn; power and safety chan, safety rods	2–5 per chan	Reactors-TIF; operates in high flux region, not compensated for γ background
A—d-c; PHD—can use 1; PHA; RR; S; CRM—linear	Optional; analytical area, control room, health physics	1–5	Survey or analytical use; uses photomultiplier, light tight and stable d-c power required
A—d-c; PHA—none; RR; S; CRM—linear	Optional; analytical area, control room, reactor area, survey	0.15 to 1	Survey; nonlinear, no discrimination of radiation energy
A—d-c, preamp; PHD, for α, β, γ; PHA—to establish energy spectrum; RR; S; CRM—linear	1 or more, control room monitor; analyt area, health physics	0.15 to 1.2	Survey; delicate, very low output signals require preamp and amplifiers
A—preamp, d-c; PHD—for α particles; PHA—to establish energy spectrum; RR; S; CRM—linear	1 or more, materials handling; analytical area, health physics, control room	0.5–5	Survey surface contamination, air exhaust, personnel safety; particles must be in chamber for α, γ sensitive chamber to monitor rupture
A—linear preamp and amp; RR; S; CRM—linear	1 each circulating loop; heat exchanger area—condensate line	3–5	Reactor-water types with clean coolants; detects activation and fission products
A—2 preamp, 2 d-c; PHD—1; PHA—1; RR; CRM—2 linear, 1 difference	1–12 or more; in coolant stream matrix	6–10	Reactor-water or gas cooled; no alarm for 1 malfunction of instrument, rupture actuates 2
A—d-c; PHD—1; RR—54 channel; CRM—linear	1 or more; in coolant stream from sample tubes	3–6	Reactor-gas cooled; high sensitivity discriminates against non-fission product activity
A—preamp, d-c; RR; CRM—linear	1 or more; in coolant stream		Reator-gas or water cooled; high sensitivity for fission products, can be put in coolant pipe

Column Loudspeakers for

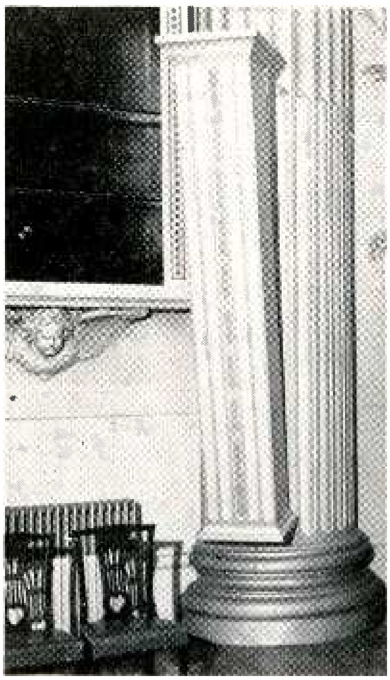
Using slot-radiator principle, column loudspeakers have wide-angle coverage in horizontal plane and narrow-angle coverage in vertical plane to produce best sound distribution in large areas where intelligibility may be masked by reverberation

By **M. L. GAYFORD,** Standard Telephones and Cables Limited, London, England

INTELLIGIBILITY OF SPEECH or enjoyment of music in many halls and public places is often lowered by the masking effect of background noise and blurring from excessive reverberation and discrete echoes which often characterize large audience enclosures. In halls where listeners are confined to particular areas, column loudspeakers have been used with great effect due to their directional properties.

To obtain the most effective sound distribution with minimum amplifier power and the greatest margin over acoustic feedback, loudspeakers should have a preferred type of directional response. This response should be restricted to an angle of ±15 to 20 degrees on each side of the loudspeaker axis in the vertical plane, and substantially unidirectional within an angle of ±60 degrees in the horizontal plane.

Loudspeaker enclosures that approximate the ideal radiating system with constant directivity over the important parts of the audio range have been designed using acoustic phase shift at one side of the enclosure. This phase shift is introduced by an acoustic network at the rear of the enclosure resulting in a unidirectional or cordioid polar response similar to the phase shift of unidirectional microphones. The acoustic phase shift method forms the basis of a column loudspeaker enclosure design which produces a response much more directional in the vertical plane than in the horizontal plane.



Column loudspeaker designed to blend into design of surrounding area

Practical Design

A practical column speaker system consists of a vertical row of horns or direct-radiating loudspeaker units. The finite width of the radiating surfaces causes the high-frequency polar response to become directional in the horizontal plane. This defect can be largely overcome by the use of horns which are narrow in the horizontal direction and by the use of the slot radiator principle. A narrow vertical slot is used instead of the full circular opening in front of the loudspeaker cone, thus maintaining a broad polar response in the horizontal plane because of the small width of the virtual sound source.

Restriction of the sound opening must be made with care to avoid any deterioration in the loudspeaker frequency or transient response. This can occur because the slot acting in conjunction with the enclosed air cavity between it and the loudspeaker cone constitutes a Helmholtz resonator whose general properties and damping must be carefully investigated.

Satisfactory results can be obtained if the slot proportions are carefully chosen and the enclosed air volume minimized by the use of loudspeakers with shallow angles or elliptical cones mounted with their major axes vertical. Figure 1 shows some axial response curves of a loudspeaker unit with and without a slotted front. The slot generally modifies the frequency response curve by causing a slight loss up to 1 kc and a larger loss over the region from 1.5 to 7 kc, flattening that portion of the curve.

The construction of a typical slotted-column loudspeaker is shown in Fig. 2. Elliptical shallow-angle cone moving-coil loudspeaker units are mounted as closely as possible one above the other behind a series

Public Address Systems

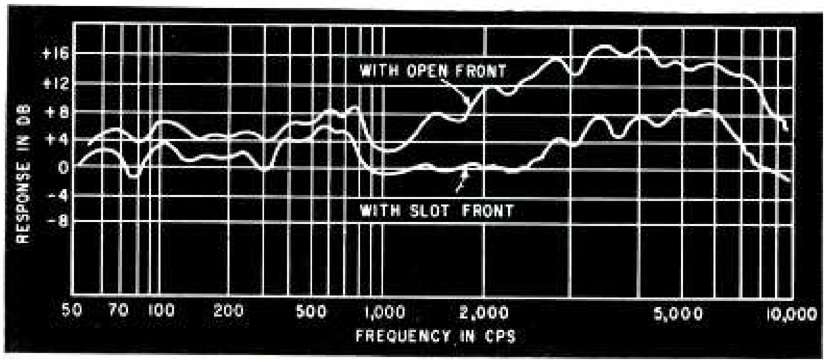


FIG. 1—Frequency response of a moving coil 10-in. cone loudspeaker with conventional open front and with 1½-in. wide slotted front

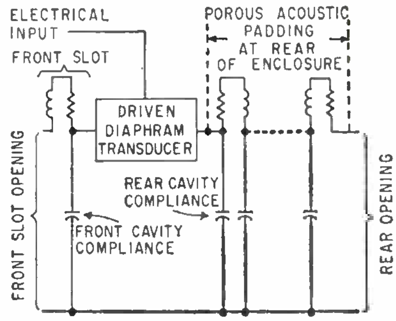


FIG. 3—Approximate electrical analogy circuit representing phase shift of elements of a slotted column loudspeaker at low frequencies

of vertical slots in the 5-ft high cabinet. The slots are approximately 1½-in. wide in the horizontal dimension. The rear of the cabinet is vented to the outside by a slab of porous acoustic material. This material is acoustically coupled to the loudspeaker units through the air volume within the cabinet. Such an ararngement transmits a sound wave with a phase shift due to the acoustic elements represented by the back coupling volume and an equivalent series acoustic resistance

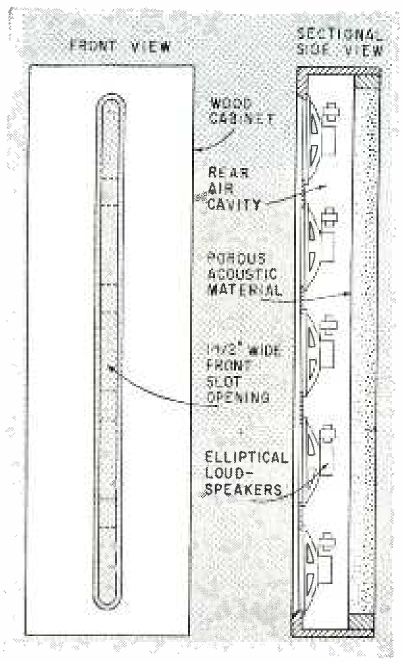


FIG. 2—A typical slotted column loudspeaker showing construction details

mainly encountered in the porous acoustic material.

Additional phase shift occurs as the wave travels through the porous acoustic material because of the constrictions and voids encountered. This is analogous to a low-pass LRC ladder network. If the constants are chosen correctly, the wave appearing at the back of the loudspeaker cabinet will have a phase shift proportional to frequency and of identical magnitude to that of the wave from the front of the cabinet in the course of propagation around the bulk of the cabinet. The net effect is to produce a cancellation of the sound pressure at the rear of the cabinet thus suppressing rearward radiations.

This effect operates over the low frequency range up to approximately 200 cps. Above this frequency, sound diffraction effects around the cabinet bulk begin to confine the frontal radiation to the front spatial hemisphere. Rear radiation through the porous acoustic material is progressively cut off due to the low-pass filter effect of the phase-shifting network. Figure 3 shows an approximate electrical network equivalent for the loudspeaker system.

Figure 4 shows the vertical and horizontal polar curves for a typical column loudspeaker. A fair approximation of the desired slab-shaped solid angle radiation pattern has been achieved.

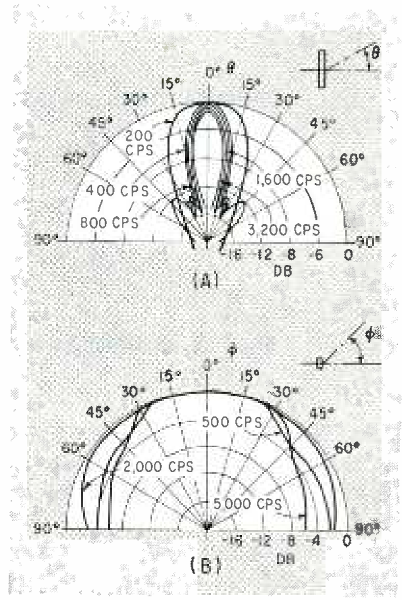


FIG. 4—Polar responses of a typical column loudspeaker in the vertical plane (A), and in the horizontal plane (B)

It is not possible to totally suppress side lobes and rearward radiation completely, but radiation in these unwanted directions is sufficiently low as to be impossible to detect in practical use.

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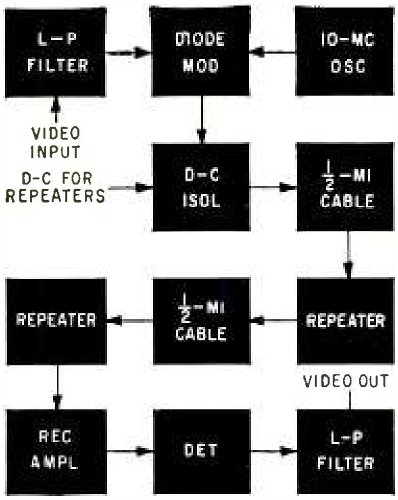


FIG. 1—Basic transmission system

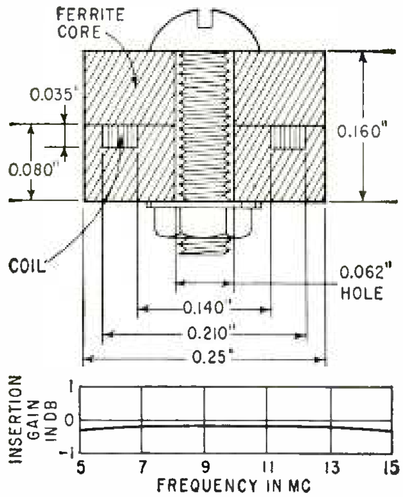


FIG. 2—Transformer and response

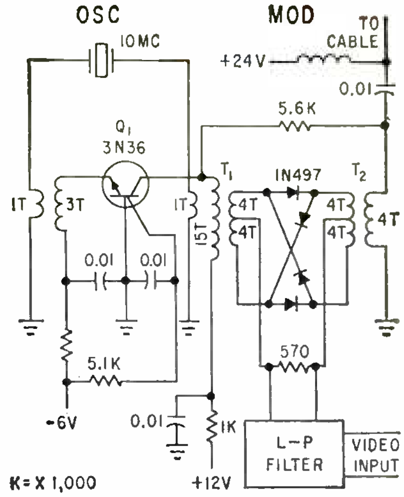


FIG. 3—Transmitting terminal

Carrier Transmission for

Simple and inexpensive coaxial-cable transmission system passes high-quality television signal with 4.5-mc bandwidth. Transistorized terminal and repeater circuits minimize space and power requirements. Unusual power supply sends d-c repeater power through signal cable

By L. G. SCHIMPF, Bell Telephone Laboratories, Murray Hill, N. J.

INEXPENSIVE TV TRANSMISSION SYSTEMS for 4.5-mc bandwidth high-quality signals would be useful in closed-circuit television where one common pickup is used to transmit a picture to one or more viewers.

In such service the transmission links are usually short (up to several miles) and it is seldom necessary to connect a number of systems in tandem. With these limitations, a system has been designed to meet the bandwidth and picture-quality requirements without meeting the exacting requirements of each link in a transcontinental transmission system.

To save power and keep the apparatus small, terminals and repeaters were transistorized. A double-sideband carrier system was used even though it requires about twice the bandwidth of the other coaxial-cable transmission systems. Transmitting twice the bandwidth results in a less complicated system since the terminal equipment for the double sideband system is simple.

System Considerations

A 10-mc carrier frequency was selected as a compromise between the various factors in favor of a higher or a lower frequency. The system is blocked out as shown in Fig. 1.

Carrier frequency is generated by a crystal-controlled transistor oscillator; the output is modulated by the video signal in a semiconductor modulator. Before being fed to the cable, the modulated signal passes through a d-c isolation circuit that permits d-c power to be fed to the repeaters through the cable.

After passing through a length of cable, the signal is amplified by a transistorized repeater, which has a gain characteristic designed to match the loss characteristic of the cable. Since the output level from a repeater is too low for good linear detection, an amplifier is used in the receiving terminal between the last repeater and the detector. A low-pass filter removes the carrier from the video output.

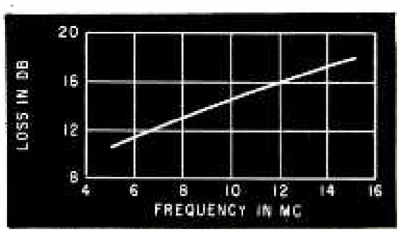


FIG. 4—Transmission characteristic of 0.5-mi cable

Transformers

The transformers are of unusual design. Their size and general method of construction are indicated in Fig. 2. The two sections of the ferrite core are held together

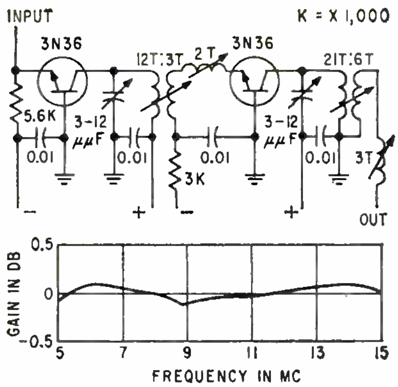
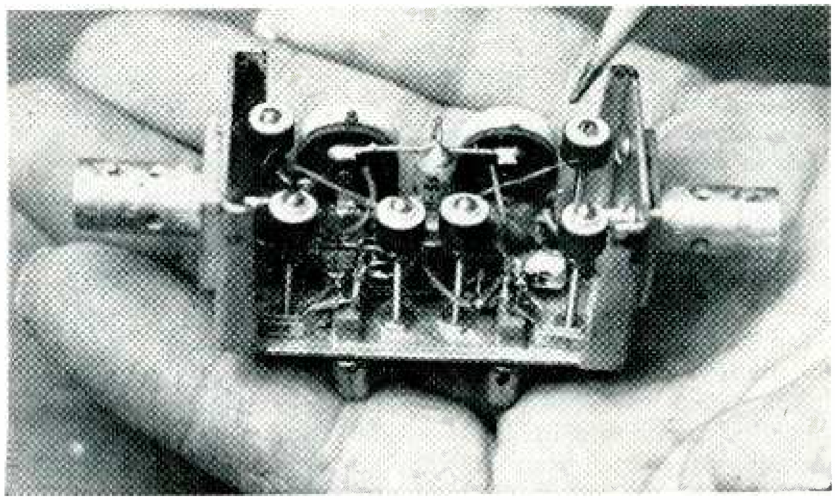


FIG. 5—Repeater and response



Closeup of terminal repeater amplifier shows ferrite core transformers

Closed-Circuit Television

by a No. 0-80 machine screw, which also serves as the transformer mounting.

Some of the coils employed in the repeaters are adjustable. In these cases the same general construction is used, but a slot is milled in each half of the core.

The transformer is assembled so the faces with the slots are together. With this arrangement, the effective length of the air gap can be varied as one half the core is rotated with respect to the other to change the inductance.

