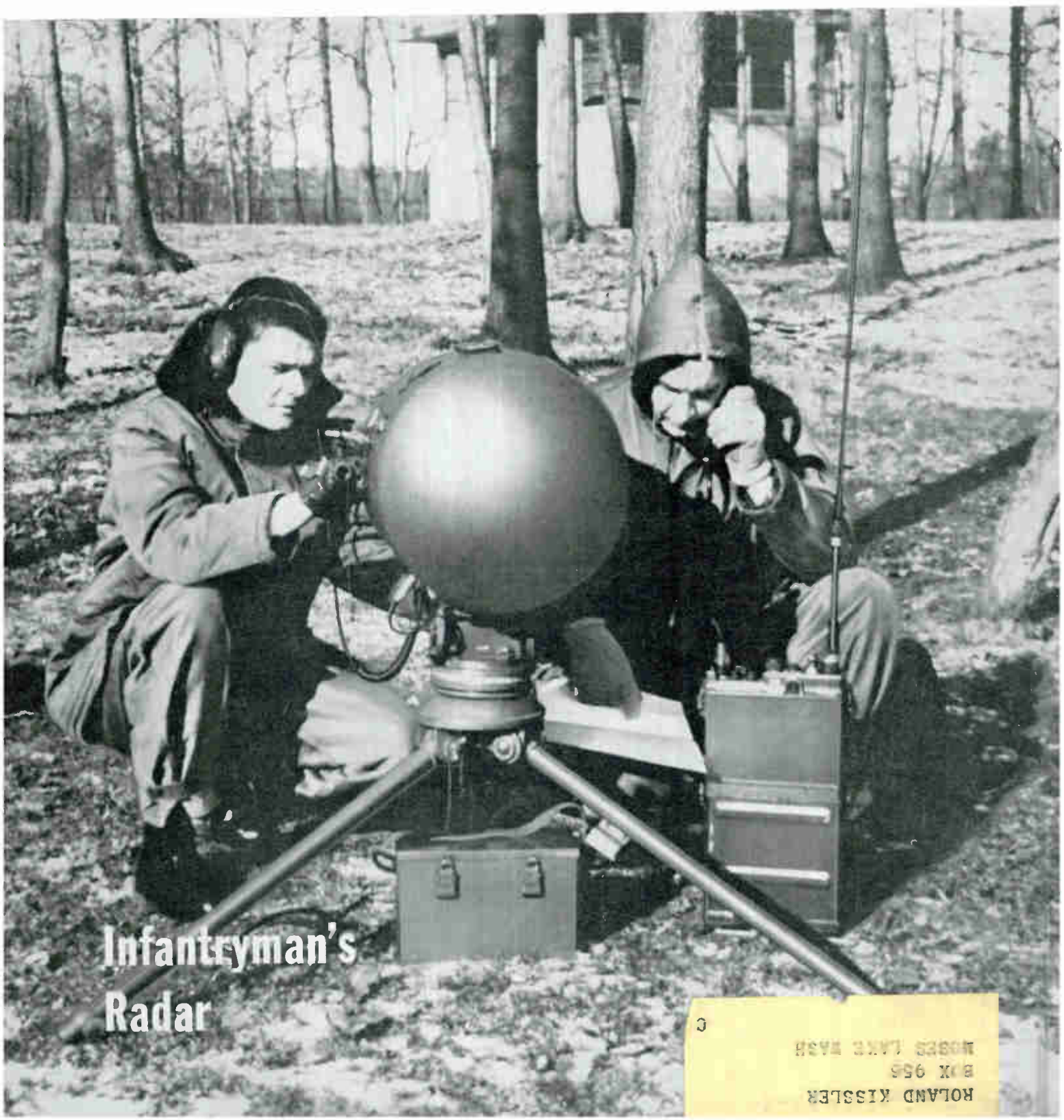
IRE Show: Clue to Imports

page 36

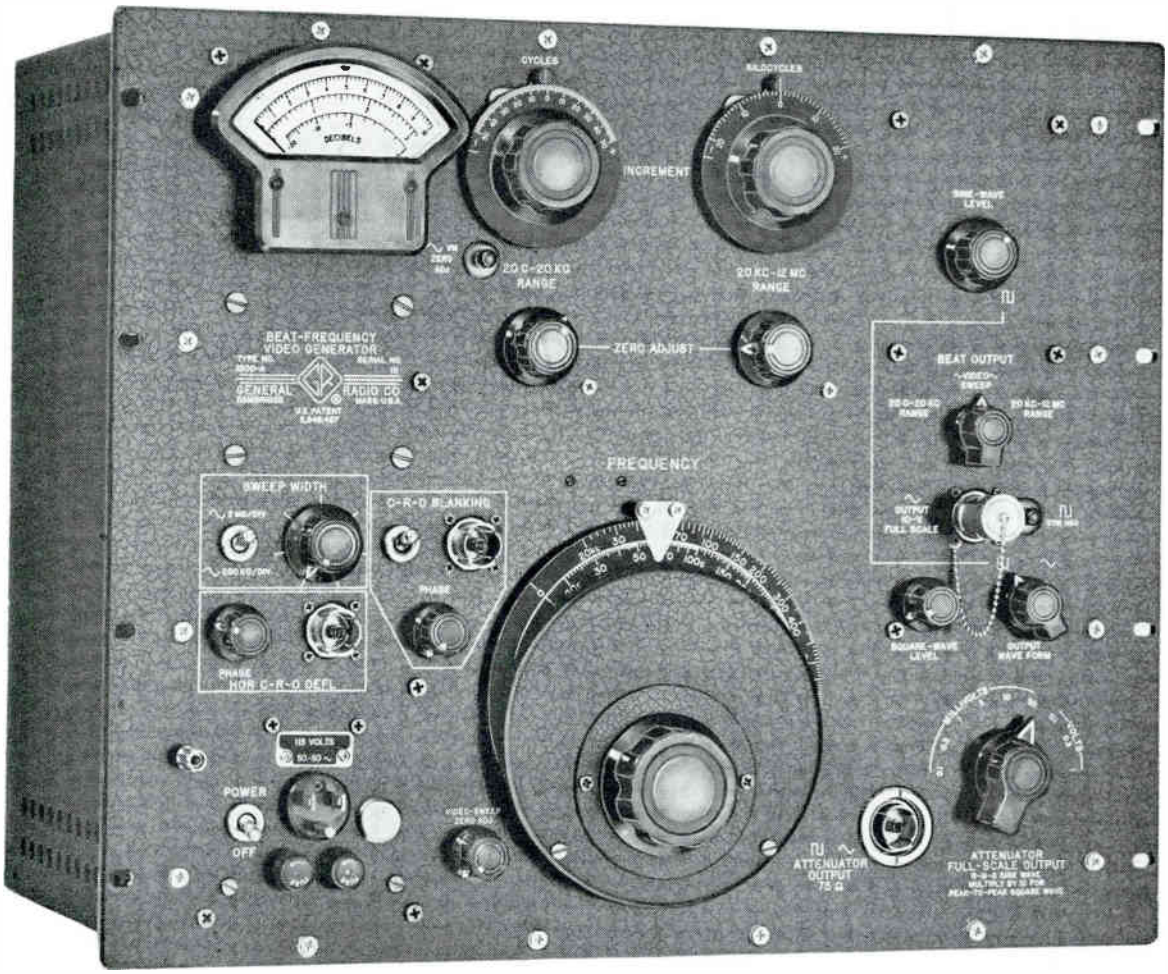
electronics

A McGRAW-HILL PUBLICATION MARCH 18, 1960 PRICE SEVENTY-FIVE CENTS



Infantryman's Radar

NEW 20c to 12-Mc Beat-Frequency Generator for Sine/Square-Wave and Sweep Applications



The features of beat-frequency generators, so well liked for audio-frequency testing, are now available for ultrasonic and video-frequency work. Features include: complete audio- or video-band coverage in one sweep of the dial without annoying range switching . . . high resolution provided by incremental frequency dials for accurate point-by-point studies of amplitude peaks and dips . . . continuously adjustable electronic sweep for video measurements at center frequencies to 12 Mc . . . automatic graphic-level and x-y recording with accessory G-R Dial Drives . . . square-wave output for frequency-response testing by transient techniques (e.g., rise-time and ramp-off measurements) . . . adjustable ± 6-Mc sweep at center frequencies from 36 to 42 Mc (obtained directly from internal oscillators) for television i-f testing.

This instrument's many outputs and different modes of operation, coupled with excellent frequency stability and high output (10v) over the entire frequency range, make it the most versatile audio-video test instrument commercially available.

Type 1300-A Beat-Frequency Video Generator . . . $1950.

As Manually-Tuned Generator:
Sine Wave: 20c to 12 Mc
Square Wave: 20c to 2 Mc

As Sweep Generator (60c sweep rate):
Sine Wave: 20 kc to 12 Mc
Sweep width is continuously adjustable from 0 to ±6 Mc at any center frequency from 0 to 12 Mc.
Horizontal deflection voltage and blanking pulse provided for scopes.

Calibration Accuracy:
20c to 20 kc, ±(1% + 1c)
20 kc to 500 kc, ±(2% + 1 kc)
500 kc to 12 Mc, ±(1% + 1 kc)

In addition to the main frequency dial, two increment dials calibrated from −50c to +50c, and −20 kc to +20 kc, are provided. Calibration accuracies are ±1c and ±0.5 kc, respectively.

Sine Wave — harmonic distortion
20c to 20 kc: < 1.5% of output
20 kc to 12 Mc: < 4% of output

Square Wave
Rise time less than 0.075 μsec above 300 kc
Top flat to 2% of peak-to-peak at 60c, 5% at 20c.

Hum: less than 0.1% of output

	Voltage Range		Accuracy	Frequency Characteristic	Output Impedance
	Sine-Wave (rms)	Square-Wave (peak-to-peak)			
Attenuator output	0.1, 0.3, 1, 3, 10, and 30 mv; 0.1, 0.3, and 1v full scale, open circuit	1, 3, 10, 30, 100, and 300 mv; 1, 3, and 10v	±3% of full scale; attenuator db increments ±1%	flat within ±0.25 db from 40c to 20 kc (±0.75 db at 20c); ±1 db from 20 kc to 12 Mc	75Ω ± 2%
High output	0 to 10v	0 to 10v	±3% of full scale	flat within ±0.25 db from 20c to 20 kc; ±1 db from 20 kc to 12 Mc (open circuit)	820Ω ± 2%

AT THE IRE SHOW

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See a Typical Standards and Measurements Laboratory in Operation . . . Impedance Measurements from D-C to Microwave Frequencies

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electronics

MARCH 18, 1960

A McGRAW-HILL PUBLICATION
Vol. 33 No. 12

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Issue at a Glance

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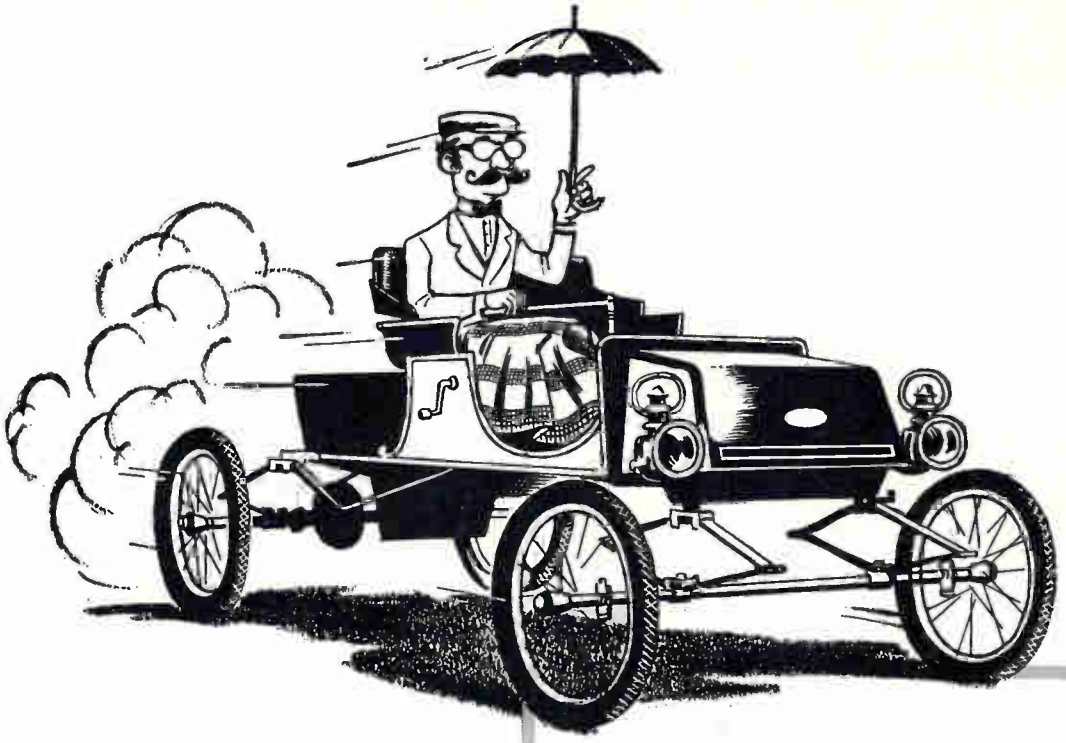
Engineering

Departments



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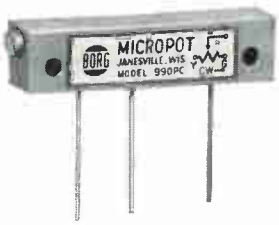

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March 18, 1960 Vol. 33, No. 12

Member ABP and ABC

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CROSSTALK . . .

BE SEEING YOU. For us, next week began last year. It's always that way with ELECTRONICS' editors and IRE shows. One ends and, immediately, we start planning for the next one.

Well, the show is here. It runs next Monday through Thursday in New York City. And along with thousands of others, our editors will be there, listening, chatting, checking new equipment, asking questions—and doing more listening.

Les Solomon will probably spend much time looking at Japanese devices. (He has written about them—and he was host when Leo Esaki took a holiday to tour New York City.) Bill Bushor is itching for the show to open. Information retrieval holds a special fascination for him.

Mike Perugini and Nilo Lindgren, recently back from a week's coverage of the Solid-State Circuits Conference in Philadelphia, will delve further into that specialty. Howard Janis (he writes our widely-read Newsletter) plans to chat with management people, particularly those active in exports-imports. For Tom Emma, it's largely financial doings. He writes Financial Roundup.

Jack Carroll will be getting an overall view of the show and placing it in perspective. Sy Vogel is certain to be found chatting with research and development men. Sam Weber will be busy soliciting and developing technical articles. Mike Wolff (he and Emma co-authored last week's lead technical feature) will be renewing acquaintances made during that thorough survey.

John Mason will be primarily probing military matters. Rolly Charest will be saying hello again to his many New England business friends, and seeking hot news wherever it is. Stanley Froud is a sure bet to talk at length with visitors from across the Atlantic and England in particular.

Our department editors will be out in full force. Mike Tomaino (Components and Materials) already has several appointments to keep. Sy Carter (Research and Development) will be shaking many hands. Bill O'Brien (On the Market) probably gets more mail than anyone else on our staff. So he will be very active. George Sideris (Buyers' Guide Editor and editor of the Production Techniques department) has dozens of story leads to follow.

Ed DeJongh (Market Research) has a pad filled with appointments. George Flynn plans to attend numerous technical sessions. And some of our field editors will be there.

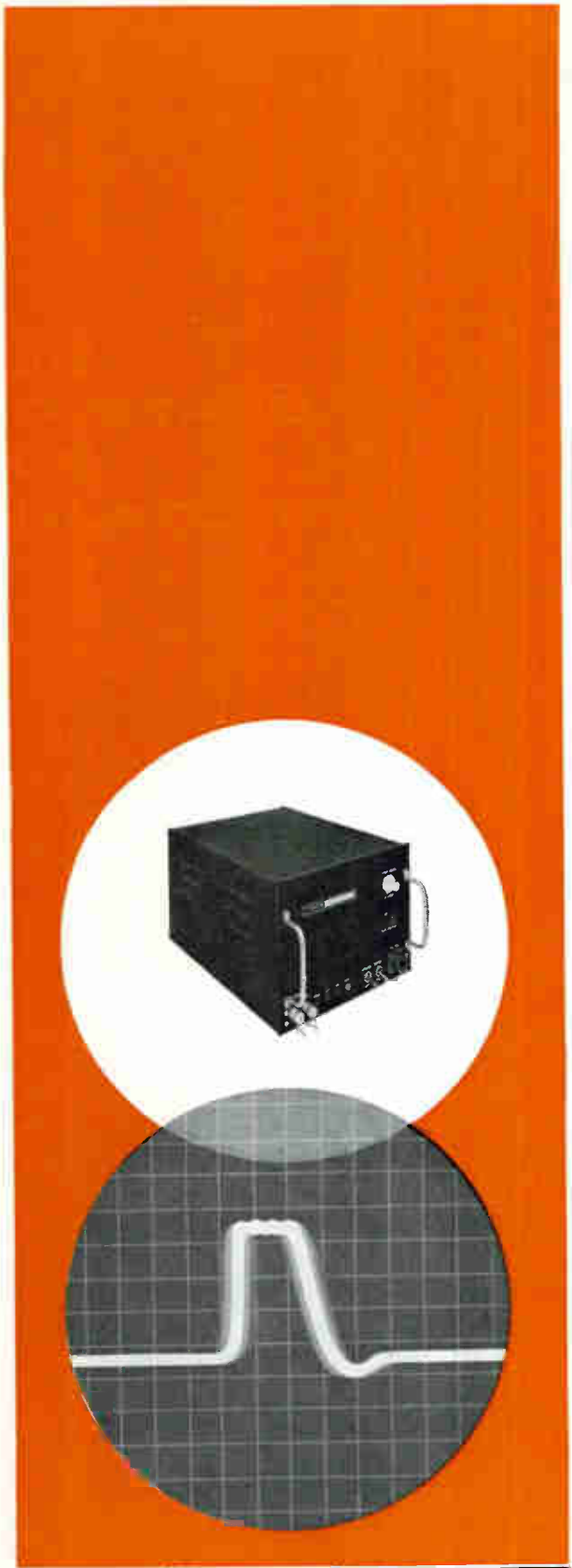
ELECTRONICS' editors will be on hand at the IRE show from start to finish. They will be working hard and enjoying seeing you again.

W W MacDonald

Editor

Coming In Our March 25 Issue . . .

AUTOMATION. As reported recently in ELECTRONICS (p 11, Feb. 19), an automated transistor assembly system has been developed by IBM. In our next issue, T. J. Leach of IBM in Poughkeepsie, N. Y., explains the operation of this significant machine which assembles and inspects transistors individually at every step, as contrasted with batch processing. You'll learn about the circuits and inspection components that permit the machine to turn out 1,800 alloy-junction transistors an hour.



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Temco has developed a family of solid state modulators suitable for a variety of military and commercial uses. One current application is in missile and airborne radar beacons. Further information is available from Temco on request.

Many excellent engineering and scientific positions are now open in this and other Temco programs. We invite your inquiry.

Visit with Temco at the IRE Show—Booth 3043

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Here is the first commercially available line of all-magnetic shift registers. Now you can have both non-destructive dynamic and static output in the same register. Now you can have the minimum number of components, the minimum number bit to bit interconnections and any serial/parallel input and output combination. Made with AMP multiaperture ferrite cores and copper wire only (see schematic below), the AMP Shift Register line has a number of other useful features:

- —40°C to +75°C temperature operating range
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- immune to nuclear radiation
- small size—ideal for miniaturization requirements
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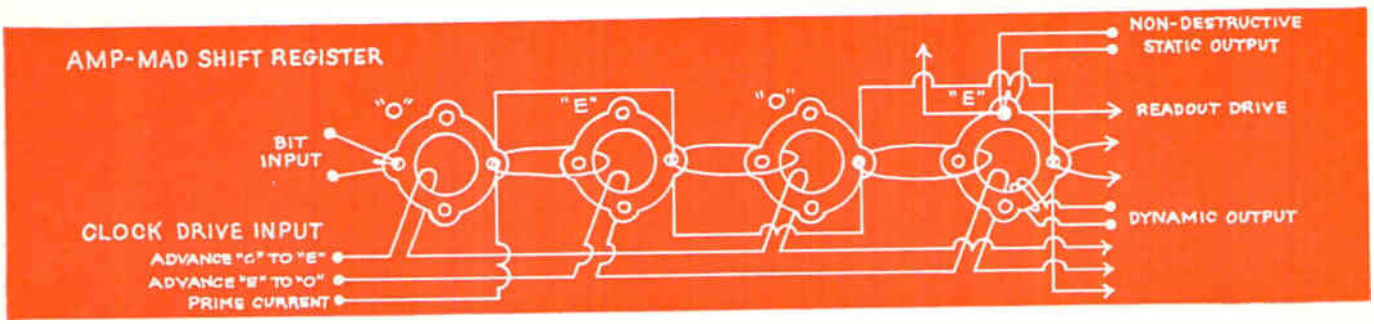

For complete information, including operating data, send for our AMP-MAD Shift Register brochure.*

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Microwave Component News from SYLVANIA

Lower relay equipment operating costs with new Sylvania Klystrons

Metallurgical and processing improvements mean superior life and performance

Sylvania's research and production capabilities have produced a series of klystrons that promise to surpass earlier types in performance.

Sylvania's klystrons have the following features:

Improved high-temperature glass seal — this permits higher bake-out temperatures and gives a lower gas level. The resulting tubes have a life expectancy of 10,000 hours, 2,000 hours longer than competitive types, and better shelf life. This means lower operating costs for relay link equipment.