The transmission characteristic of one of these transformers operating between 75-ohm impedance levels is also shown in Fig. 2; the loss is only a few tenths of a db and the characteristic is flat to within 0.1 db from 5 to 15 mc.

Transmitting Terminal

The crystal-controlled transistor oscillator for the 10-mc carrier is shown in Fig. 3. An experimental junction tetrode transistor, with an alpha cutoff of about 30 mc, was employed in a common-base connection; A 3N36 tetrode transistor should be a suitable commercial substitution, though undoubtedly a conventional triode transistor with a similar alpha cutoff would be satisfactory also.

Neither of the two miniature transformers, about ¼-in. dia., is tuned. Output transformer T_1 couples the high impedance of the collector into the relatively low impedance of the modulator.

A third winding on T_1 couples the collector circuit to a low-impedance feedback circuit, which is best traced by starting with the transistor emitter. At an emitter current of 1 to 1.5 ma, input impedance of Q_1 is 50 to 75 ohms. This impedance is stepped down by a 9:1 impedance ratio in the transformer connected to the emitter. At series resonance, the impedance of the crystal is 8 to 10 ohms,

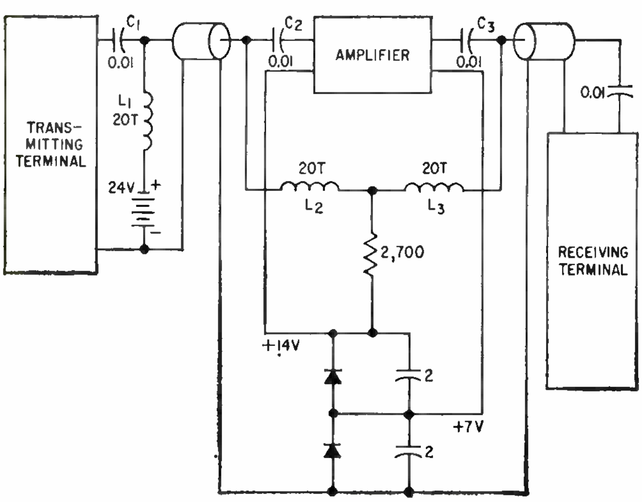


FIG. 6—Repeater d-c power supply

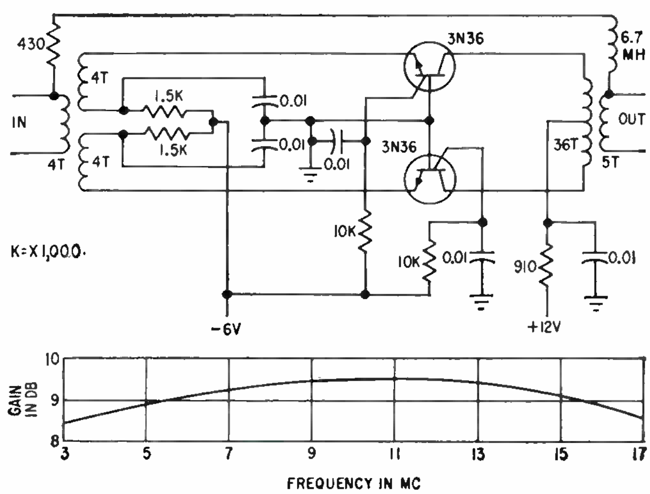


FIG. 7—Receiving amplifier and response

causing the feedback path to have a low impedance; thus sufficient power is fed back from the output to set up oscillations.

Operation at the fundamental mode of the crystal takes place for several reasons. At higher frequencies, the gain of the transistor decreases. Also, the losses in the transformer increase with frequency and the impedance of the crystal at series resonance increases for the higher modes.

The circuit has shown no tendency to operate at harmonic frequencies of the crystal. Power output is of the order of a few milliwatts.

Diode Modulator

Four gold-bonded diodes are employed in the modulator, which is also shown in Fig. 3.

The signal levels are adjusted to give a peak modulation of about 70 percent and polarization of the video signal is such that the peak signal occurs during the synchronizing pulses. The peak level at the output of the modulator is about 4 db below 1 mw.

The diodes used in this modulator are characterized by low capacitance, short storage time and a fairly high ratio of back-to-forward impedance. Ideally, a switch with zero impedance in the forward direction, infinite impedance in the reverse direction and an operate time that is short compared to 10 mc is desired. The IN497 diode approaches these characteristics.

Use of a balanced modulator eliminates a number of unwanted sidebands from the output. Since the carrier is also eliminated, it is necessary to introduce it into the output for double-sideband operation. This is done by connecting the collector circuit of the oscillator to the output through a 5,600-ohm resistor.

Low-frequency video signals cannot be transmitted to the line because of the low-frequency cut-off characteristic of T_2. This is a desirable effect. Any high-frequency video signal that appears on the line will be attenuated because the repeaters are not equalized to amplify these frequencies.

Design of a repeater for a system of this kind depends on the loss characteristics of the cable employed. A $\frac{3}{16}$-in. dia. coaxial cable using partially blown-up polystyrene was used; transmission characteristics are shown in Fig. 4 for 0.5 mile of cable.

The experimental two-stage amplifier shown in Fig. 5 was designed to have a gain characteristic to match that of the cable loss. The Tetrode transistors used are shown in simplified form.

Referring to Fig. 4, a gain of about 18 db is required at 15 mc for 0.5-mile repeater spacing. As the amplifier has a gain capability in excess of this value, mismatching is employed at the input to the

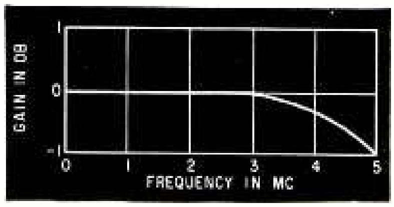


FIG. 8—Response of 1-mile system

first transistor and between stages to stabilize the gain. This stabilization technique was chosen instead of negative feedback, because of its simplicity.

Six variable circuit elements in each repeater, make it possible to match the transmission loss of a section of cable closely, as well as to compensate for variations between transistors. Measurements on one repeater with a half mile of cable are also shown in Fig. 5.

Spacing between repeaters is not limited to 0.5 mile. With two repeaters connected in tandem and one-mile spacing, circuit noise was not sufficient to be a problem. Since the repeaters are small and fed with d-c power over the cable, they could be placed at locations other than manholes; this might make closer spacing of units having less gain and fewer components economically feasible.

D-C Power Supply

The d-c power supply system is shown in simplified form in Fig. 6. At the transmitting terminal, blocking capacitor C_1 isolates the d-c from the terminal equipment. Coil L_1 in series with the 24-v battery prevents shorting of the signal.

The center conductor of the cable is held at +24 v, which is isolated from the amplifier circuit by two blocking capacitors C_2 and C_3. Coils L_2 and L_3 prevent shunting of the signal through the d-c supply circuit.

Since the amplifier employs tetrode transistors, both a positive and a negative voltage are available from the bias source. Two 7-v avalanche diodes in series serve as voltage regulators.

If a number of repeaters, connected as shown, were employed in a system, they would all be in parallel and the cable voltage would be 24 v regardless of their number. Total line current is 5 ma times the number of repeaters used.

Receiving Terminal

To make up for the last section of cable, a repeater is used as the first element of the receiving terminal. Linear detection requires that a certain minimum amplitude of signal, greater than that provided by the repeater, be maintained. Therefore, the repeater is followed by an amplifier which increases the level by about 10 db.

This experimental amplifier and its response are shown in Fig. 7. Selective negative feedback improves the transmission characteristic.

The output of the amplifier is rectified by a full-wave circuit and passed through a low-pass filter to remove the 10-mc carrier frequency. If desired, this video output can then be amplified to a standard output level.

Results

A 1-mile experimental system has been set up for demonstration purposes. On an A-B test, no degradation could be detected by most observers when a standard television signal was transmitted over the system. This would indicate that a system several miles long could be employed without undue degradation. The video-frequency response of this one mile of system is shown in Fig. 8.

The author is indebted to R. L. Wallace, Jr. for many helpful suggestions. The transistor repeaters were designed by J. G. Linvill, who is at present a member of the staff of Stanford University.

Intermetallic Rectifiers

An examination of certain properties of intermetallic compounds currently considered as having rectification possibilities

By G. B. KICH, Physicist, Fansteel Metallurgical Corp., North Chicago, Ill.

THE POSSIBILITY of making commercial rectifiers from the intermetallic compounds of Groups III-V of the periodic table has been recognized since Welker showed, in 1952, that aluminum antimonide and indium antimonide were semiconductors.

Of the nine usually discussed III-V compounds, indium arsenide and indium antimonide have poor temperature and low blocking characteristics while gallium antimonide should approximate germanium. Gallium phosphide, aluminum phosphide and aluminum arsenide have higher forward voltages than silicon; however, their melting points, higher than silicon, indicate fabrication problems. The remaining three compounds, indium phosphide, gallium arsenide and aluminum antimonide seem to have a theoretical potential better than silicon.

The compounds of interest as rectifiers have not been purified to the degree necessary to realize their theoretical potential. Information available to date on III-V compound rectifiers is presented below.

Table I—Typical Characteristics of Developmental III-V Compound Rectifiers

Group III-V Compound	Type	DC Characteristics: Forward Current	Forward Volts	Temp (°C)	Reverse Current	Reverse Volts	Remarks	References
Ga Sb	grown junction	160 ma	1	25	40 ma	5	Saturation-poor	D. P. Detwiler, Electrical Properties of Ga Sb, *Phys. Rev.* *97*, p 1.575 Mar. 15, 1955.
In P	diffused junction	1.4 ma	3	25	0.1 ma	3		K. Weiser, Decomposition Method for Producing *p-n* Junctions in In P, *J. Appl. Phys.* *29*, p 229 Feb. 1958.
	point contact					400 250	*p*-type *n*-type Rectif ratio = 10^5 at 100 v	W. N. Reynolds, M. T. Lilburne, R. M. Dell, Some Properties of Semi-conducting In P, *Proc. Phys. Soc.*, *71*, p 416 Mar. 1, 1958.
Al Sb	growh junction	$\frac{500 \text{ ma}}{\text{cm}^2}$	2	25	<300 μa	>30	With suitable heat treatment and surface treatment	H. A. Schell, Single Crystal and *p-n* Layer Crystals from Al Sb, *Z. Metallk.*, *49*, p 140 1958.
	grown junction	1 ma 1 ma 1 ma	1 0.4 0.3	25 110 148	1 ma 1 ma 1 ma	18 12 8.5	Units failed above 200 C	A. Herczog, R. R. Haberecht, A. E. Middleton, Research on Al Sb for Semiconductor Devices, PB 131849, Mar. 1958.
	point contact	1 ma 1 ma 1 ma	2.0 1.0 0.6	25 110 250	1 ma 1 ma 1 ma	26 20 10 85	Low resistivity AlSb used, so high blocking voltages not expected; all failed above 250 C. Lead solder used. W point contact 0.007 in. diam	
Ga As	point contact	40 ma 40 ma	1 0.9	24 170	<1 μa 1 μa	1.5 1.5	Microwave diode.*	D. A. Jenny, A Ga-As Microwave Diode, *Proc. IRE*, *46*, p 717 Apr. 1958.

* For these pilot plant runs 1N21 type ceramic cartridge cases used. Spreading resistance ≈ 9 ohms. Ga As diodes more resistant to burnout than Si or Ge. Point contacts of Be-copper or phosphor-bronze. Switching times less than 10^{-9} sec. At 6,000 mc conversion loss is 4.8 db, noise temperature ratio is 1.25 and i-f inpedance is 420 ohms

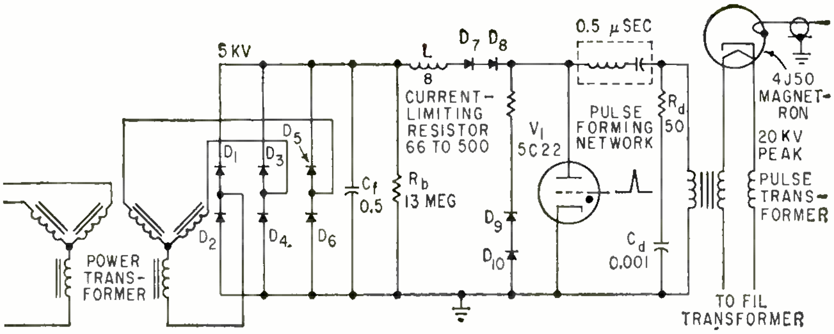


FIG. 1—Radar modulator uses ten silicon diodes to replace five vacuum tubes

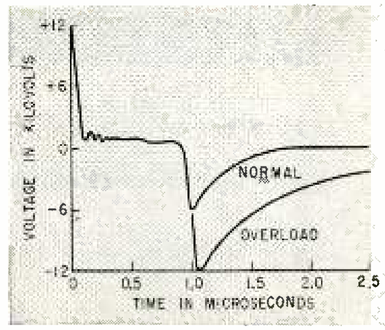


FIG. 2—Thyratron plate voltage

Using Silicon Diodes

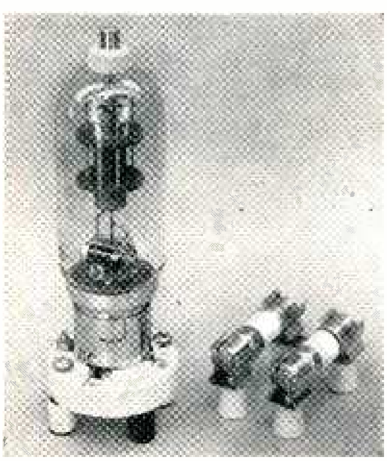
ADVANTAGES of using silicon diodes to replace vacuum tubes in radar modulators include a decrease in size, weight and cooling requirements and an increase in reliability and serviceability. An artificial line-type modulator for an airborne radar operating at a peak power of 250 kw is shown in Fig. 1. This modulator uses silicon diodes as high voltage rectifiers, a hold-off diode and an inverse diode.

Modulator

The high voltage power supply consists of the power transformer, rectifiers D_1 to D_6, filter capacitor C_f and bleeder resistor R_b. Direct-current resonant charging is accomplished with choke L and the capacitance in the pulse-forming network. Rectifiers D_7 and D_8 function as hold off diodes when operation at several pulse repetition frequencies is required. The pulse-forming network line discharges through the thyratron switch and the load.

A despiking network, P_d and C_d, eliminates the overshoot on the leading edge of the pulse applied to the magnetron. The current-limiting resistor and D_9 and D_{10} clip the inverse voltage reflected on the pulse-forming network when there is a mismatch between the network and its load.

The ten diodes (D_1 to D_{10}) replace five vacuum tubes normally used. Each set of two diodes replaces one vacuum tube. Each diode consists of a series string of diode cells rated at 150 ma d-c at 150 C. The cells are mounted in a cartridge 2.5 inches long and ⅝ inch in diameter. The cartridge peak inverse voltage rating is 7 kv. The PIV for each cell varies from 400 to 600 v.



Silicon diodes and mountings require less than one-half volume of 577 diode

Silicon Clipper

The application of silicon diodes as rectifiers and hold-off diodes is fairly conventional. The inverse diode or clipper application is unique in that peak currents, voltages and instantaneous power dissipation in the silicon cartridges are extremely high. This application requires the silicon units to pass high surge currents and to recover from its peak inverse voltage to the maximum value of the forward surge current in a fraction of a microsecond. Figure 2 shows the voltage pulse across the thyratron for the circuit shown in Fig. 1. Zero time on the curve is referenced to the point in time at which the thyratron begins to fire.

It is desirable to remove the negative spike, which according to tests[1], cleans up the hydrogen gas in less than 0.1 microsecond and, while doing so, causes a sizeable positive ion current to be drawn to the anode. The inverse voltage which follows the initial 0.1-micro-

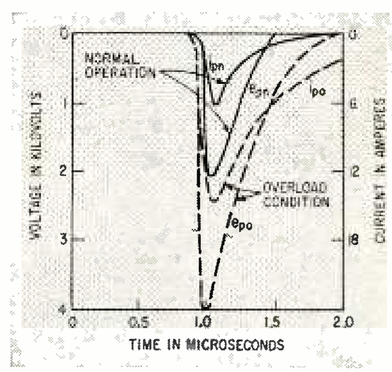


FIG. 3—Voltage and current relationships across clipper diodes

Table I—Diode Design Data

CLR in ohms	66	124	232
Normal i_p in a	30	22	14
Overload i_p in a	103	76	43
Normal e_{p1} in v	1,350	1,400	1,400
Overload e_{p1} in v	3,035	2,300	2,100
Normal e_c in v	97	100	100
Overload e_c in v	218	164	150

i_p is peak diode current
e_{p1} is peak voltage across each diode
e_c is peak voltage per diode unit
CLR is current-limiting resistor

Radar modulator with peak power of 250 kw uses silicon diodes to replace vacuum tubes. Diode clipper handles extremely high peak voltages and currents without damage. Far-end-of-line clipping proves superior to front-end-of-line clipping

By **MELVIN G. GRAY,** Air Arm Division, Westinghouse Electric Corp., Baltimore, Md.

In Radar Modulators

second spike must be removed so that the pulse-forming network will be charged to its proper value during the next cycle. If large enough, this inverse voltage can cause damage to the plate.

The voltage and current pulses imposed on the clipper circuit (silicon diodes only) are shown in Fig. 3 for normal operation and for an overload condition, which occurs when the magnetron arcs.