Purer metals and materials – the premium quality metals used in these tubes, combined with new, exacting processing techniques permit higher bake-out temperatures and result in longer trouble-free operation with low gas levels.

Superior performance – full coverage from 5925 to 8100 mc with 1 watt nominal output power. Most of these tubes have a minimum electronic bandwidth of 28 mc.

Sylvania klystrons will give you added cost savings because of their longer life and fewer early-life failures. Send for the data.

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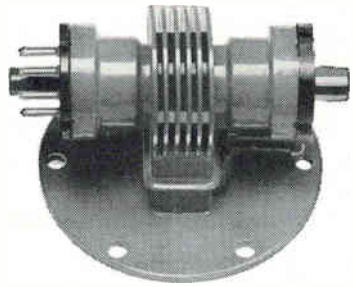
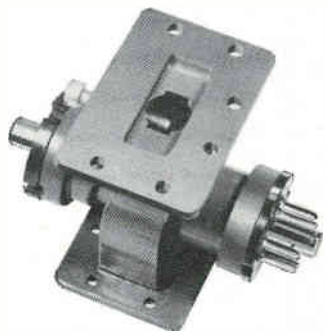


SK-220B, shown approx. 1/3 actual size.
Fins facilitate forced-air cooling.



SK-222D, shown approx. 1/2 actual size.
Flange connects to heat sink.

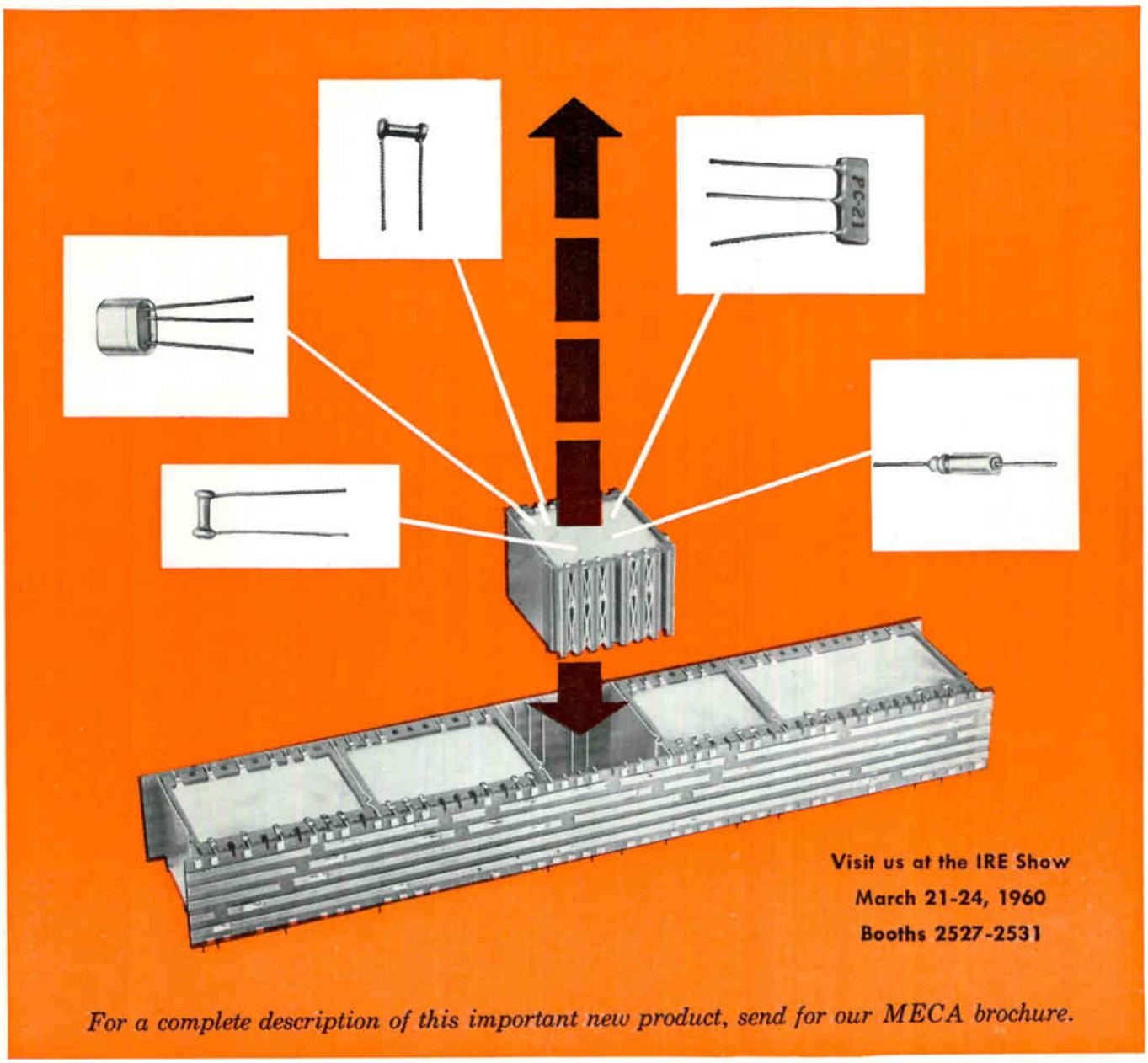
Forced air cooled	Conduction cooled	Frequency
SK-220F	SK-222F	5925-6225 mc
SK-220E	SK-222E	6125-6425 mc
SK-220G	SK-222G	6425-6575 mc
SK-220D	SK-222D	6575-6875 mc
SK-220C	SK-222C	6875-7125 mc
SK-220B	SK-222B	7125-7425 mc
SK-220A	SK-222A	7425-7750 mc
SK-220Z	SK-222Z	7750-8100 mc

NOW! 3-D PROGRAMED CIRCUITS!

with "Put 'N Take" servicing of individual functions

Here's a major new concept in interconnecting circuitry that offers the most advanced approach to reliability and maintainability—the AMP MECA (Maintainable Electronic Component Assembly). With MECA, you simply encapsulate your components in replaceable AMP-CELLS which are then plugged into AMP's 3-D Circuit Boards. Result: Instant servicing by substitution and throwaway.

The AMP-CELLS can grow or shrink in 3 dimensions on the 0.1 or 0.2 grid system. Hand, semi, or completely automatic tape programming produces these simple 3-D circuits. The AMP-CELL contacts do not protrude, cannot be damaged by abusive handling. All AMP-CELLS are wholly contained within the 3-D Circuits—totally secured to resist vibration and physical damage.



For a complete description of this important new product, send for our MECA brochure.

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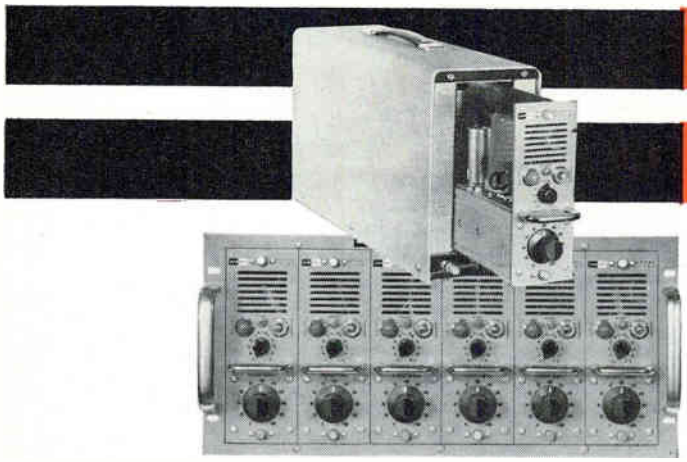

111BF DC amplifiers in Model 195 single-amplifier cabinet and Model 190 six-amplifier 19" rack module.

HERE'S WHY THE KIN TEL 111BF DC AMPLIFIER IS THE BASIC COMPONENT FOR ACCURATE, DRIFT-FREE AMPLIFICATION OF MICROVOLT-LEVEL SIGNALS:

KIN TEL 111BF DC wideband amplifiers allow extremely accurate measurement of dynamic physical phenomena such as strain, temperature, vibration, pressure, flow, torque, and displacement. They greatly simplify the design of data measurement systems, offering more bandwidth and accuracy, reduced maintenance, and none of the capacitive balance problems inherent in AC carrier equipment. KIN TEL's proved chopper amplifier circuitry with multiple feedback loops assures operational stability and uniform frequency response regardless of load or gain changes. The capability of providing full bandwidth and full output into large capacitive loads, at high gain settings, places virtually no restrictions on the type of output device that can be driven and allows the use of longer output cable runs.

The 111BFO, an operational version of the 111BF, has an open-loop position instead of a zero-gain position. In this position the user may employ external networks to provide up to 100% resistive or capacitive feedback around the amplifier, allowing its use as an integrator, active filter, or to generate complex linear transfer functions.

Many thousands of KIN TEL DC amplifiers, with millions of cumulative hours of operation, are in day-to-day use. Virtually all major missile programs—including ICBM-employ KIN TEL DC amplifiers in ground support instrumentation.

- **Less than 2μv drift for 100's of hours**
- **DC – 40kc bandwidth**
- **0.1% gain stability**
- **$\pm$45v, $\pm$40ma output**
- **100kΩ input, $<$ 1Ω output impedance**
- **20 to 2000 gain**
- **Full output into 1μf loads**
- **Integral power supply**

Prices:

111BF DC Amplifier	$625
111BFO DC Amplifier	$635
195 Single-amplifier Cabinet	$125
190 Six-amplifier 19" Rack Module	$295

Immediate delivery from stock on reasonable quantities.

(Note: Amplifiers must be operated in 190 Module or 195 Cabinet.)

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BUSINESS THIS WEEK

Digital and Analog Computermakers Seek Wide Marketing Through Pricing and Design Flexibility

Cost-cutting by manufacturers of small and medium-sized computers and flexible design continue to be emphasized in announcements of new machines.

Bowmar Instrument Corp., Fort Wayne, Ind., says it has developed a "desktop" analog computer priced at $2,000 which can be expanded later by the addition of modular units. The company says the initial unit can be expanded to a $25,000 floor model with pre-programmed, removable patchboard system, up to 64 amplifiers, electronic multipliers and diode function generators—all requiring less power than a toaster. The computer, called the "AD-1" Electronic Differential Analyzer, was designed by four University of Michigan professors who incorporated themselves as Applied Dynamics, Inc. Bowmar acquired the company last month.

Litton Industries' Monroe Calculating Machine division reports its new 300-lb Monrobot Mark XI solid-state alphanumeric general-purpose computer sells for $24,500. The company claims versatility and performance equal to machines costing three times as much, hopes it may reverse the trend towards centralized corporate data-processing. Firm's reasoning: Lower cost machines might make it feasible for branch offices to process their own data, with resulting benefit for local management, before consolidation of data in a central office. Computer's 5,200 rpm magnetic drum stores 1,024 32-bit words. Machine averages 5,000 computations a minute. It uses input-output of punched tape, or cards, electric typewriter or teletypewriter; numerical keyboard can also be used for input.

Delivery of New Single-Sideband Systems For Military and Commercial Use Reported

Single-sideband communications systems are making news in both the military and commercial markets.

A system called "Short Order" is reported now in operation for the Strategic Air Command. **Using any combination of four widely-scattered transmitters and receivers, and with a special microphone, the SAC commander can communicate on any one of several different frequencies to airborne SAC craft.**

Collins Radio developed and manufactured the equipment. Alpha Corp., a Collins subsidiary which is installing the system, says SAC's ground-to-air communications system has been increased from 500 to 45,000 watts by "Short Order."

Two of four powerful stations at Barksdale AFB and Offutt AFB each have a 172-ft Wullenweber antenna plus 15 single-sideband transmitter-receiver antennas. Two others will soon be in operation at March AFB and Westover AFB. Any one of the installations can usually handle all communications, according to Alpha, with the three other sites serving as "standby" centers.

Collins also announced that the Marine Corps has ordered $21 million worth of single-sideband gear for jeep and truck mounting. Equipment provides long and short-range communication on 28,000 channels covering the 2- to 30-Mc band and is compatible with existing military single-sideband gear.

On the commercial front, a single-sideband suppressed carrier multiplex system covering 470 miles and costing about $1.5 million will be constructed by the Columbia Gas System. Equipment provided by the Texas division of Collins Radio, will provide voice and data communication, telemetering, and supervisory control.

ELECTRONICS NEWSLETTER

An orbiting astronomical observatory big enough to hold a 50-in. remotely-controlled optical telescope and involving one or more systems for communicating data back to earth is in the early stages of planning by the National Science Foundation and the National Aeronautics and Space Administration.

Present preliminary design calls for a cylindrical satellite 20 ft long with a skirt around the aft end containing instrumentation. **A television link is one of several communications systems under consideration for sending the telescope's observations back to earth.** An electronic technique of coding optical signals is also being considered.

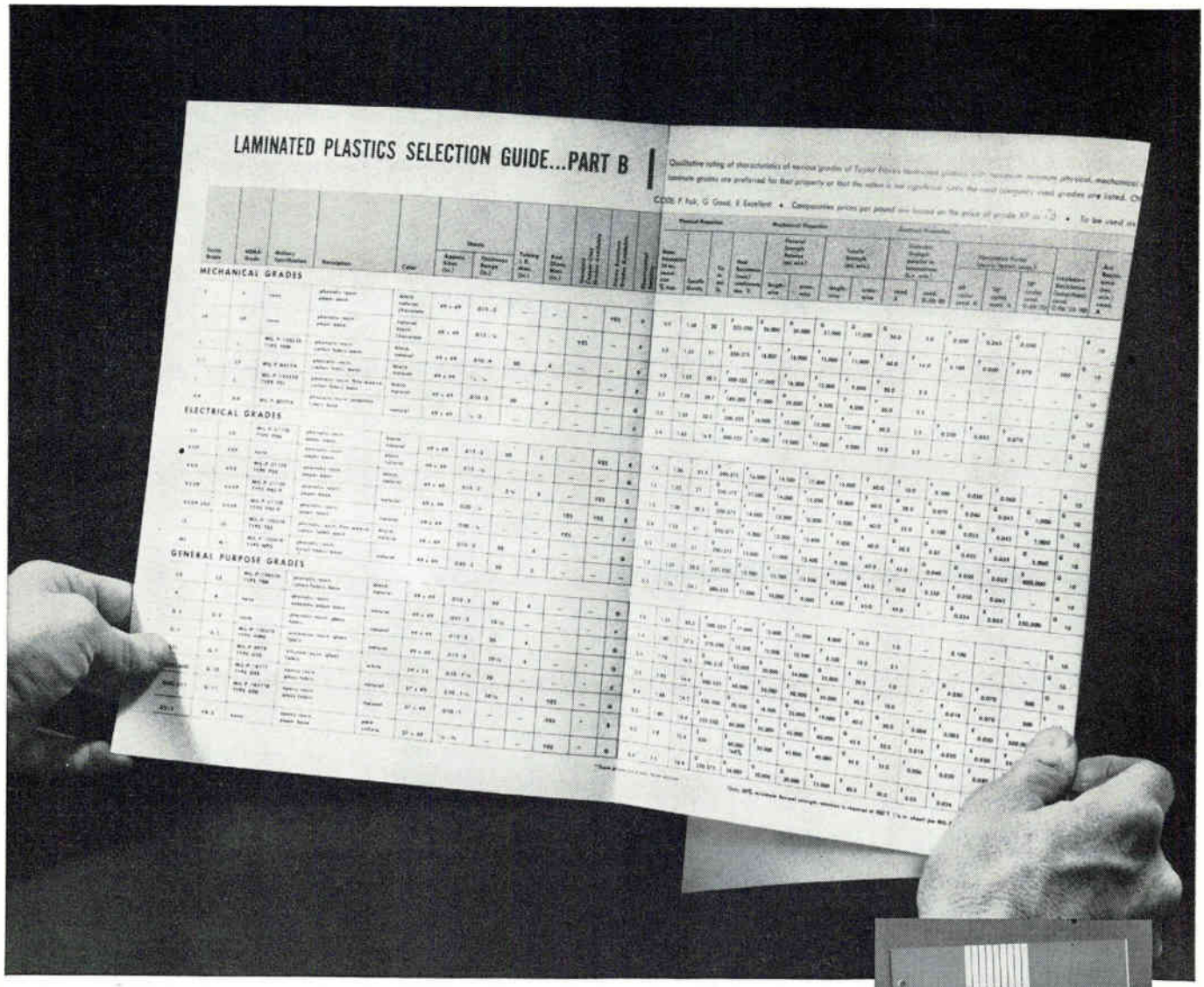
An NSF spokesman emphasized that the orbital telescope is a long-range project, and that it is expected that such "a large, fully controllable instrument will not be placed in orbit for several years." Work will be carried out in close cooperation with NASA.

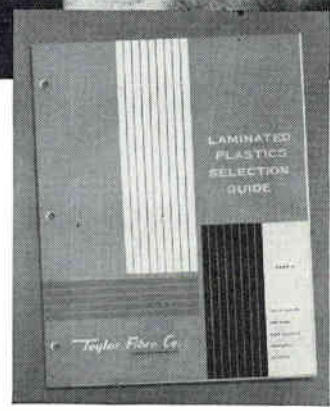
Experimental design of the 50-in. aperture telescope is underway at NSF's Kitt Peak National Observatory near Tucson, Ariz., which was dedicated this week. So far, $160,000 in NSF funds are involved for "preliminary conceptual design." **The telescope is expected to have a lifetime of 5 to 10 years in an orbit thousands of miles beyond the earth's atmosphere.** NSF describes it as "an accurately pointable instrument of high resolving power that can make observations on command from earth and communicate them back to earth."

Japan Electronics Parts Show held last week in Osaka featured new consumer products, with hi-fi and stereo attracting the most attention. Color tv is still beyond the reach of most Japanese, but sets are being produced in small numbers for promotional displays. Tape recorders about one foot by eight inches and small tv sets were among the new miniature sets of all kinds still appearing. Another trend: Japanese manufacturers are stepping up efforts to make their own components according to Western standards so that exported gear can be easily maintained.

Important facts to know about laminated plastics

New Guide Developed by Taylor

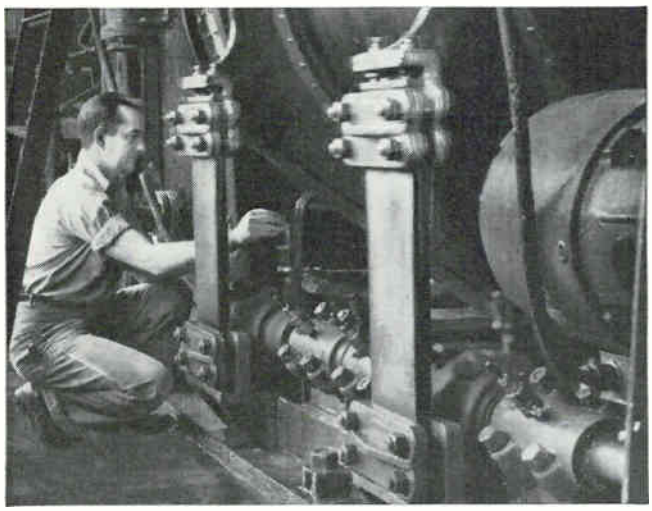




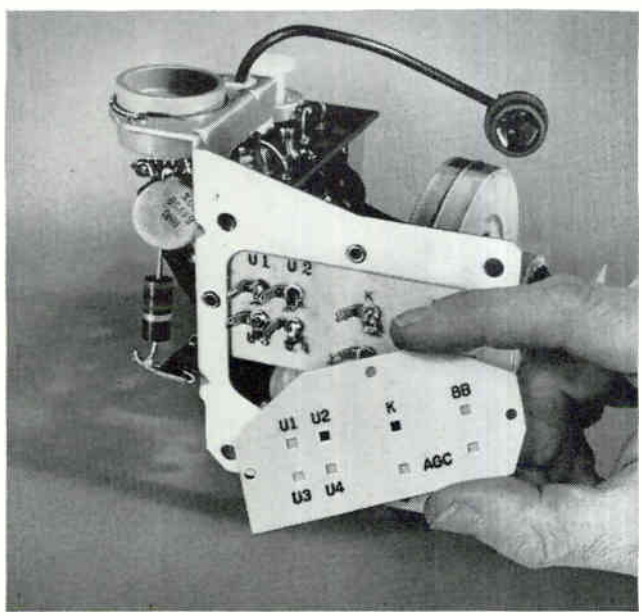
If you have specialized in metals and are considering industrial laminated plastics as a material for certain components in your design for the first time, this newly devised Taylor Selection Guide will help you evaluate the different grades available. The simplified properties chart lists the various grades now produced and clearly indicates the properties in which they excel. An accompanying booklet gives helpful hints on the selection of laminated plastics for your specific application. Write for your copy of this handy Taylor Laminated Plastics Selection Guide today. Use it to make tentative selections of the laminated plastics that most nearly fit your requirements. Then consult us on the design and application of laminated plastics and parts fabricated from them before making a final decision. Our application engineers will be glad to discuss them with you. Write Taylor Fibre Co., Norristown 40, Pa.