Current Delay

The type of diode cells used in the modulator has had surge currents of as much as 100 amperes for 400 microseconds applied to it during tests by the manufacturer. The one-shot surge applied in these tests has been a low-frequency pulse having a relatively long rise time. Because of the long rise time of the voltage pulse, the current is able to follow the voltage, and only a few volts drop across each cell of the diode results.

In the application of these cells in the circuit of Fig. 1, the rise time is just a few tenths of a microsecond, and an inherent current delay in solid state silicon becomes apparent. This initial delay in the rise of current does not allow for clipping of the initial inverse voltage spike which can cause damage to the hydrogen thyratron.[1, 2]

To alleviate this situation, it is necessary to remove some inductance from the pulse-forming network and connect it directly to the plate of the thyratron. When the current through the thyratron reverses or begins to fall, the voltage across this inductance, $e = -L\, di/dt$, changes its sign and goes negative. This causes the silicon clipper to conduct before the end of the pulse. Consequently, the carriers in the solid state silicon get started before seeing the inverse spike.

Figure 4 shows the voltage and current pulses which are applied to the silicon units of Fig. 1 when an 8-μh inductance is inserted in the plate circuit of the thyratron. Here the current-limiting resistor equals 232 ohms. These curves show that the amplitudes of the voltage spikes across the diodes are reduced by about three-quarters when the 8-μh inductance is inserted in the plate of the thyratron. The instantaneous power dissipation represented by these voltages and current pulses is shown in Fig. 5 and the instantaneous impedance in Fig. 6.

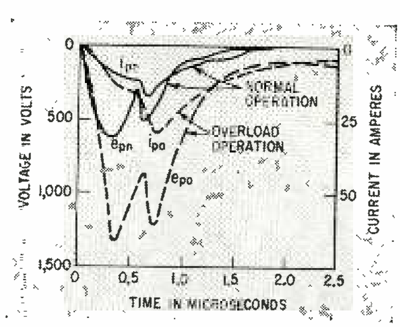


FIG. 4—Voltage and current with inductance in thyratron plate circuit

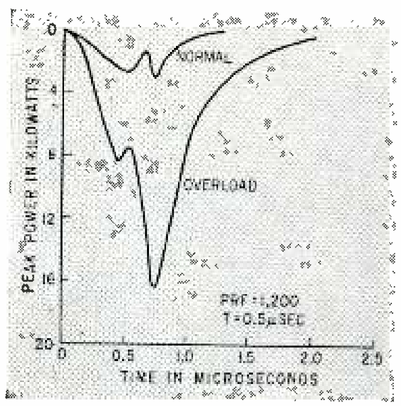


FIG. 5—Peak power across clipper diodes

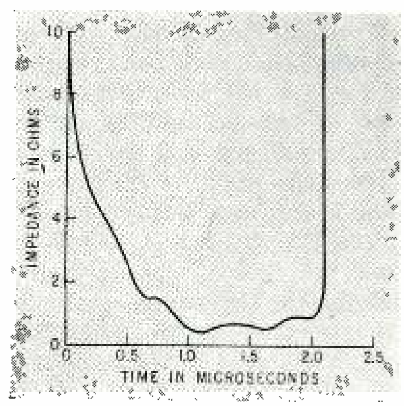


FIG. 6—Impedance for each diode junction

Far-End-of-Line Clipping

It has been determined[3] that the optimum location of a clipper in a line-type pulse modulator is at the far end of the artificial transmission line and that the optimum type of clipper is a matched impedance pretriggered gas clipper. To compare far-end-of-line with front-end-

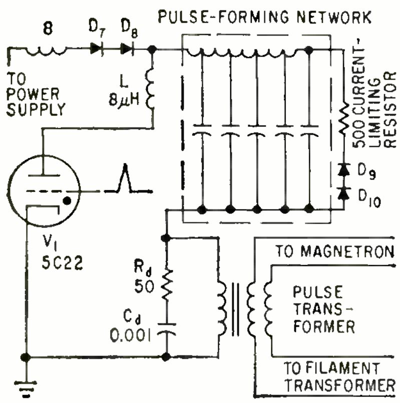


FIG. 7—Clipper is shown in optimum location at far end of line

of-line clipping and the results of clipping with a gas tube and silicon diodes, silicon diodes were used in the far-end-of-line clipping arrangement shown in Fig. 7.

The only significant difference between this circuit and the circuit of Fig. 1 is the relocation of rectifiers D_9 and D_{10} and the current-limiting resistor. The inductance L in the plate circuit of the thyratron is no longer used to pretrigger the silicon clippers but is required to limit the rate of rise of current through the thyratron.

Figure 8 shows the inverse voltage at the input to the pulse-forming network for front-end and far-end-of-line clipping for pulse widths of 0.5 and 2 microsecond. The silicon diodes conduct early in both cases, thus alleviating the current-delay problem of solid-state silicon.

Neither arrangement removes the inverse spike as well as the corresponding arrangement using a pretriggered gas clipper. However, the increased power dissipation resulting from the inverse spike on the thyratron plate when silicon is used is less than the power required to operate the filaments of a gas clipper. In this particular application, the use of a gas clipper in preference to silicon diodes is not justified.

Design Limit Data

Since the data required for the design of these silicon diode units into high-voltage and high-current pulse circuits were not available, it was necessary for reliability to obtain design limit data. Using the original circuit where all of the inductance is in the pulse-forming network and connecting the clipper to the thyratron plate (Fig. 1), large voltage spikes were imposed on the silicon units. To determine the limit value of voltage which would break down the cells in the forward direction, a 0.25-microsecond pulse-forming network was used to replace the 0.5-microsecond network and the value of the current limiting resistance was lowered in steps from 850 ohms to 66 ohms. When lowering the resistance it was necessary to reduce the pulse repetition frequency from 1,200 to about 300 so as not to exceed the 2-w power rating of the silicon cartridges. Table I shows the peak values of diode current and voltage obtained for several values of current-limiting resistance. Figure 9 shows peak values of current for several values of resistance.

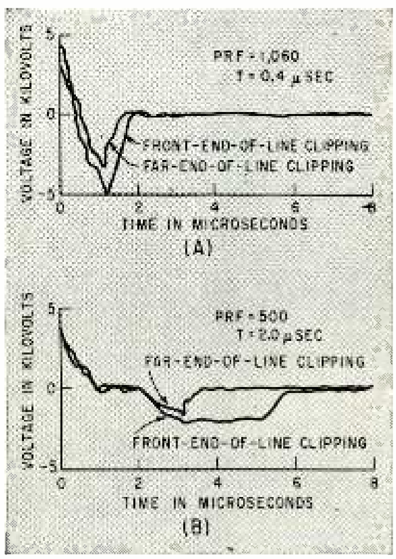


FIG. 8—Inverse voltage at pulse-forming network for 0.4-μsec network (A) and 2-μsec network (B)

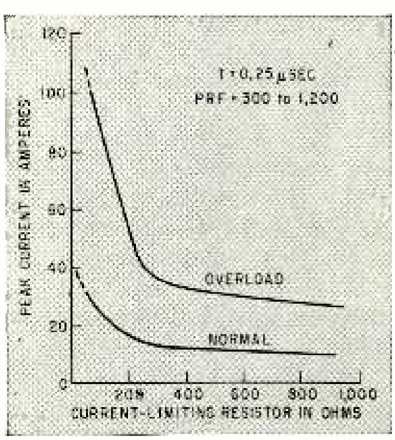


FIG. 9—Effect on diode peak current of varying value of current-limiting resistor

The tests were discontinued with the value of 66 ohms for the resistor. This condition represents the following instantaneous peak power dissipation for a single 2-watt cartridge for normal peak operating conditions:

$$e_p \times i_p = 1{,}350 \times 30 \approx 40{,}000 \text{ watts}$$

For peak power under overload conditions:

$$e_p \times i_p = 3{,}035 \times 103 \approx 313{,}000 \text{ watts}$$

The only explanation for the silicon junctions' ability to handle this amount of instantaneous power seems to lie in the thermal time constant of the cell junction.

Conclusions

Great savings in space and weight are made by using silicon diodes. Two silicon diodes and their mounting assemblies require less than one-half the volume of a 577 diode plus its mounting assembly. The filament transformer, now required only for the hydrogen thyratron, is reduced to about one-third its former size and about one-half its former weight.

The diodes should have high reliability since there are no filaments to burn out and there is ample safety factor in the circuit design. It is expected that the diodes will be superior to vacuum tubes in withstanding shock and vibration. Field servicing will be simplified, since extra heater connections are not required and the diode units are replaceable in the same manner as fuses. Because of less filament power dissipation, the modulator will run cooler, improving the reliability of other components in its housing.

Although life tests have not yet been completed, these preliminary results are encouraging and point to an advance in the state of the art for both solid state electronics and high power-radar modulators.

References

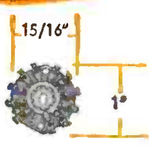
(1) S. Martin, Some Factors Involved in Breakdown Conduction and Recovery of the Hydrogen Thyratron, E. G. & G., Inc., Jan. 1953.

(2) N. S. Nicholls, Heat Dissipation in Pulse Modulator Thyratrons, papers presented at Fifth Symposium on Hydrogen Thyratrons & Modulators at Ft. Monmouth, N. J., May 1958.

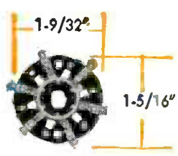
(3) Chatham Electronics, Inc., Research Study and Development of Clipper Tube Gas Filled, Signal Corps Contract No. DA-36-039 SC64621, Project 313B.

Widest Option in Low-Power Rotary Switches

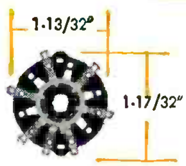
SECTIONS



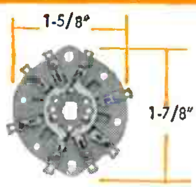
THROW: 30°, 36°, 45°
INSULATION: stator glass silicone; rotor, KEL-F



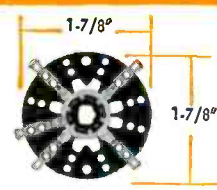
THROW: 30°, 45°, 60°, 90°
INSULATION: phenolic, Mycalex, ceramic



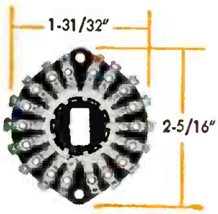
THROW: 25.7°, 30°, 36°, 45°, 60°
INSULATION: phenolic, ceramic



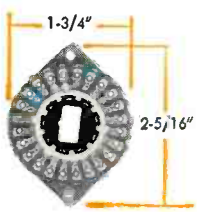
THROW: 18°, 20°, 30°, 36°, 45°, 60°, 90°
INSULATION: phenolic, Mycalex, ceramic



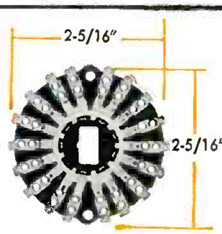
THROW: 30°, 36°, 45°, 60°, 90°
INSULATION: phenolic, Mycalex, ceramic



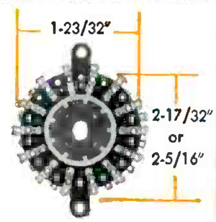
THROW: 20°, 40°
INSULATION: phenolic



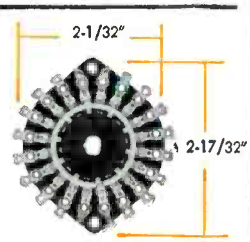
THROW: 15°, 30°
INSULATION: phenolic



THROW: 20°, 40°
INSULATION: phenolic, Mycalex



THROW: 12.85°, 25.7°
INSULATION: phenolic



THROW: 12.85°, 18°, 25.7°, 36°
INSULATION: phenolic

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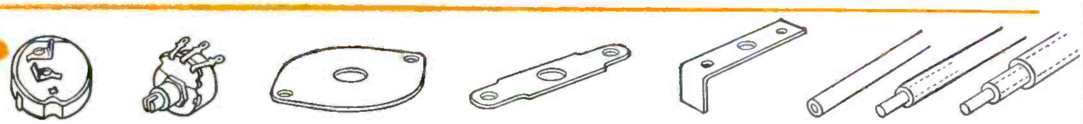

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One-Transistor "Push-Pull"

Output circuit uses single transistor to approximate push-pull class-B audio output. Variable bias is derived from audio output. Unusual circuit configuration eliminates need for input transformer.

By **JOSEPH A. WORCESTER,** Radio Receiver Department, General Electric Co., Utica, New York

OPERATIONAL advantages of an audio push-pull class-B output stage are achieved by using a single transistor in a sliding class-A output circuit. Battery drain and power output of the sliding class-A circuit approximate the values obtained from the push-pull output. In addition to the cost reduction resulting from elimination of one transistor, a further saving is obtained by elimination of the input transformer normally used. Figure 1 shows the basic class-B output system.

Circuit Description

The circuit used to replace the class-B output is shown in Fig. 2. Starting with a conventional class-A stage, the fixed bias is lowered until the collector current is reduced to quiescent proportions. A variable opening bias derived from the output audio signal is then added to achieve essentially class-B operation.

Quiescent current conditions are established by the resistors R_1 and R_2. The primary and secondary of the output transformer T_1 are stacked to provide maximum a-c voltage for bias production. This a-c voltage is applied through C_1 to germanium diode D_1. The rectified a-c is filtered by C_2 and the resulting negative d-c is used to open up the transistor in accordance with the syllabic content of the output signal.

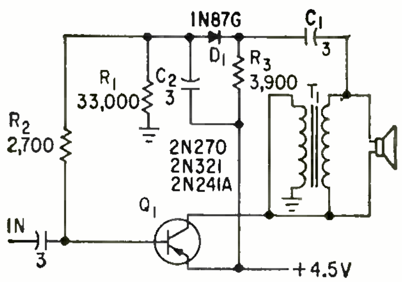

FIG. 2—Sliding class-A output has one transistor and no input transformer

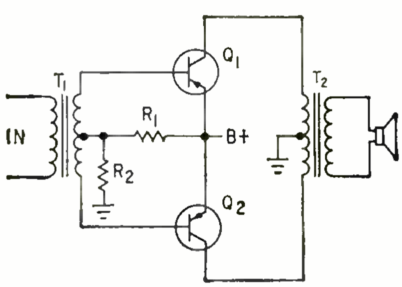

FIG. 1—Conventional push-pull class-B output uses two transistors

Proper operation of this circuit requires some attention to design details. The first few cycles of a syllable which produces the opening bias are clipped to some extent as the transistor is still operating under quiescent conditions. Distortion from this cause is not troublesome if the time constant of the diode output circuit, R_2C_2, is made just large enough to prevent feedback of low frequency audio signals. So that the bias circuit operates without observable delay from a syllabic standpoint, this time constant should not be much longer than required.

The diode is biased so that it starts to conduct just before the maximum undistorted output permitted by quiescent current alone is approached. If the diode operates later than this, distortion results. If it opens substantially sooner, the transistor is open more than required to handle the audio signal, causing excessive battery drain.

Diode bias is obtained by dividing the total resistance used to provide transistor quiescent current between R_1 and R_2. If R_1 is made relatively smaller and R_2 increased, the anode of the diode will be moved closer to ground potential and the cut-off bias will be increased since the diode emitter returns to B+ through R_3.

Biasing Resistance

Distribution of the quiescent biasing resistance between R_1 and R_2 is an initial circuit design consideration and, once determined, further adjustment or selection is not necessary to account for variations in transistors and diodes. Such is not the case for resistor R_3. By varying R_3 it is possible to regulate the percentage of the total control voltage developed by the diode that is utilized to open the transistor. The larger this resistor is made, the smaller the potential applied to the transistor. This adjustment is important since the gain of production transistors varies over such wide limits. For a low limit transistor, the a-c voltage in the collector circuit will be low and nearly all the developed control potential may be required to provide sufficient opening bias. This would necessitate a low value of R_3.

On the other hand, very high gain units will produce control bias greatly in excess of requirements and R_3 will have to be increased substantially. In practice values of R_3 are selected to provide the proper battery drain at a maximum output distortion of 10 percent.

The writer acknowledges the importance of the contributions made toward the practical use of this circuit by R. L. Miller.

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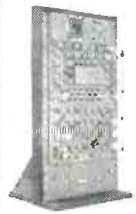

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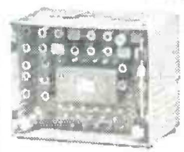
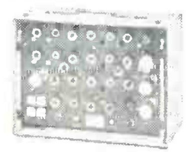
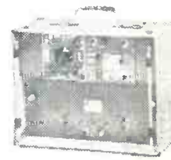


490W1 Waveform generator. Generates keying signals for the 72 different wipes.



490S1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.



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Frequency Standard Uses Transistors

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One problem of constructing highly accurate crystal units is that leads and metal plating interfere with what would otherwise be free, unrestrained vibration of the crystal. Bell solved this problem by preparing a polished, lens-like crystal with a dense plating of pure gold, and by attaching the leads to the thin outer edge. Crystal vibrations are concentrated toward the center of the lens, and the leads have relatively little effect.

The crystal unit is glass enclosed. By itself, the unit has a maximum temperature coefficient of only about 0.5 part/million/deg C. With the inductor and thermistor in Fig. 1, the temperature coefficient has been reduced about one tenth.