Simplifies Laminate Selection

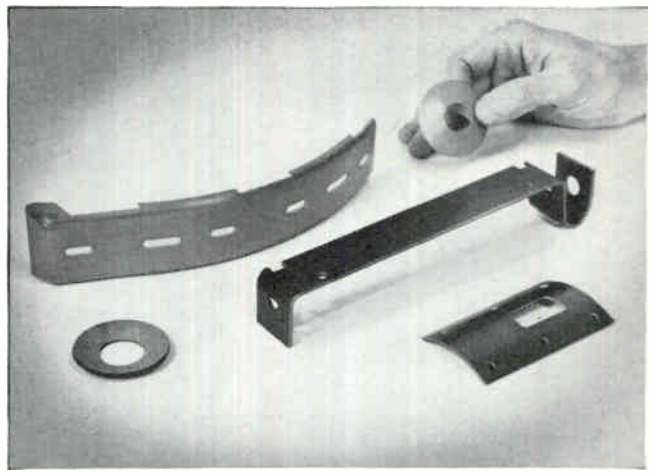
Suggested applications of different grades of Taylor Laminated Plastics



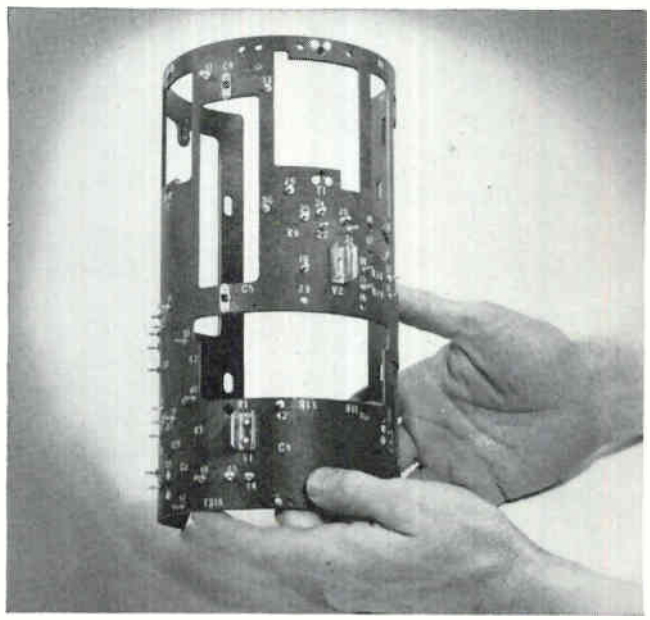
For the fabrication of springs, silent gears, pinions, cams and bearings: Taylor Grade C—a phenolic resin, cotton fabric base, mechanical grade and Taylor Grade L, a phenolic resin, fine weave cotton fabric base grade.



For high-temperature electrical applications and high-frequency radio equipment: Taylor Grade GSC—a silicone resin, glass fabric base, high-heat-resistant electromechanical grade.



For forming into intricate shapes, compound curves, and deep draws: Taylor Grade C-7—a phenolic resin, cotton fabric base, postforming grade. Also Taylor XX-7—a phenolic resin, paper-base postforming grade.



For applications requiring high-strength retention at elevated temperatures: Taylor Grade GEC—an epoxy resin, glass-fabric base grade

Taylor

LAMINATED PLASTICS VULCANIZED FIBRE

WASHINGTON OUTLOOK

THE AIR FORCE has introduced an additional contracting step for weapon system development projects. The step will tend to stretch out the projects' hardware fabrication schedules and, in addition, the awarding of major subcontracts.

The new stage is formally called "Phase Alpha." As an Air Force general explains it to ELECTRONICS, it requires prime contractors to "further refine" study proposals submitted during the source section competition before a conventional "Phase 1" development contract is awarded.

First project to be affected by the new procedure is the Dyna-Soar manned boost-glide vehicle. Presumably, the major subcontracts will not be awarded until Phase Alpha is completed later this spring.

The new procedure reflects the Air Force's increased caution on costly new projects in the face of rising costs, stringent budget restrictions, and the technological unknowns of manned space flight. Says ELECTRONICS' source: "The purpose of Phase Alpha is to increase our confidence that we are on the proper development course in a project that promises to be exceedingly expensive."

Actually, Dyna-Soar is not yet considered a weapon system project in the sense that the Atlas ICBM or the B-58 bomber projects are weapon systems. Instead, the Pentagon calls it an "advanced development project", to underscore the fact that the future production potential is still not under serious consideration.

Dyna-Soar's first objective is to design and test a glider to bring a man back to a normal landing after hypersonic flight speeds.

In addition to the introduction of "Phase Alpha", the Dyna-Soar project represents a sharp departure from recent USAF development policy in another sense. USAF has taken on more direct control over Dyna-Soar than it has exercised in similar development programs. USAF's Air Development division, rather than the prime industrial contractor, is acting as system manager.

Boeing is prime for design and construction of the vehicle, Martin for production of the rocket launcher.

Among the electronics companies bidding for important subcontracts for Dyna-Soar are Bendix Aviation, Minneapolis-Honeywell, Ramo-Wooldridge, General Electric, and North American Aviation's Autonetics division. These companies were on the competitive Boeing and Martin teams during the source selection phase.

But their relationship with the two companies will have no bearing on the final selection of subcontractors.

- **The Army plans to install a prototype** of the Nike-Zeus antimissile system's target track radar at Ascension Island in the south Atlantic and a prototype of the Zeus missile track radar at Pt. Mugu, Calif. Purpose is to test the two radars in "operational environments" prior to the first test demonstration of the full-scale Zeus system. That demonstration is scheduled for late 1962 or early 1963 at Kwajalein Island in the southwest Pacific.

  The Ascension Zeus radar installation—a local acquisition type—will be used to track impacting ballistic missiles test-fired from Cape Canaveral. The Pt. Mugu unit will be used for guidance in long-range test launchings of the Zeus missile.

  The Army's deployment plans for the Nike-Zeus system call for the installation of three target track or local acquisition radars and nine missile track radars at each operational Zeus battery. Each site will hold 50 Zeus missiles.

Which of these

APPLICATION NOTES

can help you?

#16 WAVES ON TRANSMISSION LINES

#17 SQUARE WAVE AND PULSE TESTING

#18 INTRODUCTION TO SOLID STATE DEVICES

#21 MICROWAVE STANDARDS PROSPECTUS

#27 BASIC MICROWAVE MEASUREMENTS

#29 CONVENIENT METHOD FOR MEASURING PHASE SHIFT

#30 MEASUREMENT OF CABLE CHARACTERISTICS

#34 AC CURRENT MEASUREMENTS

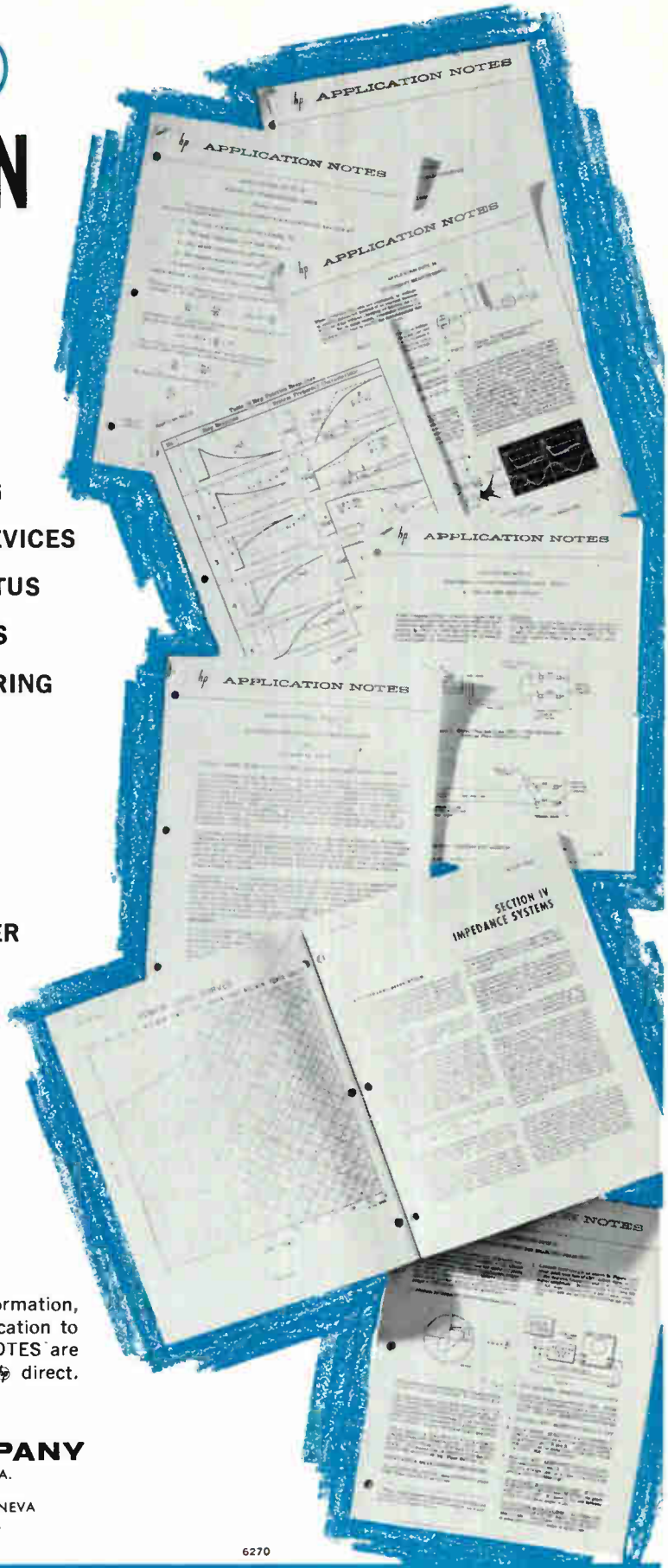
#36 SAMPLING OSCILLOGRAPHY

#37 MONITORING A RADIO TRANSMITTER SIGNAL WITH AN hp 120A OR 130B OSCILLOSCOPE

#38 MICROWAVE MEASUREMENTS FOR CALIBRATION LABORATORIES

#39 STANDARDS CALIBRATION PROCEDURES

#40 HEWLETT-PACKARD ELECTRONICS INSTRUMENTATION FOR TRANSDUCER APPLICATIONS



The above involve both theoretical and "how to do it" information, illustrated, complete, designed for swift practical application to your problem. These and all other hp APPLICATION NOTES are available by calling your hp representative, or writing hp direct. No charge, no obligation.

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Moreover, these pages are respected. Subject to audit by the oldest circulation-auditing bureau in the world, the *Audit Bureau of Circulations*, they have integrity.

Probably this is the first Publisher's Statement you have ever seen. As far as we know, such a statement has never before been published in a magazine for electronics men. We are doing it now for several reasons:

ONE. We want *you* to know what company you keep.

TWO. It explains why we ask so many questions of our subscribers.

THREE. We want you to know that the editors know who *you* are, and therefore know how to help you.

FOUR. Frankly, we are proud of you and the other 52,000 progress-minded men who have asked for and paid for the leading publication in the electronics field . . . we say leading because far more men like you pay to read ELECTRONICS than any other publication claiming to serve this industry.

How A.B.C. helps YOU. A.B.C. constantly urges and helps editors to develop and supply the kind of information and help for which *you* are willing to pay.

How A.B.C. helps US. The facts in the following four pages help us describe the audience to our advertisers and prospective advertisers. This is important to *you* because . . . Without advertising, ELECTRONICS would have two alternatives:

ONE. Increase the subscription price to cover the true cost of publication, or

TWO. Reduce the editorial service.

How A.B.C. helps the ADVERTISER (and you). These blue pages provide the advertiser with information which he can appraise and evaluate in selecting those publications which promise the most effective results. Like the editors, he, too, can study the people in the audience and gear both his product and copy in terms of their interests.

And, because of all of this, you are the boss.

The success or failure of an A.B.C. publication is in the hands of its subscribers. If the editorial service rendered does not measure up to *your* expectations, you will reject the service and the audience of the publication will shrink. Advertisers will find the medium less attractive.

Most publishers recognize this fact and gear editorial service to the needs and interests of the subscriber, knowing full well that a publication's success will be contingent on how well it performs in this vital area. ELECTRONICS has a continuing and running bench-mark by which to measure results. If A.B.C. certified circulation maintains and grows it's on the right track. If renewal percentages maintain and improve we can be doubly sure we are supplying the right service to *you*.

James Gindwood

PUBLISHER

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

ACCEPTED — to indicate a subscriber is actually engaged in research-design/production/management as a maker or user of electronics equipment.

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electronics is a member of a select group too—The Audit Bureau of Circulation publications—comprised of those magazines and newspapers whose publishers believe that a reader's interest in a publication is best demonstrated when he pays to receive it—those publishers willing to submit to exhaustive periodic audits in order to prove that their circulation is among those individuals they are pledged to serve, and among screened *selected* individuals ONLY.

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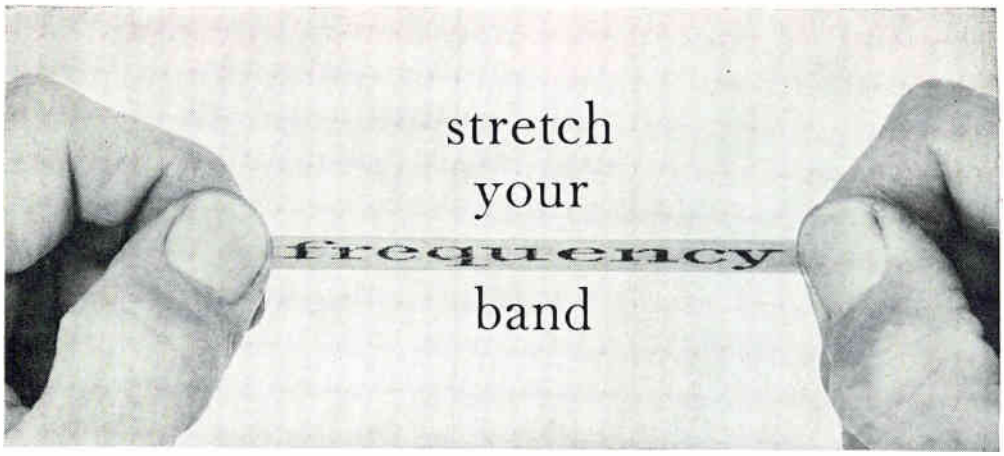

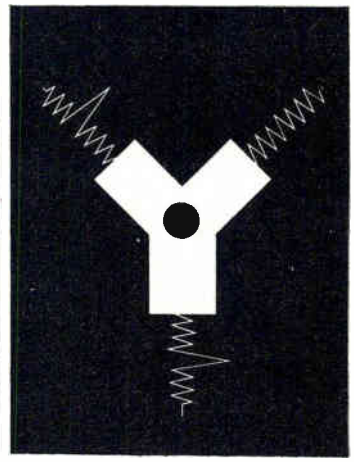

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	Model C-201A	Model X-230A (Illustrated)
Frequency:	4.9-6.2 Kmc	8.0-9.8 Kmc
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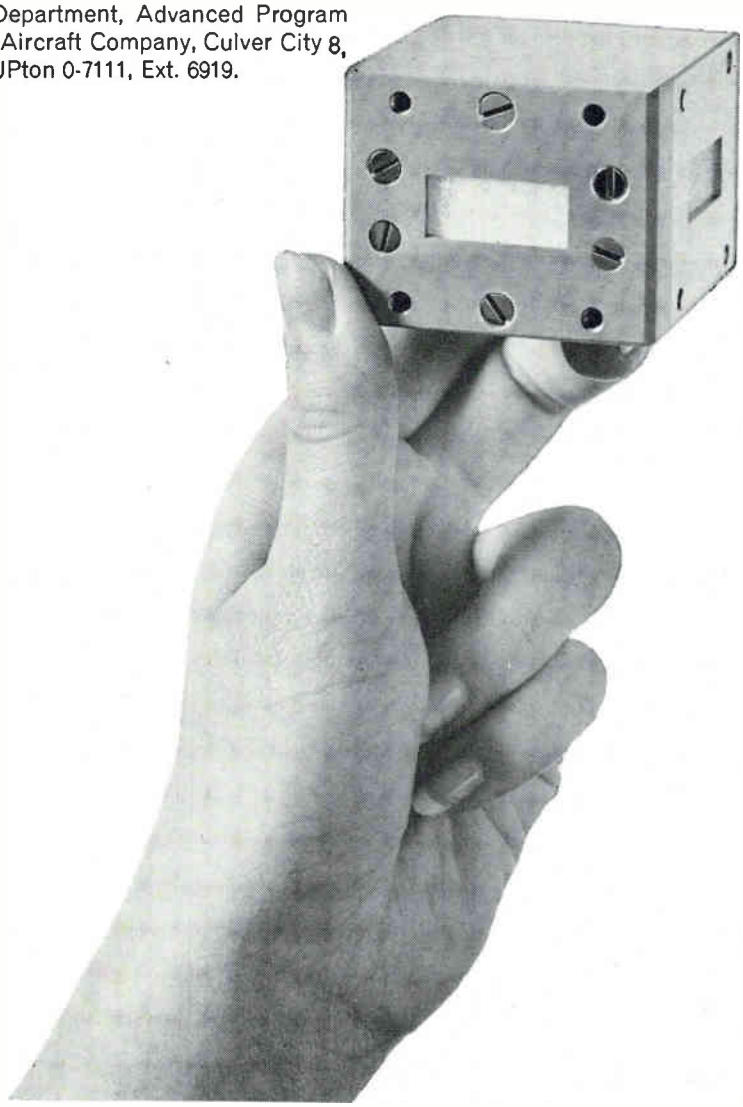


Company's Income Soars 136%

TEXAS INSTRUMENTS, INC., Dallas, reports 110-percent rise in sales, 136-percent rise in net income for 1959. Sales for the year were $193,212,809, net income was $14,-142,788, compared with 1958 sales of $91,953,845, net income of $6,000,928. Earnings per share of common stock in 1959 were $3.59, or 95 percent greater than the previous high of $1.84 in 1958.

• All-time high in sales is reported by **Radio Corporation of America** this week. Sales rise of 19 percent over 1958 brings the total figure for 1959 to $1,395, 620,-000. Profits after taxes amounted to $40,142,000, compared with $30,-942,000 the year before. Earnings per share of common stock were $2.65, compared with $2.01 in 1958. RCA's David Sarnoff says he expects a doubling of business in the next five years.

• **Perkin-Elmer**, Norwalk, Conn., announces second quarter sales were 39 percent ahead of the same period last year, and earnings 61 percent higher for the period ended Jan. 31. Sales for the first six months of the firm's fiscal year were slightly up from the same period a year before. The sales were $8.6 million, earnings $342,-919, equivalent to 30 cents per share of common stock for the first six months.

• **Admiral Corp.**, Chicago, reports preliminary figures show consolidated sales of $199,000,000 for 1959. This is an increase of 17 percent over the $170,777,126 recorded in 1958. Earnings after taxes in 1959 were about $1.70 per share on 2,405,471 shares outstanding, compared with 57 cents per share in 1958.

• **Philco Corp.**, Philadelphia, announces 1959 sales increase of 13 percent over 1958. Sales total last year was $397,792,000, compared with $351,093,000 for 1958. Net income for 1959 totaled $7,176,000, compared with $2,874,000 the year before. Earnings increased in both consumer products and non-consumer areas. Earnings per share of common stock amounted to $1.67, compared with 61 cents in 1958.

• **America Bosch Arma Corp.**, Hempstead, N. Y., reports a sales increase but a decline in net income in 1959. Sales amounted to $119,957,956 for the year ended Dec. 31, 1959, as compared with $115,877,176 in 1958. Net income for 1958 was $4,100,723, equal to $2.14 a share. The comparable figures for 1959 were $3,532,530 and $1.83 respectively. At the close of 1959, the firm's backlog of defense contracts was about $128 million.

• **High Voltage Engineering Corp.**, Burlington, Mass., reports sales rise of 23 percent in 1959 over 1958. Dollar total last year was $7,087,916. Net income after taxes increased 44 percent to $626,-062. Additional income from subsidiaries brought the company's total net to $773,062.

25 MOST ACTIVE STOCKS

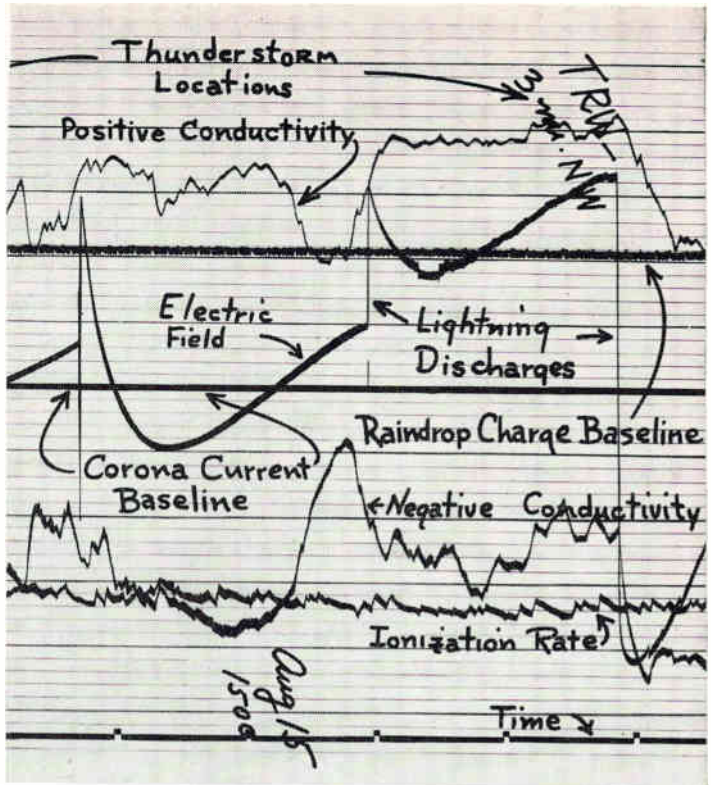
WEEK ENDING MARCH 4

	SHARES (IN 100's)	HIGH	LOW	CLOSE
Ampex	2,362	42¼	36⅛	38⅝
Philco Corp	1,745	34½	30⅝	32⅜
RCA	1,514	69¼	63⅛	64
Transitron	1,385	52¾	45⅛	47⅝
Collins Radio	1,274	63¼	56⅛	59
Siegler Corp	811	36⅜	31⅝	33¾
Litton Ind	743	75	65½	67¼
Int'l Tel & Tel	723	36¾	33	34½
Dynamics Corp Amer	694	12⅞	10⅞	11⅝
Gen Electric	687	90½	85	87⅜
Sperry Rand	675	24⅝	22⅜	22¾
Westinghouse	669	51⅞	46¾	48⅜
Avco Corp	657	13⅞	12¼	12⅝
Gen Tel & Elec	558	76	72⅝	74
Varian Assoc	545	49½	43⅜	45⅝
Zenith	483	106¾	95	97⅛
Beckman Inst	474	77⅞	69⅝	71¼
Raytheon	461	47¾	42⅛	43⅜
El Tronics	405	1⅞	1⅝	1⅝
Texas Inst	400	180¾	165⅜	169
Int'l Bus Mach	382	424½	408½	413
Amer Bosch Arma	375	25⅞	24	24⅛
Electronics Corp	375	12⅜	9¾	10
Univ Control	354	15⅛	13¾	14¼
Int'l Resistance	348	22¾	19⅞	21⅛

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

In research . . .