Individual crystals vary in their temperature coefficient from the maximum negative coefficient of 0.5 part/million/deg C to a maximum positive coefficient of the same amount. During fabrication, the coefficient of each crystal is measured and the appropriate series reactance is chosen. For a negative coefficient, the reactance is inductive; for a positive coefficient, it is capacitive.

The thermistor is of the negative-coefficient type. With proper choice of values, the network produces the desired stability over a useful temperature range.

Change of frequency with supply voltage is quite small, and since the oscillator is operated only a minute or two for each measurement, long battery life is expected. Change in oscillator frequency with load is also small. If the load is resistive and is within 5 percent of 75 ohms, the change will be less than one part in ten million.

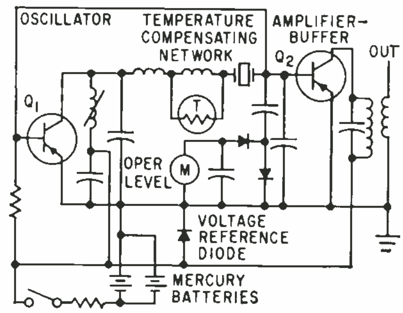


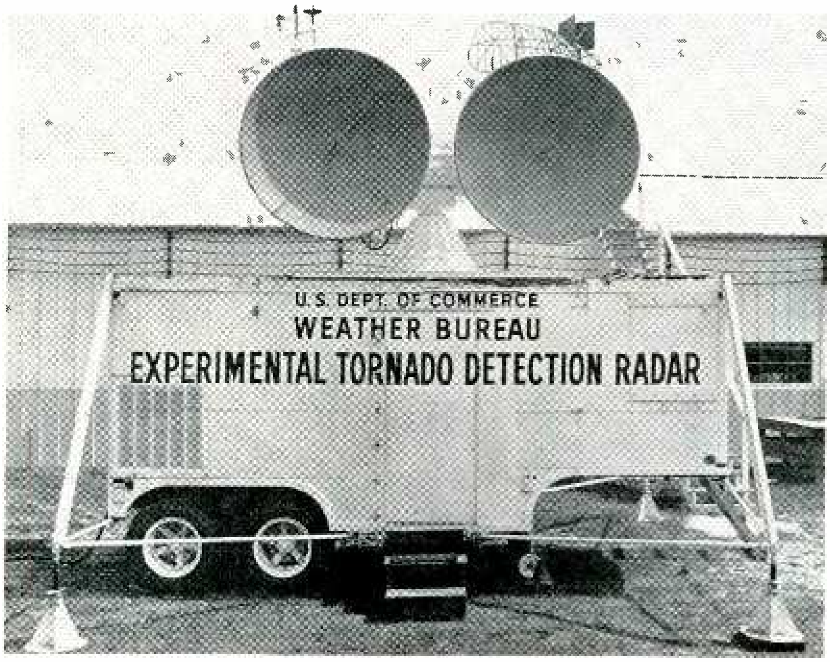
FIG. 1—Portable frequency standard provides accuracy of one part/million and can operate at frequencies from 5 to 50 mc

Transistor Q_2 amplifies the signal and isolates the oscillator from the output load. The output circuit delivers about 2 mw into 75 ohms.

Two 5-volt mercury batteries in parallel supply power, and the voltage reference diode stabilizes the input voltage to a nominal 4.5 volts.

This material was abstracted from the May 1959 Bell Laboratories Record.

Doppler Radar Detects Tornadoes



Weather Bureau at Wichita Falls, Texas, tests experimental Doppler radar by Radiation, Inc. Project, in existence for three years, detected a tornado 23 miles away last year. Modifications are being made to increase receiver sensitivity and reduce transmitter noise

Microwaves to Power Sky Platform

DEVELOPMENT of saucer-like platforms stationed miles above the earth for long periods of time are planned by Raytheon. Power to keep the flying stations aloft will be provided by microwaves. The microwave energy would be beamed skyward from powerful transmitters on the earth. It would be converted into heat energy aboard the platforms.

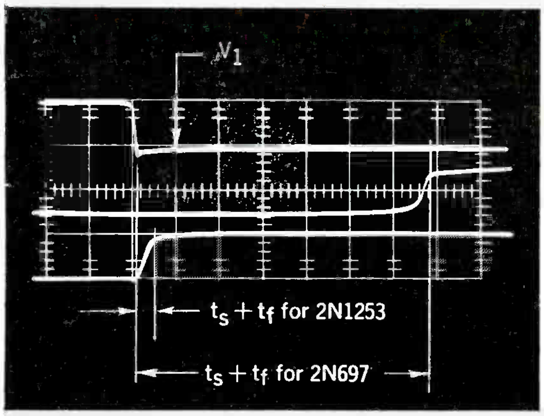
Operation

The sky stations would hover in fixed positions with the help of helicopter-type rotary wings. Microwave energy would be collected by antenna arrays and transformed into heat energy for conversion into mechanical power to drive the rotor.

The platform will be designed to propel itself to its sky position and descend again to earth with energy supplied by a lightweight supplementary chemical power plant. This plant could also provide emergency

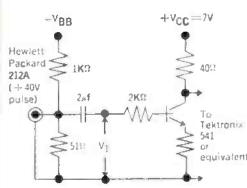
New from Fairchild

LOW STORAGE SILICON TRANSISTORS



Comparison of storage-and-fall-time performance between the new Fairchild 2N1253 and Fairchild's 2N697. The 2N1253 has performance otherwise equivalent to the 2N697 plus the additional advantage of low storage. An actual Polaroid photo is shown. Scale is 0.2μsec. per oscilloscope division. Scope was a Tektronix 543 with 53/54S plug-in giving a rise time of 15mμ sec.

CIRCUIT USED IN COMPARING 2N697 AND 2N1253



NOTE:

V_{BB} is adjusted to make $V_1=30V$ during turn-on and $V_1=-10V$ during turn-off.

TENTATIVE SPECIFICATIONS, 2N1252 AND 2N1253

ABSOLUTE MAXIMUM RATINGS (25°C)

V_{CER}	–	Collector to Emitter Voltage ($R \leq 10\,\Omega$)	20 v
V_{CBO}	–	Collector to Base Voltage	30 v
V_{EBO}	–	Emitter to Base Voltage	5 v
Total Dissipation	at Case Temperature 25° C		2 watts
	at Case Temperature 100° C		1 watt
	at 25° C Free-Air Ambient		0.6 watts

ELECTRICAL CHARACTERISTICS (25°C)

SYMBOL	CHARACTERISTIC	MIN.	TYPICAL	MAX.	TEST CONDITIONS	
h_{FE}	D.C. pulse current gain 2N1252	15		45	$I_C=150mA$	$V_C=10V$
	current gain 2N1253	30		90		
V_{BE} SAT.	Base saturation voltage		1.0V	1.3	$I_C=150mA$	$I_B=15mA$
V_{CE} SAT.	Collector saturation voltage		0.8V	1.5V	$I_C=150mA$	$I_B=15mA$
h_{fe}	Small signal current gain at f=20mc	2.5	5.0		$I_C=50mA$	$V_C=10V$
C_{ob}	Collector capacitance		30μμf	45μμf	$I_E=0mA$	$V_C=10V$
I_{CBO}	Collector cutoff current		0.1μA	10μA	$V_C=20V$	T = 25° C
			100μA	600μA	$V_C=20V$	T = 150° C
$t_s + t_f$	Turn-off time		75mμs	150mμs	$I_C=150mA$	$I_{B1}=15mA$
						$I_{B2}=5mA$
					$R_L=40\Omega$, 10ms pulse	

Fairchild's 2N1252 and 2N1253 provide the guaranteed shorter total switching time necessary for direct-coupled transistor logic circuits (DCTL) *in combination with the inherent reliability and power dissipation that silicon mesa construction affords.*

75 mμseconds is typical storage-plus-fall time at 150 ma collector current on these new devices; 150 mμs. is guaranteed. For low level operation, typical storage time is 35 mμs. for $I_C=I_{B1}=I_{B2}=10$ ma. This performance makes them usable for saturating type logic circuits and high-current-level saturating switching circuits. A few of the many applications are magnetic core drivers, drum and tape write drivers, high-current pulse generators and clock amplifiers. They also provide extra safety factor in less critical applications.

To achieve high reliability, these transistors are preaged at 300° C, a temperature that would destroy most other types. This preaging time at 300° C accomplishes a stabilization of characteristics equivalent to thousands of hours of operation at junction temperatures as high as 175° C.

For full information, write Dept. A-6.

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Insulation for Space-Age Circuitry

A NEW APPROACH to insulation could provide the answers to some electronics problems in missile re-entry guidance systems, as well as other more earthbound high-temperature applications. These flexible, non-porous coatings should be satisfactory almost up to the melting point of the conductor.

Fluoride Dielectrics

The new insulation method, developed at Bell Labs by S. S. Flaschen and P. D. Garn, is formed right on the surface of freshly-cleaned aluminum, copper or any other metal by exposing it to oxidizing carriers of fluorine, such as hydrogen fluoride or elemental fluorine at temperatures from 300 to 600 C. This coating provides exceptionally high insulation values at elevated temperatures while retaining flexibility and freedom from porosity.

The thickness of the resulting copper fluoride and aluminum fluoride films depends on the temperatures at which they are formed, the concentration of fluorine and the time of exposure. Aluminum forms a fluoride film one-micron thick in a few minutes at 550 C. These films remain adherent even when bent repeatedly at 90-deg. angles.

A strip of metal, coated with a fluoride film, is inspected by S. S. Flaschen (left) and P. D. Garn of Bell Labs, who developed an insulating technique that may solve problems in space electronics.

Insulation Values

Electrical insulation values are very high for both copper and aluminum films, being in the order of 10^{10} and 10^{11} ohms at room temperature for films one to two-microns thick, between probe electrodes $\frac{1}{4}$-in. in dia. Aluminum fluoride films exhibit resistances of about 7×10^{8} ohms at temperatures as high as 500 C.

The aluminum-fluoride films show excellent resistance to oxidation even above 600 C. They also show no tendency to hydrate or dissolve on exposure to high humidity. The insulation does not break down even at 450 v at 500 C.

The technique is not limited to copper and aluminum, according to its inventors, but can be used to form thin, flexible films on any other metal as well.

Fluoride dielectrics may be an answer to space problems.

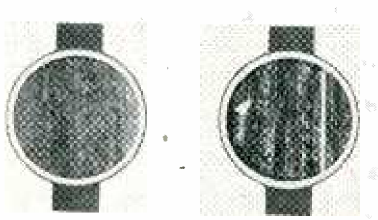
Computer Tape Solves Signal Drop-Outs

OXIDE RUB-OFF on recording heads, one of the big problems in data processing, has virtually disappeared at computer installations that have converted their Datafile bins to a plastic-coated tape manufactured by Minnesota Mining and Manufacturing Co.

The plastic-coated sandwich tapes use the same oxide coating, but this coating is protected by a 50 micro-inch layer which prevents the iron oxide from contacting any part of the recording system. In conventional tape, the oxide coating gradually wears off during the rigorous workouts imposed on it by computers. Powdered oxide, collecting on the recording heads or on the surface of the tape itself, results in signal drop-outs.

Signal attenuation, due to the protective layer on the plastic-coated tape, does not significantly alter the tape's performance. There is no loss in resolution up to 500 pulses per inch.

One company recently compared the sandwich tape with the bare, or conventional tape in a search-write, search-read test. A 30-inch portion of each tape was run past recording heads of a tape transport. The bare tape made its first error on its 1,049th pass, while the sandwich tape continued for 12,030 passes before erring by picking up a bit.



A B

These photomicrographs show parts of sandwich tape (A) and conventional tape (B) magnified about 40 times. Run through a computer 4,000 times, A shows little wear and B is completely worn out

High-Temperature High-Energy Resistors

RESISTORS capable of reliable operation at temperatures up to 1,000 F have been delivered to development laboratories from Carborundum's Globar Plant in Niagara Falls, N. Y.

Developed to meet the increasing demands for high-temperature components in electronic circuitry, the resistors are being evaluated for applications and other areas requiring stability at high temperatures. Of primary importance are electri-

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For example, a .0001″ lead error is magnified to .050″ or .100″ on the screen. Measurements are made direct on the machine's micrometer, with ease and repeatability.

Other demanding applications, such as the extremely precise measurement of critical spacing between the valve ports and the piston lands of hydraulic valves, are also performed with this new amplifier.

The dependability of this attachment was demonstrated in a series of tests conducted on a special application by J & L engineers. Among other things, it was proved beyond doubt that a group of Jo blocks can be measured within .000025″. Furthermore, these readings were easily repeated, even by different operators.

The speed, precision, flexibility and dependability of Jones & Lamson Comparators might well make a big difference in *your* operations. Write for Catalog 5700, Jones & Lamson Machine Company, 539 Clinton Street, Springfield, Vermont.

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cal circuits used to control the flow of fuel and the firing of advanced-design missile systems, and the control systems that must be operable in sections of military aircraft where there can be no cooling.

Missile applications include the encapsulating of a power resistor with other components within an oil-filled case where the ceramic resistor is employed as a fault current limiting device. In instances where other types failed during a 640-kw fault, a $1\frac{1}{4}$ x $\frac{5}{16}$ x 5-watt resistor of the high-temperature, high-energy type withstands this 640-kw fault for 50 μsecs.

Fiber and Plastic

A special temperature-resistant material, a Duroid developed by Rogers Corp., of Rogers, Conn., is credited with an important part in the recovery of the Thor-Able nose cone. It is employed in the missiles communications systems, by which information concerning the missile's flight is telemetered to earth stations.

Technique for Making Silicon Carbide Diodes

ORDINARILY, silicon carbide crystals of the highest quality are desired to fabricate SiC semiconductors. But at the present state of the art in SiC growth, the quality of the crystal is at best very low, both with respect to purity and lattice structure.

Recently, the Electronic Material Sciences Laboratory of the Air Force Cambridge Research Center, Bedford, Mass. has fabricated several experimental silicon carbide active diodes utilizing a phenomenon based on quantum mechanical tunneling. What makes the experiment of special interest is that the basic silicon carbide crystal was deliberately doped with impurities. Tests of these low quality crystals, while not conclusive, have been encouraging, according to a recent report issued by AFCRC.

The Tunneling Electron

Quantum mechanical tunneling techniques take advantage of the inherent defects in the SiC crystal.

Since the phenomenon was first reported last year, the Laboratory has led in its exploitation in SiC semiconductors.

By the quantum mechanical tunneling effect is meant the direct transfer of energy through a barrier, or *p-n* junction. In high quality semiconductor crystals, the *p-n* junction may be considered as a broad barrier preventing the direct transfer of energy. As the crystal becomes less perfect, the barrier is made increasingly narrow. If the barrier is sufficiently narrow, an electron may simultaneously occupy, under quantum mechanical concepts, positions in both the *p* and *n* material of the transistor. The electron may then be said to have tunneled through the barrier. When this tunneling takes place, it is possible to decrease the flow of current through the junction with an actual increase in voltage, or with a decrease in voltage to increase the current.

Hall-Effect Probe Detects Interference

DEVELOPED FOR THE U. S. NAVY Bureau of Ships by Armour Research Foundation, compact magnetic field detector uses a Hall-effect probe as the basic pickup. The probe is made of indium antimonide and is responsive directly to the magnetic field rather than to its time rate of change as in a conventional loop pickup.

The cell is mounted in a ceramic holder to prevent strain of the electrode wires from breaking it.

Uniform frequency response, plus small size, will give more accurate field measurements.

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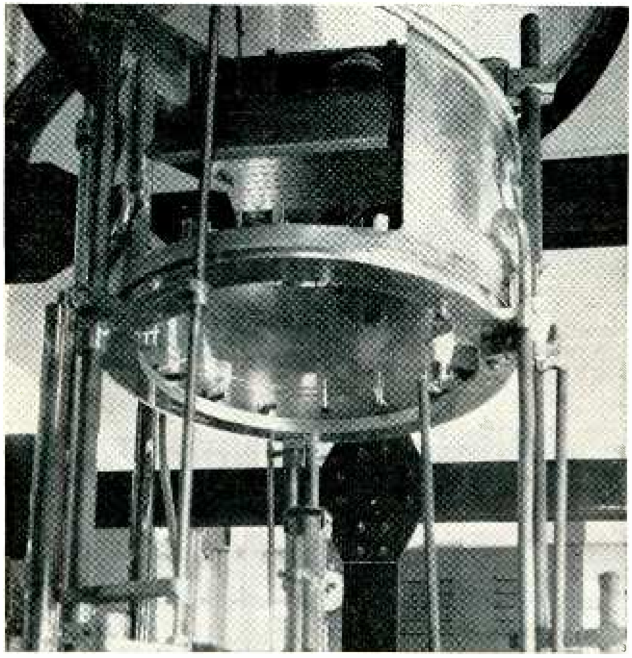

View of bell jar setup, looking up through ring source to mask

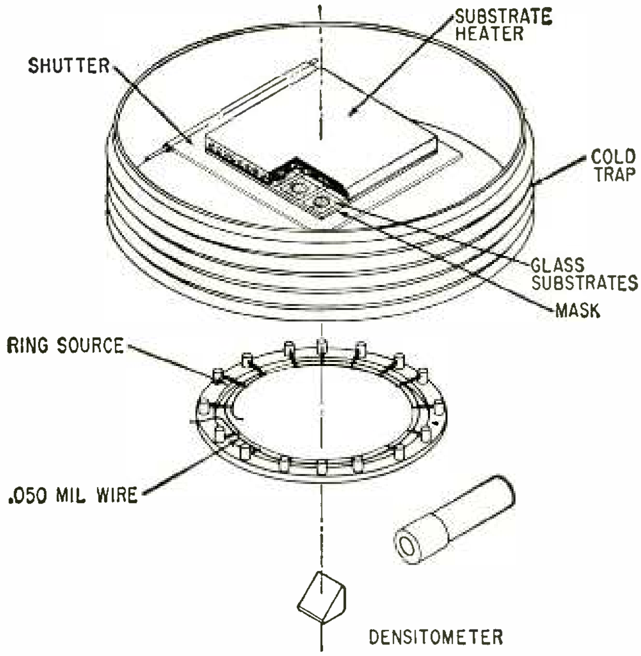

FIG. 1—Isometric view of experimental setup employing ring source

Ring Gives Even Vacuum Deposition

VACUUM EVAPORATED metallic films supplied by a ring source are more uniform in thickness over a larger area than films from a crucible source, according to a report of investigations made at International Business Machines Corp., Military Products Division, Kingston, N. Y.

Variations in chemical composition of films deposited on substrates is also less. Uniform rates of evaporation are more easily controlled due to absence of slag which normally forms in the crucibles commonly used for vacuum evaporation.

Ring sources, however, have 2 main disadvantages. Composition of evaporated films depends greatly upon evaporation temperature and time. Rate of evaporation is low, because it occurs from the solid state. The slow rate can be partially remedied by placing the source close to the substrate.

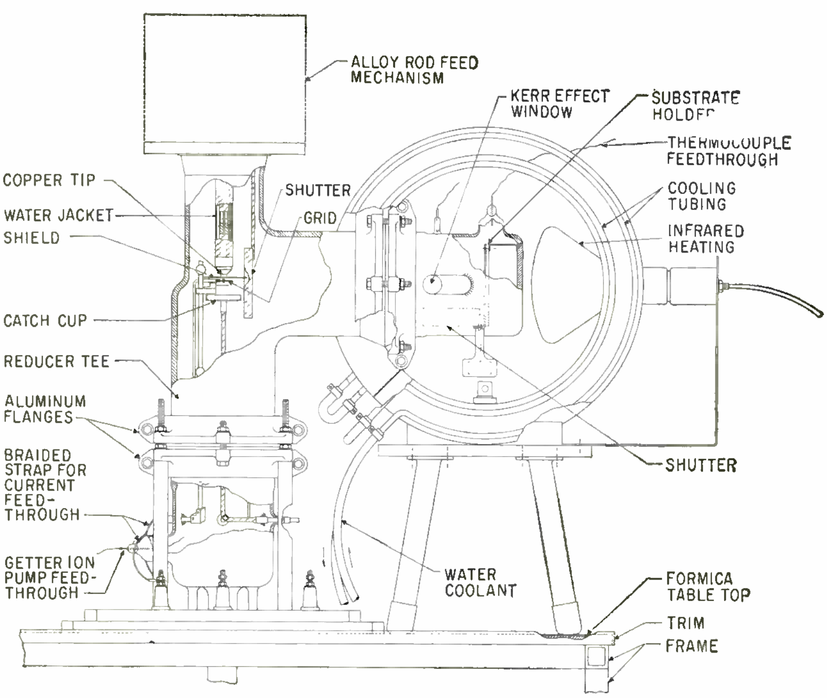

FIG. 2—Arrangement of principal parts of electron bombardment vacuum evaporator

Test Results

A comparative summary of results obtained by evaporating nickel-iron ferromagnetic films with the 2 methods is given in Fig. 3. Multiple beam interferometry, x-ray fluorescence, film output voltages obtained from a B-H loop tester and colorimetric techniques were used to obtain data.

The simplest ring source is a wire of the desired composition bent into a ring and resistance heated. A constant diameter wire evenly heated throughout its length provides uniform film desposition rate and composition.

Experimental setup for ring

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High-frequency power distribution runs are, for the first time, really practical and economical. Now, a single, central high-frequency generator can completely power tens of thousands of square feet.

At 400 cycles and up, new Westinghouse high-frequency bus duct will deliver power with a maximum voltage drop of only 1.28 volts each 100 feet under full load of 800 amps. Here is performance that cannot economically be begged, borrowed or coaxed out of cable-conduit or other bus duct. Compare this efficiency with conventional systems in which drops of from 7 to 15 volts can normally be expected. Housing of duct is nonmagnetic aluminum . . . shields test equipment from radio frequencies originating in duct.

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source evaporation is shown in the photo. Helmholtz coils on either side of the bell jar magnetically orient the film. A densitometer above the base plate detects film thickness and rate of evaporation. The substrate holder is covered by a cold trap of liquid nitrogen flowing in copper tubing. The double ring of 50-mil diameter nickel-iron wire is supported by ceramic rods fastened to a water-cooled stainless steel frame. The setup is shown schematically, without Helmholtz coils, in Fig. 1.

Tryouts of the process and film composition were first conducted with straight wire heated within glass tubing. Details of procedures and results are contained in a paper, "A Comparison Between the Evaporation Characteristics of a Crucible and Ring Source," by K. H. Behrndt and R. A. Jones, of IBM, at the 1958 National Vacuum Symposium.

	Crucible	Ring Source
Substrate area covered (mm)	67 x 70 (4,680 mm^2)	75 x 112 (8,400 mm^2)
Max variation of chem composition	0.6%	0.5%
Standard deviation of composition	±0.2%	±0.15%
Thickness variation	±5.1%	±0.6%
Evaporation rate of equipment used	3 to 12 A/sec	approx 3 A/sec

FIG. 3—Comparison of results obtained by evaporating from crucible and ring sources

Another method of vacuum depositing high-purity ferromagnetic films was described at the conference by D. M. Hart, of IBM, in "A Demountable Glass Vacuum System Using Electron Bombardment in the Vacuum Deposition of Ferromagnetic Films."

While the system was designed for laboratory use and is small, some of its features may be applicable to production. It is relatively easy to construct, maintains a vacuum of about 10^{-8} mm Hg. and provides facilities for analyzing the films under vacuum. The system can be revised for easier dismantling and resistance heating may be used in place of electron bombardment.

Substrates are heated by an external infrared source, avoiding outgassing and providing improved control over substrate tempera-

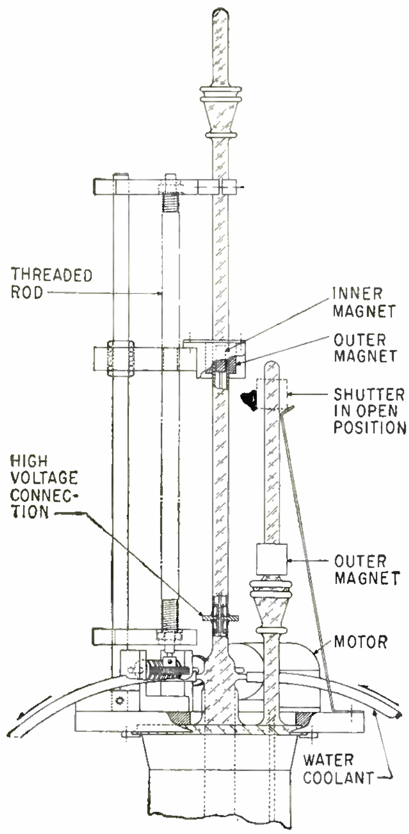


FIG. 4—Alloy feed rod mechanism

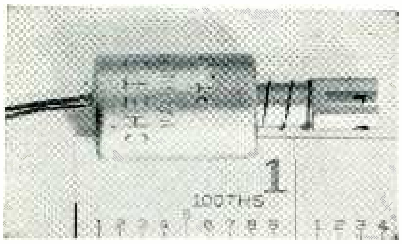
tures. The Kerr magneto-optical effect is used to measure magnetic properties without removing the work from the vacuum.

Bombardment System

The system is shown in Fig. 2. The main structure is a standard 4-by-4-by-3-inch glass reducing tee. End cap and base section are modified standard 4-inch end caps. Feed rate of the alloy feed rod mechanism (Fig. 4) is ¼ inch to 1½ inches. The mechanism is coupled to the rod by coaxial magnets.

A positive voltage of 600 to 1,000 v is applied to the rod by sliding contacts in a disc seal. The electron source is a turn of 25-mil tungsten wire heated to about 2,000 C, producing a bombardment current of 15 to 75 ma. A film 2,000 Angstrom units thick is deposited by 5 inches of 50-mil rod or 1¼ inches of 100-mil rod.

On The Market



Solenoid subminiature

CHET ENGINEERING CO., 8156 Orian Ave., Van Nuys, Calif. Model 2490 versatile subminiature solenoid may be used intermittently at 115 v a-c or continuous duty d-c with the following voltage ranges: 18-30; 30-60; 60-100. Body size is 0.750 in. long and 0.500 in. diameter. Solenoid has spring return, and will pull, or push, 1 lb at 0.020 stroke, 68 F—30 v d-c. Ambient temperature is 65 F to 300 F.

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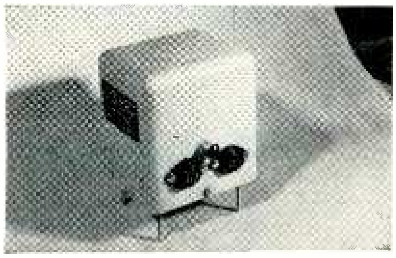
Converters d-c to d-c

STATIC INVERTERS CORP., 2501 E. 68th St., Long Beach, Calif. Model 12-500 D series d-c to d-c static converters, encapsulated and ruggedized for reliable operation under



extreme environmental conditions, feature outstanding efficiency in applications requiring high-voltage d-c such as aircraft, missiles, mobile and marine equipment. Efficiency is as high as 90 percent. All units are completely protected against overload and short circuit.

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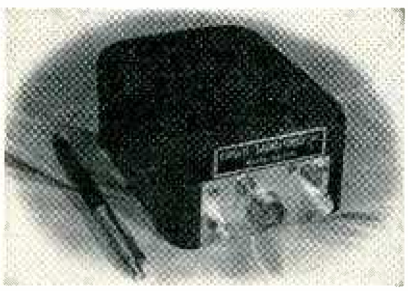

R-F Power Amplifier miniature size

DORSETT LABORATORIES, INC., 401 E. Boyd, Norman, Okla. Designed to extend the effective range of standard telemetering transmitters in the 215-260 mc band, the model A-25 r-f power amplifier features miniature construction and stabilized circuitry. A full 25 w output is claimed with a 2 w input drive; input and output nominal 50 ohms. Unique circuitry and sectionalized mechanical construction permits full power operation without the usual requirement for blowers or other forced air cooling. Unit measures 42 cu. in.

CIRCLE NO. 202 READER SERVICE CARD

Ferrite Isolator broad band

KEARFOTT CO., INC., 14844 Oxnard St., Van Nuys, Calif., announces a broad band, high power KU-band ferrite isolator of small size and weight with very high isolation to insertion characteristics. Model W-568-3A-2 consists of rectangular waveguide with permanent magnetic transverse field and ferrite sections built into the unit. Featured is a frequency range of 12.5 to 18.0 kmc with isolation at 20 db minimum and insertion loss of only 1.0 db maximum.

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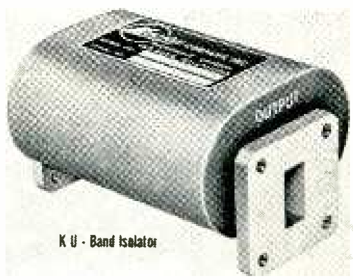

Regulation Monitor highly stable

CALIBRATION STANDARDS CO., 10 Coronet Ave., Pasadena, Calif. Model RM-4A regulation monitor is a compact instrument designed specifically to measure the stability of any d-c voltage from 4.5 v to 500 v. It reads out directly in percent deviation and is calibrated at the factory. Drift is less than 0.005 percent for an 8 hr day and short term drift is less than 0.002 percent. At maximum sensitivity the meter gives full scale deflection for a deviation of ±0.1 percent.

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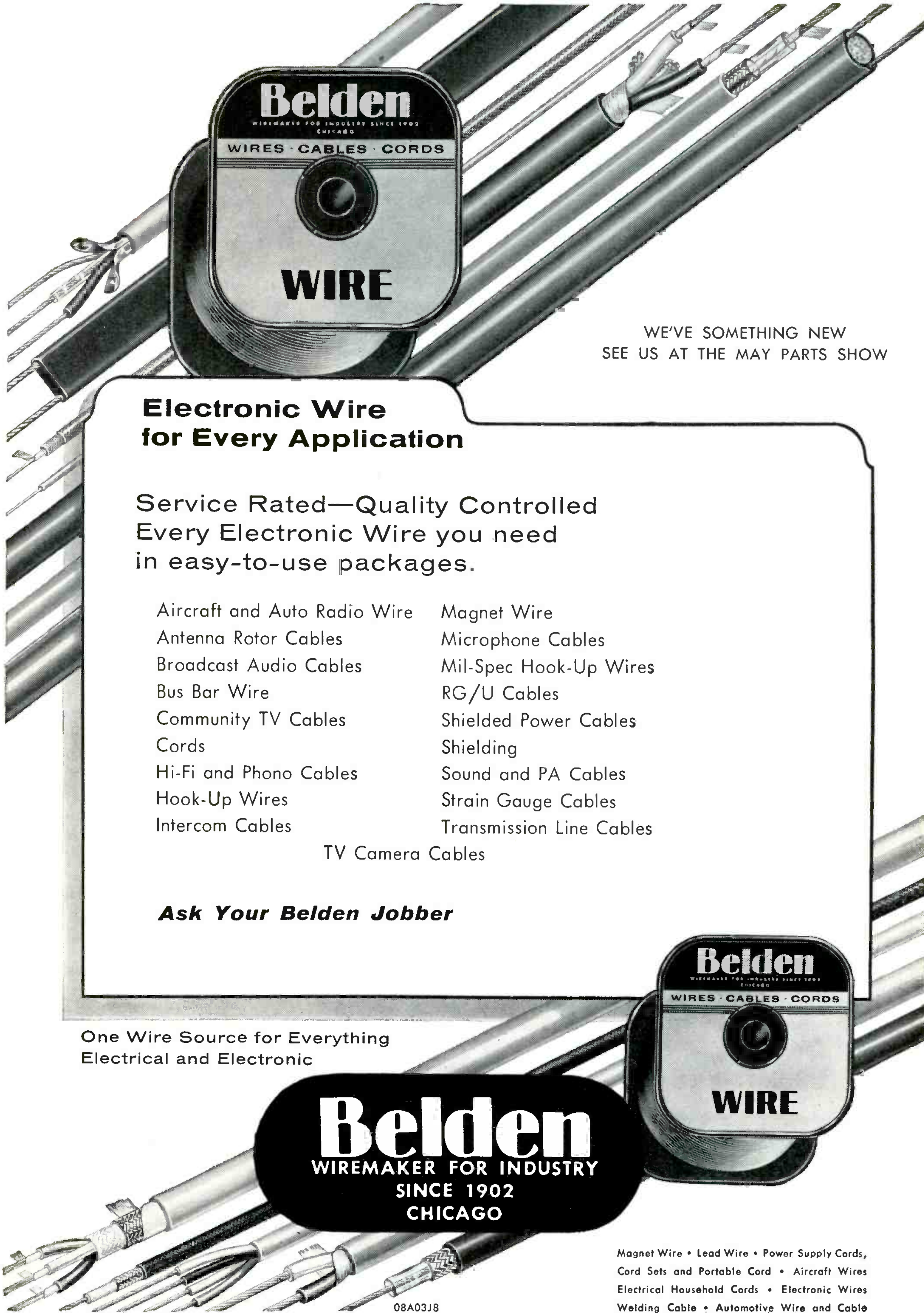
(Continued on p 90)



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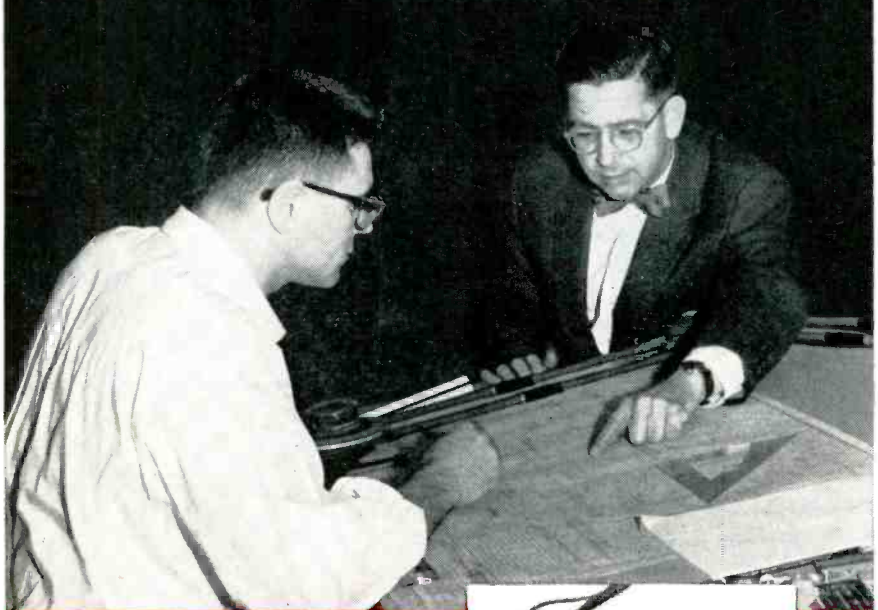

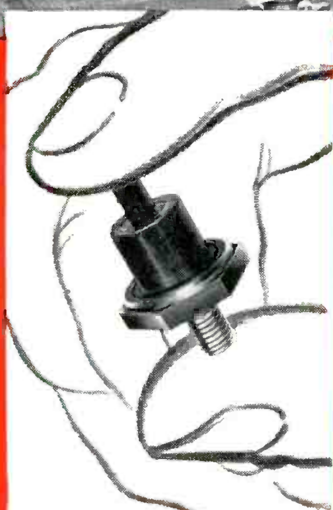

V-R Power Supplies
six new models

KEPCO LABORATORIES, INC., 131-38 Sanford Ave., Flushing 55, N. Y. A line of six new transistorized v-r power supplies cover the range 0 to 38 v, 0 to 2 amperes, with 0.02 percent regulation and stability. In addition to modular geometry, the line features low output impedance, low temperature coefficient, fuseless short circuit protection, over-current control, remote programming, and remote error signal sensing. Each model has base studs for convenient incorporation into systems as a fixed chassis component.