The analog record at upper right, made by a Model 906A Honeywell Visicorder oscillograph, gave U. S. Weather Bureau scientists immediate readout of thunderstorm data at Mt. Washburn in Yellowstone National Park. As the storm system passed, the Visicorder measured and recorded positive and negative air conductivity, rate of ionization of air, raindrop charge, corona discharge current from an insulated tree and a 4′x 6′ grass plot, times of camera exposure photographing droplet size and electrical charge, atmospheric potential gradient, and time. In any research field where high-speed variables are under study, the direct-recording Visicorder is providing instantly-readable, high-sensitivity data at frequencies from DC to 5000 cps. Models are available with 8, 14, or 36 channel capacities.

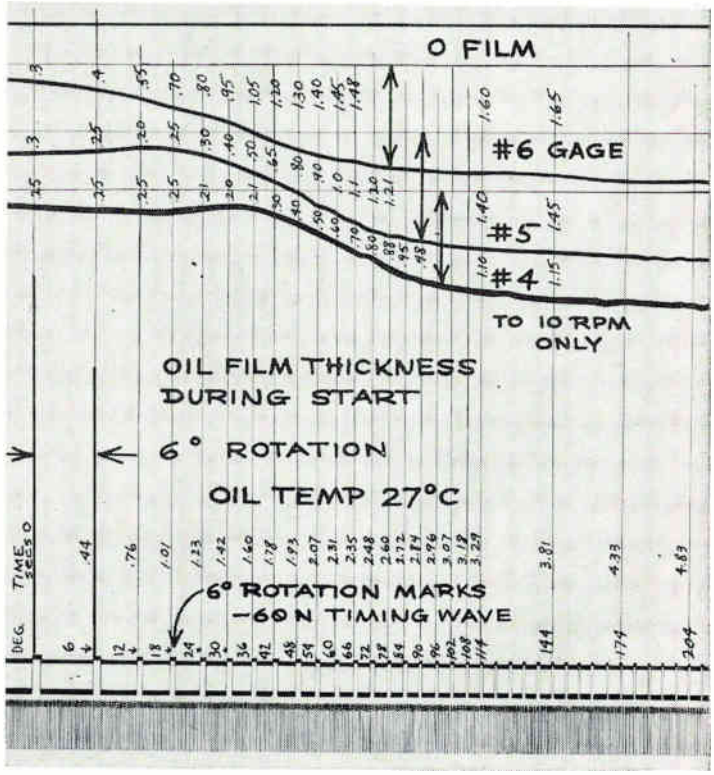


these are records of leadership

In industrial use . . .

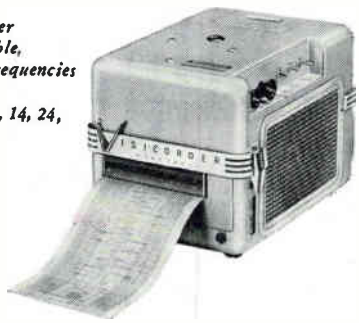
The Visicorder record at lower right, made by design engineers at Westinghouse, measured oil film thicknesses on the bearing pads of a 67,500 KW water wheel generator supplied for Chief Joseph Dam at Bridgeport, Wash. In these tests, oil thickness encountered by the leading edge of the bearing (trace #6), center (#5) and trailing edge (#4) were found to be within the limits of safety as predicted by engineering assumptions. In this and hundreds of other scientific and industrial applications, Visicorders are pointing the way to new advances in product design, rocketry, computing, control, nucleonics, and production testing.

For information on applying the unlimited usefulness of the Visicorder to your specific problems, phone your nearest Honeywell Industrial Sales Office.



Unretouched records 2/3 actual size.

The Honeywell Visicorder provides instantly-readable, high-sensitivity data at frequencies from DC to 5000 CPS. There are models with 8, 14, 24, or 36-channel capacities.

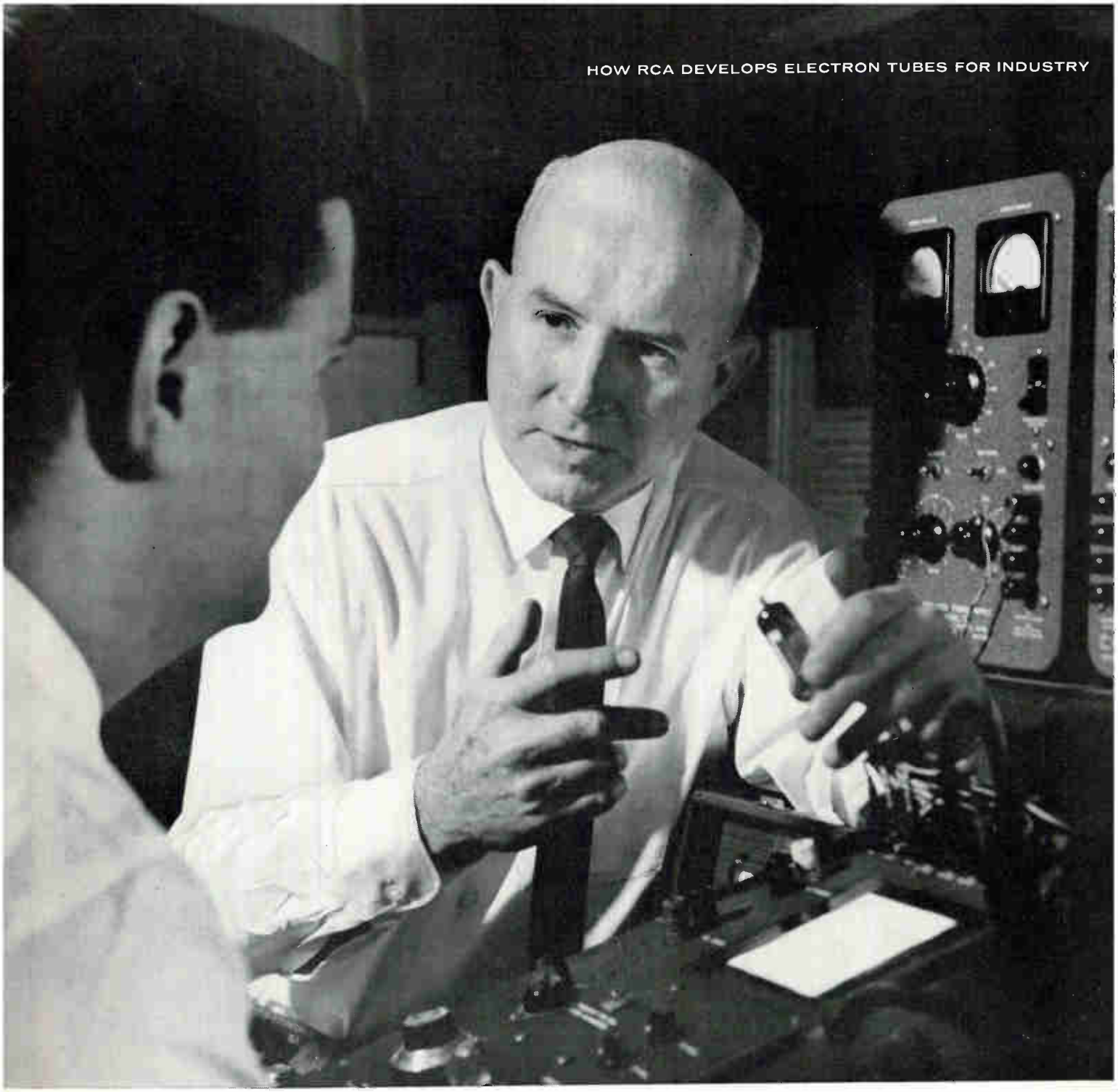


Honeywell

Industrial Products Group

Reference Data: Write for specifications on Visicorders 906B, 1108 and 1012.

Minneapolis-Honeywell Regulator Co., Industrial Products Group, Heiland Division, 5200 E. Evans Ave., Denver 22, Colorado



George Rose just won't sit still. As head of Receiving Tube Advanced Development, it is George Rose's job to direct the exciting activities of one of the most imaginative research teams at RCA. He is an able and dynamic chap: always on the move. So it's not surprising to find him not at his desk, but back in the lab pursuing his first love: the practice of shirtsleeve science.

George's multiple abilities guide the work of a group which fairly pops with new ideas. Recently he turned his staff loose on the problem of developing a modulator tube with exceptional isolation between inputs, good linearity, and high sensitivity. What emerged was an innovation in tube geometry: our new 7360 Beam Deflection Tube, one of the most significant contributions to single-sideband operation in many years. With the 7360, engineers can now design more efficient SSB circuits with fewer components.

The work of George's group, which has also been responsible for such electronic milestones as the nuvistor and the ceramic metal pencil tube, is another phase of RCA's broad continuing quest for finer, more reliable tube products for you.