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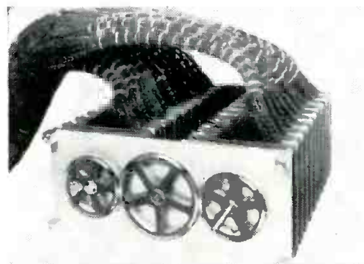

Instrument Switch
gear-driven

CINEMA ENGINEERING DIVISION, Aerovox Corp., Burbank, Calif. New gear-driven switches expand the CES and NETE types, in size and number of switch arrangements. The switch illustrated is prewired for easy assembly into the customer's equipment. Switching arrangement is for 72 positions and 20 poles. Unit is fabricated with rugged aluminum frame and is available in phenolic and glass epoxy deck materials.

CIRCLE NO. 206 READER SERVICE CARD

Shielded Coil Forms
two new types

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass., has expanded its line of shielded coil forms to include two new types, each available in two configurations and three different materials. Both can be ordered either in fixed or variable models, with a choice in both of paper phenolic, Polypenco, or Kel-F coil forms. Lightweight aluminum housings, anodized finish, and flanged mounting complete the design. The larger variable type is series 2590 and the fixed type 2690, while the smaller form is series 2585 in the variable and 2685 in the fixed type.

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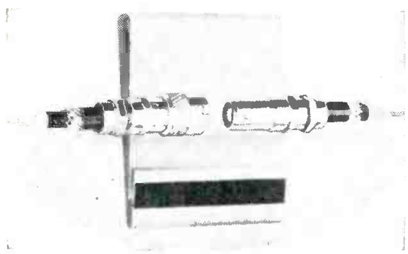


Connectors
triaxial

DAGE ELECTRIC CO., INC., 67 N. Second St., Beech Grove, Ind., announces a new series of miniature, triaxial connectors. Plugs and jacks measure only 1 in. by ⅜ in. yet they provide two separate concentric shields, accommodate cables up to 0.212 in. o-d and have a 500 v rated capacity. The connectors are bayonet locking, have Teflon insulation and are available in 4 different polarity groups.

CIRCLE NO. 208 READER SERVICE CARD

Test Chambers
walk-in type

THE AMERICAN RESEARCH CORP., Farmington, Conn., has announced a walk-in type environmental test chamber measuring 6 ft by 6 ft by 7½ ft. It simulates temperatures from −100 to +250 F and relative humidities from 20 percent between +35 and +185. The test chamber has automatic temperature control, two-pen round chart recording humidity control, automatic float control of water level, water cooled condenser, and safety thermostat to protect heaters from accidental burnout.

CIRCLE NO. 209 READER SERVICE CARD

UHF Triode
low-noise

BRITISH INDUSTRIES CORP., 80 Shore Rd., Port Washington, N. Y. The Genalex A2521, is now available for use as a grounded grid r-f amplifier at frequencies up to 1,000 mc. It has a transconductance of 12,000 μmhos and a plate dissipation of 2½ w. In normal receiver applications, the noise factors are 9 and 12 db at 500 and 900 mc respectively, and the tube is free of microphonics. Power gain and bandwidth are easily adjusted. At 900 mc for power gains of 6 and 16 db, the available bandwidths are 80 and 4 mc respectively.

CIRCLE NO. 210 READER SERVICE CARD

Two-Pole Switches
shock-resistant

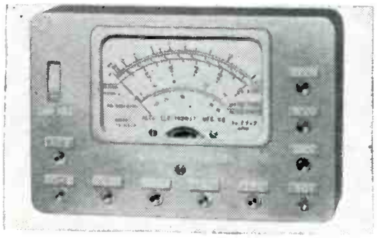
MICRO SWITCH, Freeport, Ill. The 1EN75-R switch meets the requirements of MIL-S-901B (Navy) which call for a 2,000-ft-lb shock test without injury to the housing or the two enclosed spdt switching units. It is expected to find wide application on missile and rocket launching platforms, gun mounts and other equipment requiring a sealed limit switch capable of withstanding impacts.

CIRCLE NO. 211 READER SERVICE CARD

Potentiometers
low torque

GIANNINI CONTROLS CORP., 918 E. Green St., Pasadena 1, Calif. Two low-torque, ultrasensitive pots are designed to operate specifically under normal aircraft environmental conditions. Model 85151 Minitorque accurately divides an electric current or voltage in proportion to shaft rotation. Model 85111 Microtorque is also a low torque, low moment of inertia unit which divides an electric current or voltage proportional to angular shaft position. Vibration to 1,000 cps at 10 g shock will not alter their output accuracy. Both units are available with resistance ranging from 100 to 100,000 ohms, and all offer standard linearity of ±0.5 percent.

CIRCLE NO. 212 READER SERVICE CARD



Multitester
1,000 ohms per v

ALCO ELECTRONICS MFG. CO., 3 Wolcott Ave., Lawrence, Mass. Model TS-55A multitester features a wide angle meter and 1 percent precision shunts and resistors. It has five a-c and d-c ranges: 0-10, 50, 250, 500 and 1,000 v, with d-c current ranges of 0-1 and 500 ma, and an ohms range to 100 K. Multitester ranges are selected by means of pin jacks on the front of the meter case. Instrument measures 3¼ in. by 1⅞ in. by 5 in.

CIRCLE NO. 213 READER SERVICE CARD

Component Holder
spring-loaded

GENERAL COMPONENTS INC., 225 E. 144th St., New York 51, N. Y. This spring-loaded component holder is used to hold component leads such as: resistors, capacitors, dials etc., for test purposes. It will handle wires from 0.005 to 0.090 in. in diameter. The holders are gold plated for low contact resistance and for maximum corrosion resistance.

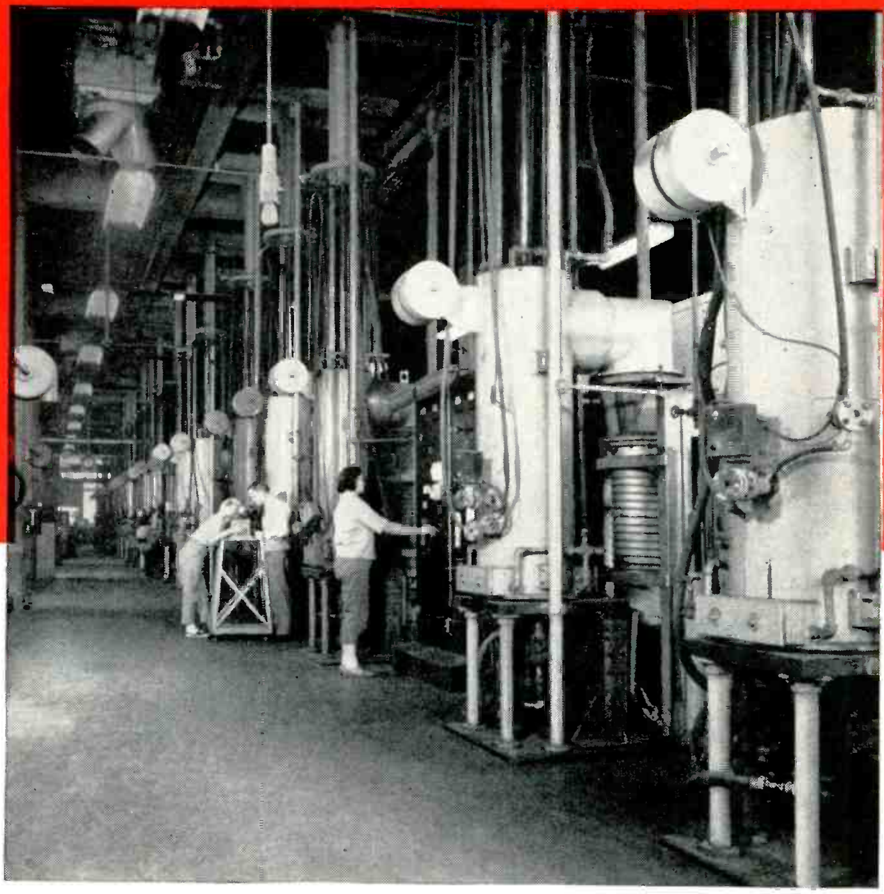
CIRCLE NO. 214 READER SERVICE CARD

Frequency Meter
for military uses

AMERICAN MACHINE & FOUNDRY CO., 1025 N. Royal St., Alexandria, Va. A new direct reading precision

TANTALUM...

The Fansteel Metallurgy Behind It....



A battery of vacuum sintering furnaces, designed and built by Fansteel engineers, used in the production of Capacitor Grade Tantalum.

THE FIRST great step in making tantalum was the production of pure, ductile metal, which Fansteel's director of research, Dr. Clarence W. Balke, accomplished in 1922.

The second great step is still in progress. It is one thing to make a new metal; it is another thing to make it freely available in commercial quantities and to render technical assistance to its users. This metallurgical task will never be fully completed as far as Fansteel is concerned. For, our definition of metallurgy includes the making of metals for a particular end use.

Our work with tantalum capacitors has paralleled our development of tantalum itself. And, from the many grades of tantalum, Fansteel metallurgists developed one grade which is particularly suited to capacitor manufacturing.

Fansteel Capacitor Grade Tantalum is a premium grade with properties especially useful in capacitor applications. It is unequalled for quality and uniformity, designed strictly to give outstanding capacitor performance and reliability.

Fansteel Capacitor Grade Tantalum is specified by all leading capacitor manufacturers. The outstanding performance of today's tantalum capacitor is directly attributable to Fansteel Capacitor Grade Tantalum. Fansteel Metallurgical Corporation, Rectifier-Capacitor Division, North Chicago, Ill.

FANSTEEL®

CAPACITOR GRADE

TANTALUM

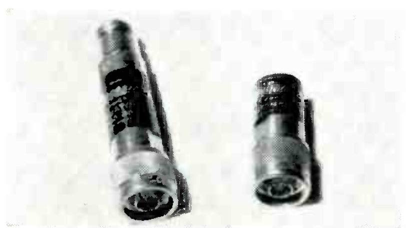
A Premium Grade of Tantalum available to capacitor manufacturers in these forms:

FOIL • SHEET • STRIP • WIRE • ROD • FABRICATED WIRE LEADS
SINTERED POROUS ANODES • METAL POWDER

X594

frequency meter has an expanded scale providing a range from 397 to 403 cps. It is ruggedized and ideally suited to military field applications. An accuracy of 0.1 percent is provided by the meter. A small ruggedized sensing element is packaged in a single can with the meter movement to provide a very compact design (about 10 cu in.). Instrument needs no field calibration with expensive tuning forks or other sources.

CIRCLE NO. 215 READER SERVICE CARD



Attenuators and terminations

APPLIED RESEARCH INC., 76 S. Bayles Ave., Port Washington, N. Y., is now supplying a family of fixed pad coaxial attenuators and a termination for applications using type N connectors. Type HFA/N-50 attenuators have a nominal impedance of 52.5 ohms. They are useable in a frequency range from d-c to 2,500 mc; maximum vswr through this range is 1.2. It is available in standard models for attenuation values of 1, 2, 3, 4, 6, 10, 12, 15 and 20 db. The coax termination is designated type HFT/N-50.

CIRCLE NO. 216 READER SERVICE CARD

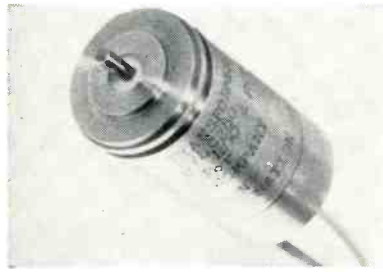
Precision Pot ten-turn

HELIPOT DIVISION of Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, Calif., has announced a new standard linearity of ± 0.25 percent (down from ± 0.5 percent) for the 1 13/16 in., ten-turn model A precision pot. This new linearity applies to resistances ranging from 100 to 100,000 ohms. The resistance tolerance over this range has also been tightened to ± 3 percent. Up to three sections of the model A can be factory ganged. As many as 28 taps can be added to a single section, each spot

CIRCLE NO. 95 READER SERVICE CARD

welded to a single turn of resistance wire. The housing, precision machined from a one-piece Bakelite molding, provides dimensional stability and minimal electrical leakage.

CIRCLE NO. 217 READER SERVICE CARD



Synchros high-temperature

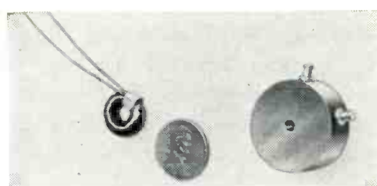
Bendix Aviation Corp., South Montrose, Pa., announces high-temperature synchros in both size 11 and size 23 frames. The size 11 is capable of withstanding a 450 F ambient temperature; the size 23, an ambient temperature of 350 F. Both meet the requirements of MIL-S-2335.

CIRCLE NO. 218 READER SERVICE CARD

Beam Power Pentode high-output

CBS-Hytron, Parker St., Newburyport, Mass. Type 7189 miniature beam power amplifier features high power output and high power sensitivity. Maximum plate voltage rating is 450 v. Two 7189's operating in push-pull, with a peak a-f input voltage (grid-to-grid) of 29 v, provide 24 w at less than 4 percent distortion. The 9-pin miniature mounts in any position. Its 6.3-v heater draws 760 ma.

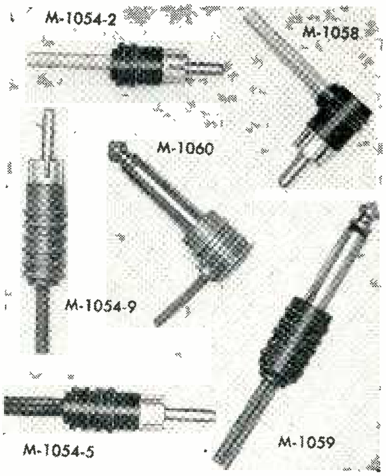
CIRCLE NO. 219 READER SERVICE CARD



Toroid Inductors varied sizes

Kelvin Electric Co., 5907 Noble Ave., Van Nuys, Calif., introduces a new line of toroid inductors, series KT, in a complete range of sizes. High Q factors, excellent stability vs temperature and current, and self-shielding effects are main features. Coils are available in three forms: uncased, with protective wax coating, hermetically sealed in steel cases to MIL-T-27A specifications, and encapsulated in high temperature plastic to withstand extreme humidity and severe mechanical shock; temperature range of −55 C to +125 C.

CIRCLE NO. 220 READER SERVICE CARD



Phone/Phono Plugs
complete line

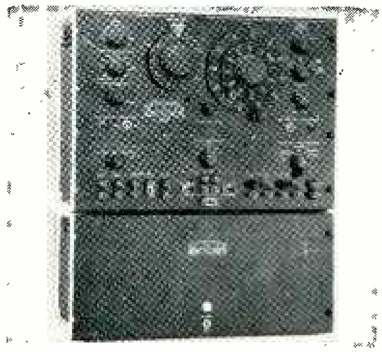
PHALO PLASTICS CORP., Shrewsbury, Mass., has in production a complete line of phone and phono plugs for use in the stereophonic, tape recorder and audio fields. Line includes the straight phono plug M-1054 (shown in three sizes: M-1054-2, 5, 9); right angle phono plug, M-1058; straight phone plug, M-1059; right angle phone plug, M-1060.

CIRCLE NO. 221 READER SERVICE CARD

VTVM
1 mv to 1,000 v

ELSIN ELECTRONICS CORP., Eileen Way, Syosset, N. Y. Designed to read from 1 mv to 1,000 v, this voltmeter comes equipped with a front panel mounted fuse for easy replacement and a mirrored scale for easy reading. The unit has 2 percent accuracy and can be used as a high gain amplifier. It operates 110-120 or 220-440 line volts at 50-420 cps at 30 w.

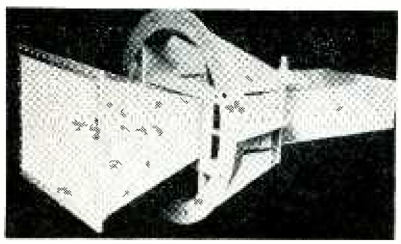
CIRCLE NO. 222 READER SERVICE CARD



Time-Delay Generator
also pulse, sweep

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1391-B generates push-pull pulses, linear sweep voltages, time delays, and delayed trigger pulses which can be used independently or to delay the initiation time of the sweep and main pulse relative to the input driving signal. Signals of almost any wave shape will trigger the input timing circuits. Transition times of the output pulses (0.015 μsec rise time) are compatible with most present-day oscilloscopes.

CIRCLE NO. 223 READER SERVICE CARD



UHF Horn
primary feed

THE GABRIEL CO., 135 Crescent Road, Needham Heights, Mass., has developed a uhf horn to serve as a primary feed for a 60-ft parabolic reflector. It is capable of operating at two frequencies (400 and 650 mc region) over narrow bands with low vswr's and high power output without adjustment. The input impedance is 75 ohms using a doorknob type transition from coax to the waveguide. The feed horn has a mounting ring which permits the horn to be oriented at 0, 45 and 90 deg. It is also pressurized and has a polyester fiberglass radome capable of withstanding an internal pressure of 3 lb.

CIRCLE NO. 224 READER SERVICE CARD

SPACE ORIENTED ELECTRICAL ENGINEERS AND PHYSICISTS

Vast new space and missile projects have created outstanding opportunities in research, development and design at Douglas. Here are some of the areas in which we have immediate openings for engineers and physicists with advanced degrees (B.S. also considered):

SPACE NAVIGATION — Utilize Bode and Nyquist techniques, root loci, Z plane, quasi linear, non-linear and other techniques in the analysis and development of guidance and control systems.

SPACE COMMUNICATIONS — Telemetry system research and development, research in wave propagation in ionized gas, high frequency breakdown and many other areas.

SPACE POWER — Unconventional power research and development to supply power in space stations and on other planets.

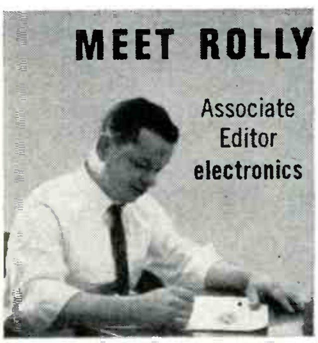
LOGICAL DESIGN — Solid state digital circuits as applied to automatic test and firing equipment, utilization of complex switching and logic circuitry, and utilization of computers in detailed circuit design.

ANTENNA DEVELOPMENT — Complete research, advance design and development of antenna and radome systems for use on space vehicles.

For full information write to Mr. C. C. LaVene, Staff Asst. Vice-president, Engineering, Box F-620, Douglas Aircraft Company, Inc., Santa Monica, Calif.

DOUGLAS The most respected name in aircraft, missile and space technology.

MEET ROLLY CHAREST



RESUME:

Charest, Roland J., Boston University, BS in Journalism. Formerly New England editor for **electronics**. Navy sonarman. Writer, reporter, editor for Lynn Item, Boston Globe, Boston Traveler. Won a New England Associated Press (AP) award in 1955 for writing feature articles in the major city newspaper class.

PRESENT OCCUPATION:

Rolly Charest supports Managing Editor Jack Carroll for editorial content accuracy and expediting putting each weekly issue to bed. Rolly reworks headlines for greater readability, is involved in makeup, and helps polish editorial content. Rolly's across-the-board background assures you accuracy in the face of journalistic pressures; articles in this week's issue that could be held over to the next deadline, but are not. The readers' interests come first!

REFERENCES:

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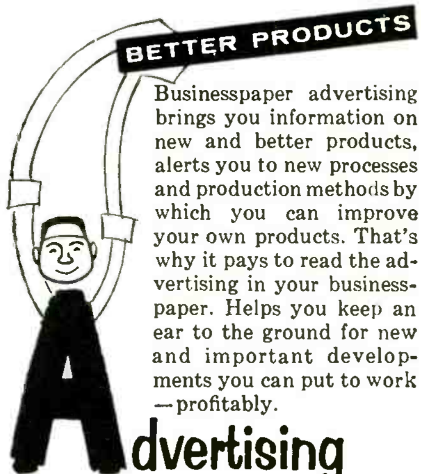
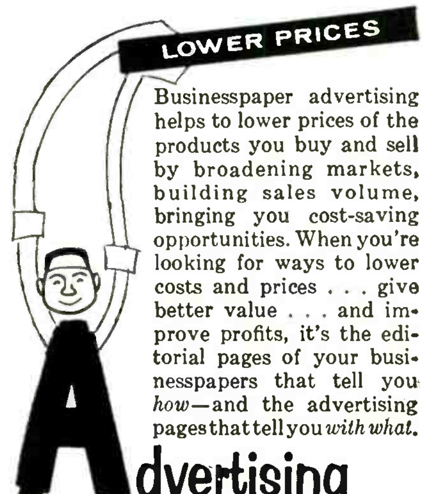


Businesspaper advertising brings you information on new and better products, alerts you to new processes and production methods by which you can improve your own products. That's why it pays to read the advertising in your businesspaper. Helps you keep an ear to the ground for new and important developments you can put to work —profitably.

Advertising works for you!



Businesspaper advertising helps to lower prices of the products you buy and sell by broadening markets, building sales volume, bringing you cost-saving opportunities. When you're looking for ways to lower costs and prices . . . give better value . . . and improve profits, it's the editorial pages of your businesspapers that tell you *how*—and the advertising pages that tell you *with what*.

Advertising works for you!

Businesspaper advertising helps create demand, improve products, step-up production, distribution and sales. With new companies, new factories, new products, new services constantly being developed, you get a healthy, vigorous economy—a full-employment economy. Yes, sir! Advertising works. And it works for you.

Advertising works for you!

Advertising Federation of America
Advertising Association of the West

Prepared for AFA and AAW by the Associated Business Publications in the interest of better understanding of businesspaper advertising.

Literature of

MATERIALS

Beryllium Copper Alloys. Penn-rold Div. of The Brush Beryllium Co., 501 Crescent Ave., Reading, Pa. Full information on beryllium copper 10, 25, and 165 alloys is given in a new 12-page data sheet series.

CIRCLE NO. 275 READER SERVICE CARD

COMPONENTS

Trimmer Potentiometers. Atohm Electronics, 7648 San Fernando Road, Sun Valley, Calif., has available catalog sheets fully describing the W-10 miniature and W-5 subminiature precision trimmer potentiometers.

CIRCLE NO. 276 READER SERVICE CARD

LC Tuners. JFD Electronics Corp., 6101 Sixteenth Ave., Brooklyn 4, N. Y., has published bulletin 216 with illustrations and descriptions of electrical and mechanical characteristics of the new LC tuner series.

CIRCLE NO. 277 READER SERVICE CARD

Selenium Rectifiers. Rectico, Inc., 963 Frelinghuysen Ave., Newark 12, N. J. An 8-page catalog on a line of selenium rectifiers contains their basic characteristics in great detail with temperature derating table as well as an overload and allowable-currents-under - various - forced - cooling curves.

CIRCLE NO. 278 READER SERVICE CARD

Electrolytic Capacitors. Ohmite Mfg. Co., 3673 Howard St., Skokie, Ill. Bulletin 148F provides complete data on an expanded line of subminiature tantalum wire electrolytic capacitors.

CIRCLE NO. 279 READER SERVICE CARD

EQUIPMENT

Instruments. Marconi Instruments, 111 Cedar Lane, Englewood, N. J. Among the instruments illustrated and described in a recent short form catalog are signal and sweep generators,

bridges, wave analyzers, and a wide variety of meters.
CIRCLE NO. 280 READER SERVICE CARD

Signal Generator. Hewlett-Packard Co., 4873A Page Mill Road, Palo Alto, Calif. Reprint of Ad No. 4873R illustrates and describes model 606A, a 50 kc to 65 mc signal generator.
CIRCLE NO. 281 READER SERVICE CARD

Cooling Packages. Pesco Products Division, Borg-Warner Corp., 24700 N. Miles Blvd., Bedford, Ohio. A loose-leaf catalog folder describes four cooling packages designed for use in electronics systems requiring airliquid coolant mediums.
CIRCLE NO. 282 READER SERVICE CARD

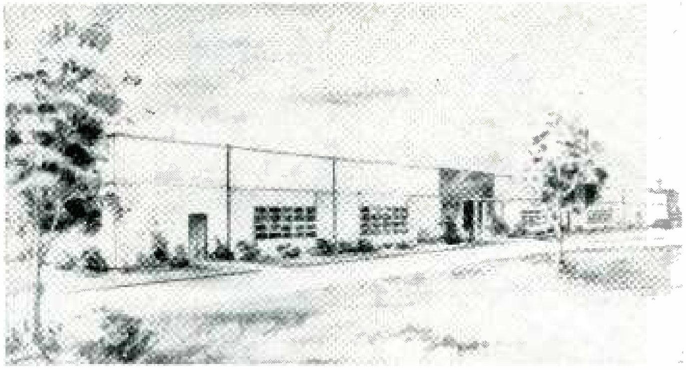
Klystron Power Supplies. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y. A recent catalog sheet contains an illustrated description and lists performance characteristics of the type 812 klystron power supplies.
CIRCLE NO. 283 READER SERVICE CARD

Control Meter. International Instruments Inc., P. O. Box 2954, New Haven 15, Conn. A 4-page engineering data sheet carries a complete description of the recently developed model 2545 miniature electronic control meter.
CIRCLE NO. 284 READER SERVICE CARD

FACILITIES

Wire-Wound Components. Precision, Inc., 4748 France Ave. No., Minneapolis, Minn. A 6-page brochure describes the firm's specialized manufacturing facilities for the production of custom-made miniature wire-wound components.
CIRCLE NO. 285 READER SERVICE CARD

Missile and Space Vehicles. General Electric Co., 3198 Chestnut St., Philadelphia 4, Pa. How the company conducts its research and development work on missiles and space vehicles is explained in a new, 23-page booklet.
CIRCLE NO. 286 READER SERVICE CARD



Sperry Expands for Polaris

A MAJOR plant expansion for Navy's top priority Polaris program was recently announced by Sperry Gyroscope Co. Another building in Syosset, Long Island, N. Y., has been rented by the firm's marine division to meet its expanding role in the program. The 52,000 sq ft building, located on three acres of land, is approximately 600 ft from the company's other Syosset facility. It is being rented under a 5-year lease.

Expansion became necessary when Sperry was assigned responsibility for integrating all navigation equipment under the program. In addition, the company has had responsibility for development and production of advanced equipment used to exactly position the Polaris-launching sub for firing.

The Ship's Inertial Navigation System (SINS) used to navigate submarines for extended periods without reference to conventional external sources such as radio, radar, and celestial navigation, is being produced by Sperry. SINS indicates exactly where the ship is located and where it's headed. Also being produced by the company is the Navigation Data Assimilation Center (NAVDAC). This digitalized electronic brain absorbs a wide variety of navigational data and collates, analyzes, decodes and displays this information, simultaneously selecting the most accurate data.

According to W. R. Griswold, manager of the company's SINS program, the new building will be used for administrative, engineering, design, and laboratory operations needed for Sperry's role as a navigation systems manager. The move provides added space at the marine division's Roosevelt Field, L. I., plant that can be used for production.

Raytheon Hires Fundingsland

OSMUND T. FUNDINGSLAND has been named to the newly created post of director of research for Raytheon Mfg. Co. He resigned as manager of Sylvania Electric Products, Inc., Microwave Physics Laboratory at Palo Alto, Calif., to take the Raytheon appointment.

In his new position, Fundingsland will direct long range research planning activity, provide functional guidance, and coordinate activities of the research and other operating divisions. A corporate staff member, he will report to the vice-president of engineering and research.

Varian Sets Up Subsidiary

FORMATION of a new research and development subsidiary, S-F-D Laboratories, Inc., was recently announced by H. Myrl Stearns, president of Varian Associates, Palo Alto, Calif.

The new organization, to be located in northern New Jersey, will be headed by three prominent scientists formerly of Bell Laboratories.

Joseph A. Saloom, who will be president of S-F-D Laboratories, Inc., was responsible for all microwave tube work done at the Bell branch laboratories at Laureldale, Pa.

Joseph Feinstein, executive vice-president and director of research of the new firm, has been responsible for R&D on crossed field amplifiers and magnetrons as well as for exploratory work on plasma and solid state physics.

Jerome Drexler, who will be vice president and director of engineering, has been in charge of a development group working on crossed field devices including coaxial magnetrons.

Immediate plans include a staff of 40 to 50 employees.

DCA Names V-P

ELECTION of A. C. DeAngelis as vice president of Dynamics Corp. of America was recently announced. New v-p, who is also president of DCA's communications subsidiary,

Radio Engineering Laboratories, Inc., joined DAC in 1950.

Before joining DCA, DeAngelis was president of General Armature and Mfg. Co., Lock Haven, Pa., for five years and previously (for 18 years) was with Bendix Aviation Corp., where his last job was general manager of three manufacturing divisions.

Up Novikoff to V-P at IFI

EUGENE B. NOVIKOFF was recently appointed vice-president in charge of engineering at Instruments for Industry, Inc., Hicksville, L. I., N. Y.

He joined the company in 1952 as a project engineer. Less than a year later he was appointed supervising engineer and in 1955, chief engineer. In 1957 he was named director of engineering.

Plant Briefs

Applied Technology, Inc., a new firm for sophisticated electronics systems research, development and manufacture, has been formed in Palo Alto, Calif., with William E. Ayer as president and Peter D. Strum as vice president.

Purchase of the assets and inventories of **San Jose Scientific Co.** was recently announced by G. H. Bruns, Jr., president of **Systron Corp.**, Concord, Calif.

International Electronics Mfg. Co., Washington, D. C., announces the formation of **Antran**—a division to serve as the manufacturing arm of the company. Antran is now in production on waveguide filters, frequency preselection networks, and antenna tuners for multichannel and remote control antennas.

Acoustica Associates, Inc., Mineola, N. Y., has acquired the **Universal Dynamics Corp.,** Santa Barbara, Calif., manufacturers of piezoelectric ceramics used in ultrasonic and sonar equipment. UDC will operate as a wholly owned subsidiary of Acoustica.

Kurz and Root, Pacific Division, Inc., manufacturer of aircraft and missile ground support and test equipment and commercial power apparatus, has transferred operations from East Los Angeles to new and larger quarters in Burbank, Calif.

CBS-Hytron changes its name to **CBS Electronics,** effective July 1.

Formation of **Analab Instruments Corp.,** Cedar Grove, N. J., to design and manufacture analytical laboratory instruments for science and industry, has been announced by Morton G. Scheraga, president of the new corporation.

News of Reps

Baso Inc., Milwaukee, Wisc., has appointed two new reps for its line of sensitive relays. They are: **Magnuson Associates** of Chicago, Ill., for the territory of Wisconsin, Michigan, Minnesota, Iowa, Indiana and northern Illinois; and **Design and Sales Engineering Co.** of St. Louis, Mo., for the territory of Nebraska, Kansas, Missouri, and southern Illinois.

The Amerelay Corp., New Hyde Park, N. Y., manufacturer of microminiature relays, has appointed **Gassner & Clark Co.,** of Chicago to cover northern Illinois, eastern Iowa and eastern Wisconsin areas.

The Garrett Corporation's Aero Engineering and Airsupply Division of Los Angeles, Calif., has undertaken sales representation for Elgin Micronics Division of the Elgin National Watch Co.

COMMENT

Operational Amplifier

(Re: "D-C Operational Amplifier With Transistor Chopper," p 94, Apr. 24): Congratulations to Messrs. Hochwald and Gerhard for having handled a difficult problem with imagination, and for their lucid presentation of the results.

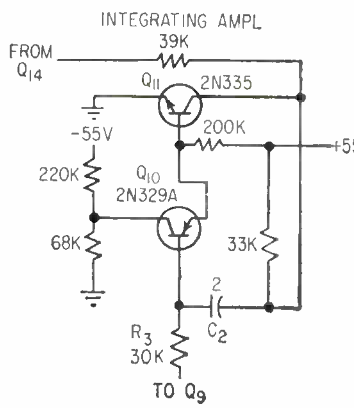
I believe, however, that there is an error in the schematic (Fig. 1) as regards the connection between the integrating amplifier output, the +55-v supply, C_2, the 200K resistor and the 33K resistor.

ALAN BRODER
GLEN OAKS, N. Y.

. . . Both authors have received several letters notifying them of errors in the schematic and are naturally desirous of seeing a corrected version published. . . .

JAMES W. CAREY
AUTONETICS
DOWNEY, CALIF.

The drawing shows a + 55-v potential applied to the junction of capacitor C_2 and the 33K resistor. The correct connection is as shown here.



Besides, the drawing shows diode D_7 (at the left of the drawing) connected backwards; its cathode should be grounded, not its anode.

Coherent Frequency Detector

It was with special interest that I read "Fast WWV Check of Frequency" (p 76, Mar. 27), and then followed it with your suggestions on p 47 of the same issue.

In our research work we have

been among the first to take advantage of the National Bureau of Standards 60-kc standard frequency signals that are now being transmitted from Boulder, Colo. These signals are far superior to WWV for accurate frequency work.

We have developed a system that will compare the 100-kc outputs of our four primary standards with the 60-kc signal from Boulder and record the result with a pen recorder. A comparison accurate to 1 part in 100 million can be made in a period as short as 15 minutes, as compared to methods requiring days when WWV transmissions are used.

A special system of coherent detection is used which gives good recorded information even though the received signal is below audibility during periods of high noise.

HOWARD F. BURGESS
SANDIA CORPORATION
ALBUQUERQUE, N. M.

Plastic Cable Jacketing

. . . Recently in several publications I have seen editorial reference to cable applications (of plastics). In one, specific reference was made to the almost universal acceptance of neoprene for cable jacketing. This is only partly true.

There is a growing acceptance of polyvinyl chloride for this use; however, there is a definite tendency on the part of cable engineers to oversimplify and to say vinyl may be used in place of neoprene. This reference is fraught with danger, not only for the cable engineer but quite frankly for the manufacturer of vinyl compounds. It is somewhat analogous to a statement which might say that plastics are a good substitute for aluminum without reference to what plastic is in mind.

We have spent a good deal of time talking to cable engineers regarding the function of neoprene, general-purpose vinyl and specially formulated vinyl, and we are surprised to discover how interested these people are in learning the difference in performance. . . .

ALLEN W. SCHMIDT
BORDEN CHEMICAL CO.
SANTA BARBARA, CALIF.

GENERAL DYNAMICS
ELECTRIC BOAT DIVISION

Designers & Builders of Nuclear Submarines

Invites Inquiries From

ENGINEERS

Interested in Unique Problems

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TRAINING EQUIPMENT

Simulators and training devices for missiles, submarines and other weapons systems.

ADVANCED SUBMARINE DEVELOPMENT

Integrated control systems for weapons guidance, missile launching, navigation, ship control, sonar.

This division of General Dynamics is currently working on 7 nuclear powered submarines (including the Polaris missile firing A-subs) as well as advanced research and development in a variety of fields. The design and construction of nuclear powered submarines and their attendant systems pose unique and intricate problems to challenge the imagination.

IMMEDIATE OPENINGS IN RESEARCH & DEVELOPMENT

MISSILE CONTROL SYSTEMS BS or MS degree in EE. For technical direction and coordination of installation and testing of Polaris weapons systems on nuclear powered submarines. 2 to 5 years experience desired in fire control, navigation, guidance or launching systems.

CIRCUITS & EQUIPMENT Development of circuits and equipment in conjunction with missile and navigation systems installations aboard submarines. Requires EE degree with advanced courses and experience in servomechanisms.

ELECTRICAL SYSTEMS 1. 5 years experience on shipboard electrical systems design. For design of electrical power and control systems for prototype nuclear propulsion systems for a marine gas cooled reactor plant. 2. EE, ME or Physics degree required. Responsible for conceptual engineering and systems analysis of large complex devices employing a combination of electrical, electronic, electromechanical, hydraulic and pneumatic systems. Should be familiar with servomechanisms theory, experienced in use of analog or digital computers as a design tool, and have a good grasp of mathematics. Will work on proposal preparations, feasibility studies and execution of hardware contracts.

SERVOMECHANISMS For engineering design of servomechanisms in both the instrument and multiple horsepower class. Will interpret performance specifications and be responsible for design of a system in accordance with the specifications, including stability studies, and the calculation of other performance criteria.

COMPUTERS Responsible for conceptual engineering and programming of special purpose digital and analog computers. Should be familiar with system engineering, experienced in programming and check systems for both analog and digital computers, with good grasp of simulation techniques. Requires EE, Physics or Mathematics degree.

CIRCUITS Responsible for conceptual and production engineering of electronic equipment. Familiar with servomechanisms and analog computer theory. Experienced in use of semiconductors, magnetic amplifiers and vacuum tube circuit elements; good grasp of mathematics; EE or Physics degree.

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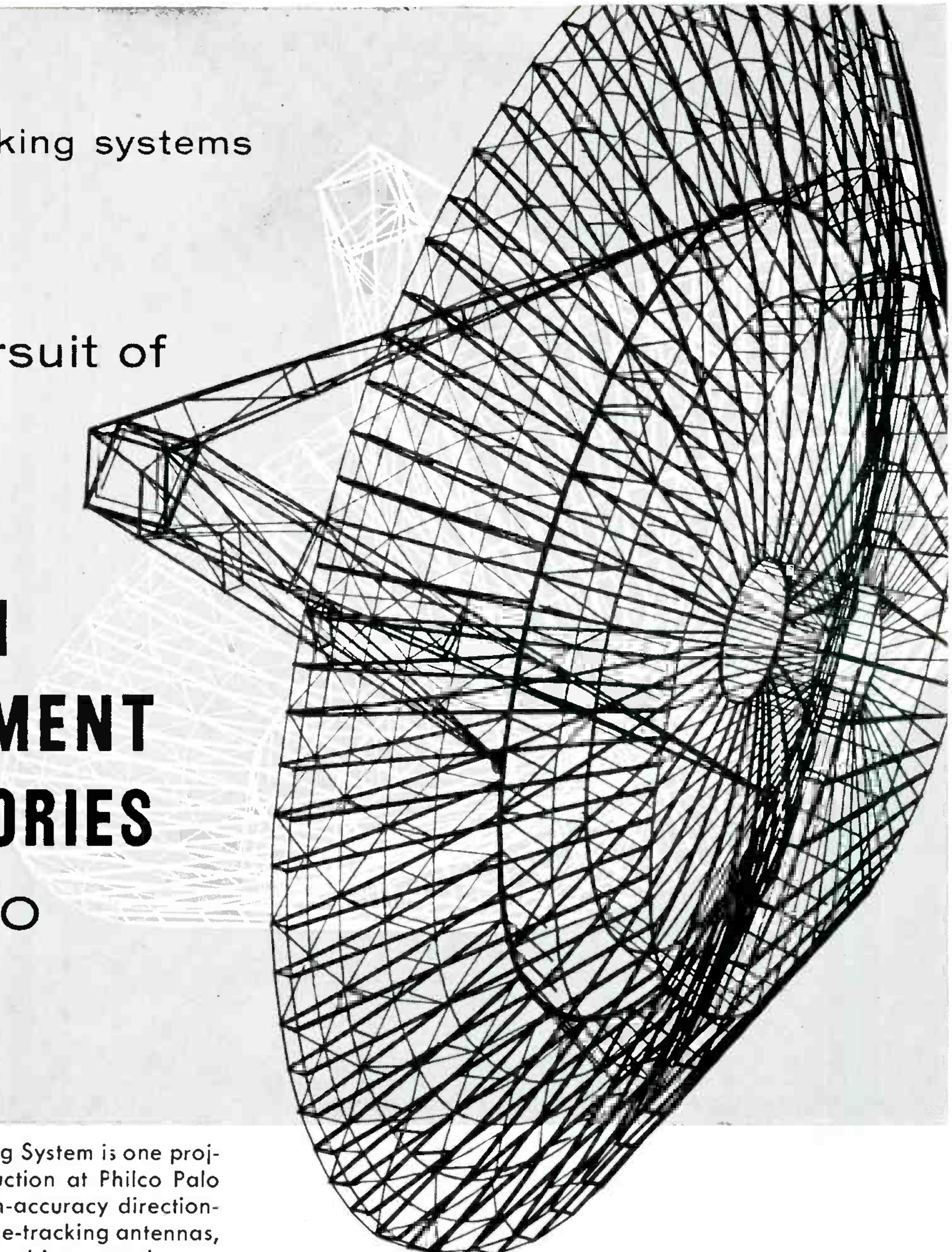

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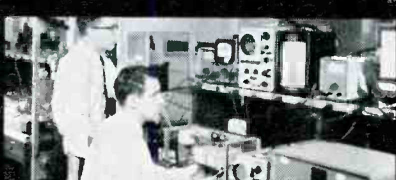
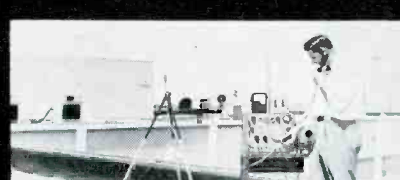


Measuring phase stability vs. temperature during prototype equipment development

Developmental helical antenna, part of sophisticated new direction finder system



Pattern measurements—vital to development on microwave dish antenna

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Galileo Meets the Martians

One memorable day in 1633, 5 space ships suddenly materialized in the sunny Italian sky over Pisa and landed directly under the nose of Galileo's telescope. Three creatures alighted from the lead ship and made straight for Galileo.

"Good morning Signor Galilei," they chorused in unison. "We are . . ."

"Don't tell me, let me guess," interrupted the scientist. "The Mars Brothers?"

"In the flesh, more or less," leered the green one in the middle, brandishing a cigar. "I'm Sloucho. Sorry about the accident. We seem to have knocked off a Pisa the Tower."

"Good for the tourist trade," Galileo smiled.

"Now for business," went on Sloucho. "The boys upstairs a fascinated with your radar. They sent us down here to find out ho you make it work without Bomac tubes."*

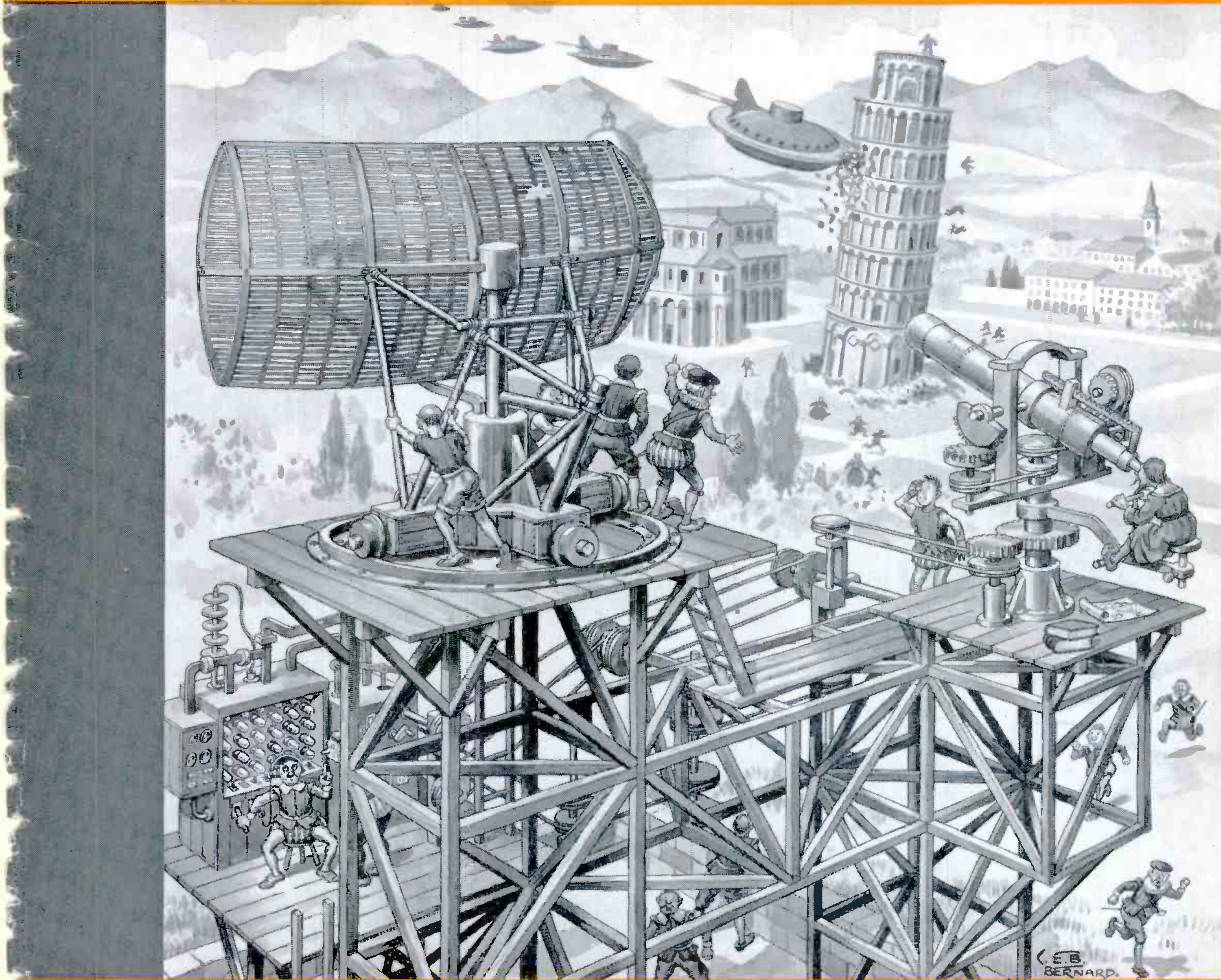
"I'm sorry to say it doesn't work at all," Galileo answere "Or rather — it didn't, until the instant your ship hit the tower."

Sloucho's cigar was aquiver with excitement. "What happen then?" he asked.

"See for yourself," Galileo said, pointing a bony finger at th radar console. There, blinking crazily, like so many overstimulate lightning bugs, the tubes were actually spelling out a single, sure-enoug word.

The word was "TILT."

No. 14 of a series . . . **BOMAC LOOKS AT RADAR THROUGH THE AGES**



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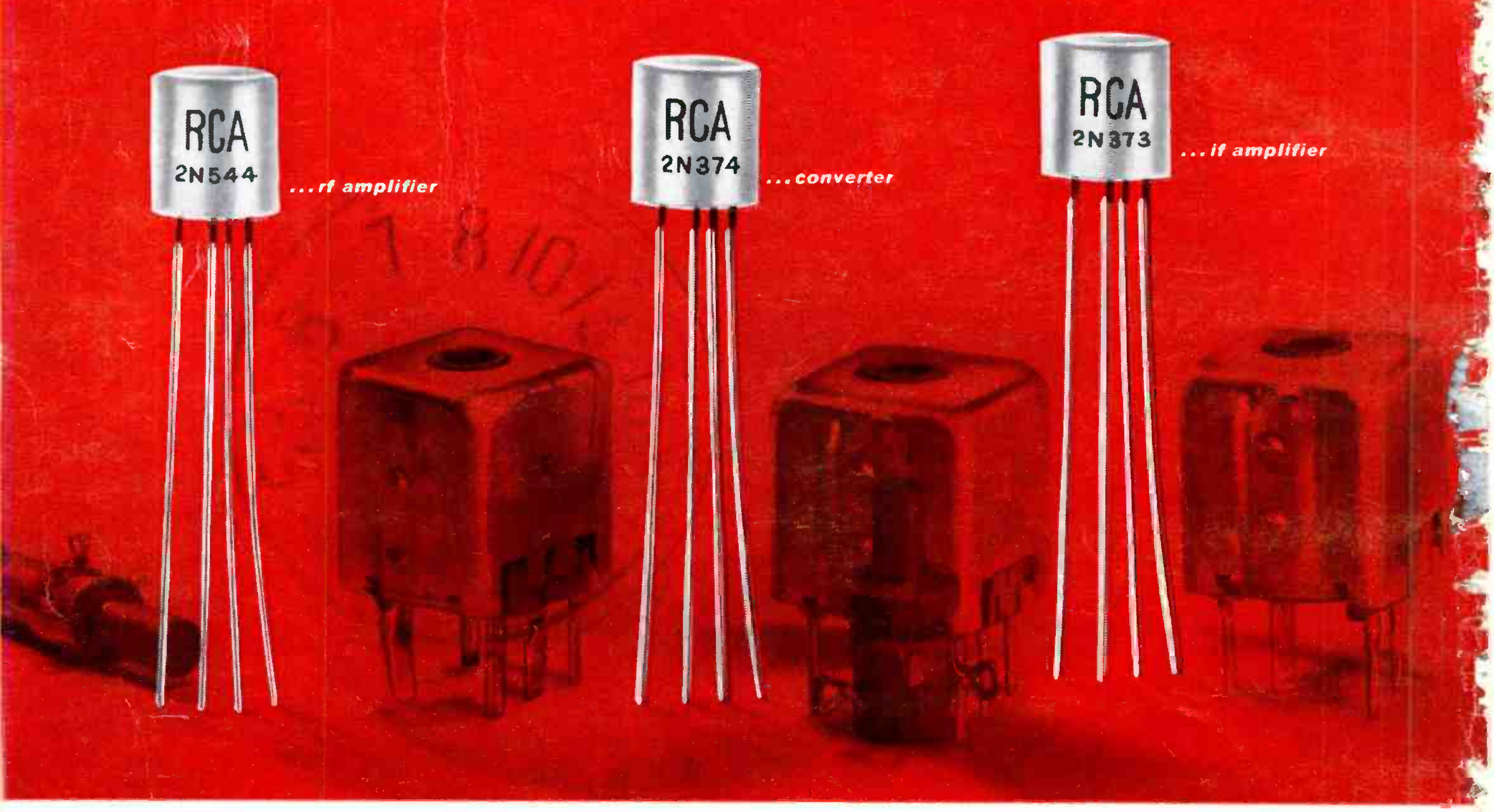

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