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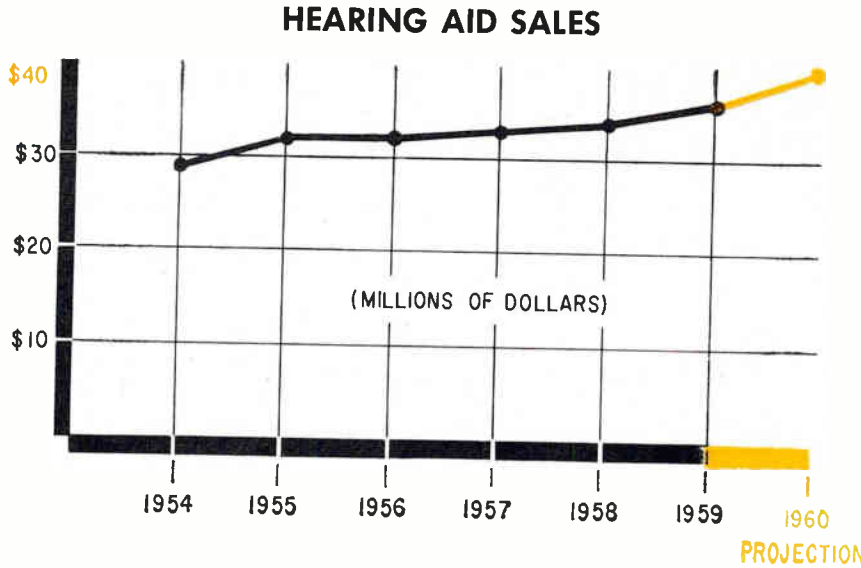
MARKET RESEARCH



Hearing Aid Sales Rise 11%

HEARING AID MARKET, stable in recent years, is perking up. Manufacturers estimate annual sales will increase by eleven percent this year.

Leland A. Watson, president of Maico Electronics, estimates 1960 factory sales value at $40 million and adds $10-$12 million dollars for accessory and battery sales.

Malte J. Carlson, president of Acousticon International division of Dictograph, figures 360,000 hearing aid instruments were sold in 1959, and he looks for unit sales to reach 400,000 in 1960. Manufacturers of components for use in hearing aids set the average unit price at $100.

See Increases

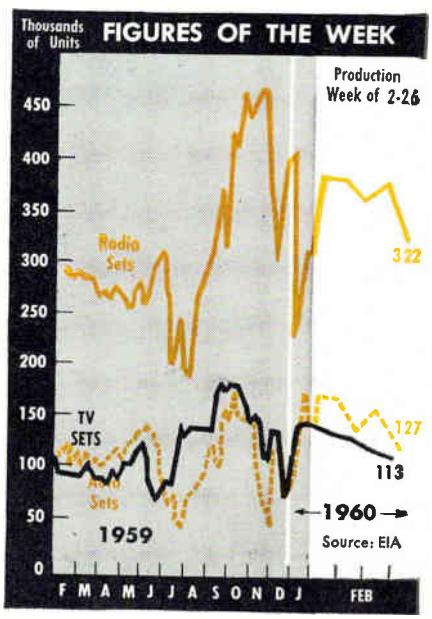
These estimates contrast with sales of $31.7 million in 1956, the latest hearing aid sales total available from the Census Bureau. For 1955 and 1954 the Bureau reports sales of $31.9 million and $29.0 million, respectively.

Rising consumer incomes, U. S. population increases and growing acceptance of hearing aids by the hard-of-hearing all point to rising hearing aid sales in future years.

Rapid growth in use of eye glass hearing aids has been a big factor in promoting greater acceptance. Manufacturers estimate that hearing glasses now account for 40 to 60 percent of all aids sold.

This trend is of special significance to manufacturers of electronic components, since 30 percent of eye glass hearing aids sold today are binaural types. They use separate microphones, amplifiers and ear phones for each ear and require twice as many components as conventional aids.

• **Crystal filter sales** are on the rise, according to reports received from both government agencies and financial sources. Rough estimate of the market size is $1.5 million for 1960, up 25 percent over estimated sales of $1.2 million last year.



THE MOST TAPE HANDLER FOR YOUR MONEY

HERE'S PROOF

The Potter 906 II, the high-speed digital magnetic tape handler that has come of age gives you higher performance, greater reliability and lower cost than any other tape handler on the market—bar none.

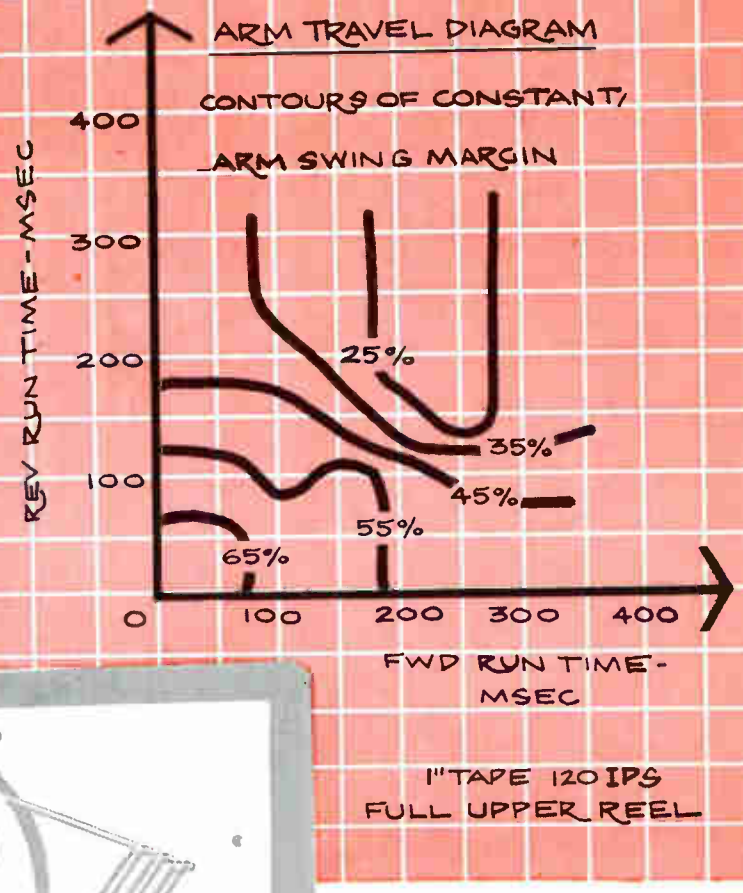
If you're interested in computer efficiency, you'll appreciate the kind of high performance shown by the actual test results plotted to the right. The Potter 906 II is the first and only tape transport to offer full forward-reverse cycling at 120 ips with 1" tape.

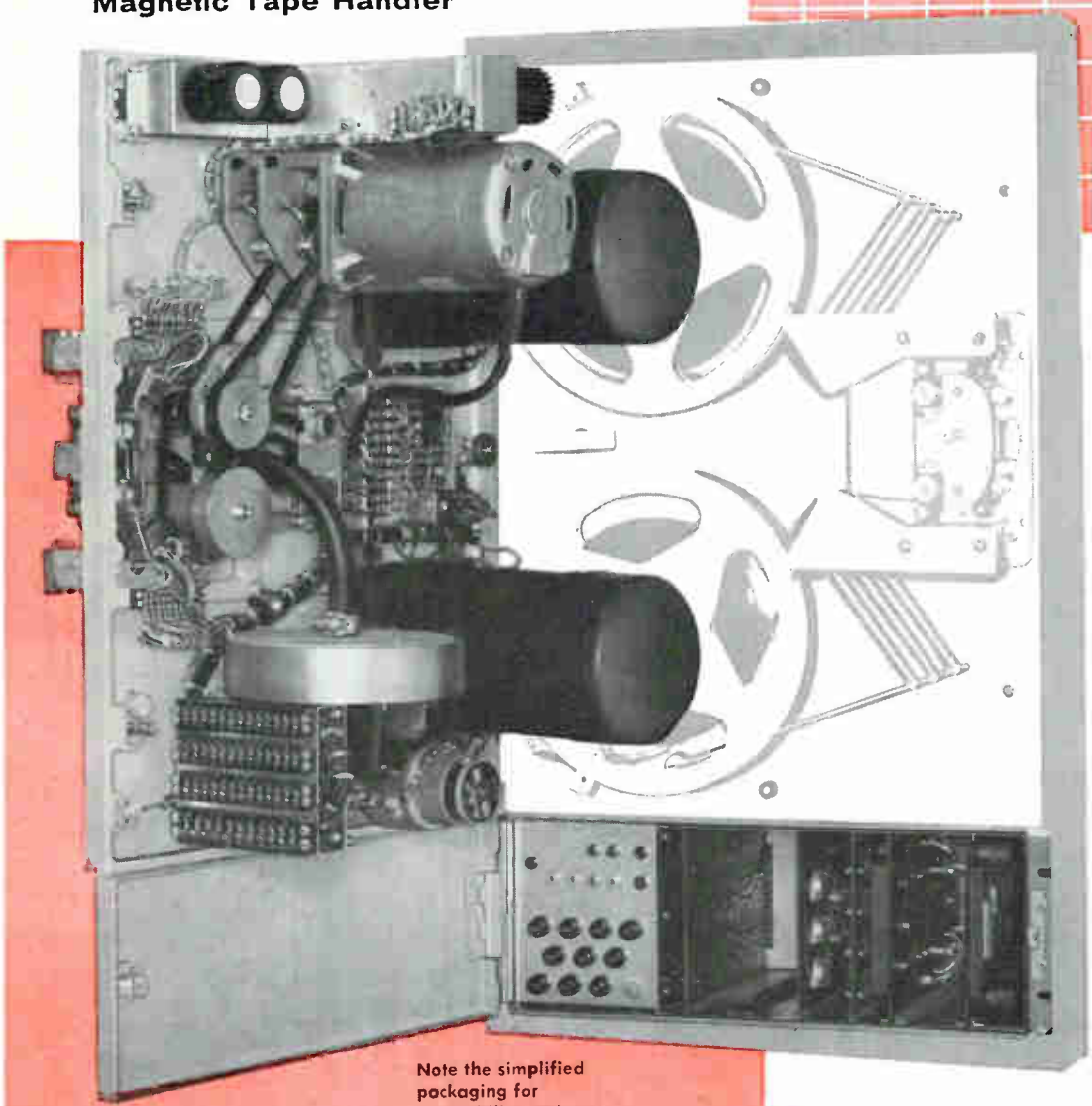
You'll be interested, too, in the other advantages that the 906 II now gives you for the first time. Among these are—

1. Low skew tape guide permits conventional recording at 400 bpi density.
2. Densities of 1500 bpi can be achieved by using this transport with the Potter Contiguous Double Transition system—450,000 8-bit characters per second on 1" tape.
3. Transistorized control of all functions simplifies computer design.
4. Simplified packaging for easy maintenance.
5. A price—far below other makes—that proves the economy of superior design.

Compare them any way you like—spec for spec, dollar for dollar, space for space—and you'll agree that the high-performance, low cost, Potter 906 II is the most tape transport at any price.

MODEL 906 II
Magnetic Tape Handler





Note the simplified packaging for accessibility and easy maintenance.

SPECIFICATIONS

TAPE SPEED
100 and 50 ips, standard. Maximum speed: 150 ips. Minimum speed: 1.0 ips.

START TIME
3 milliseconds or less.

STOP TIME
1.5 milliseconds or less.

STOP DISTANCE
0.100" ± .035" at 100 ips.

REWIND
300 ips constant speed either direction. 1¾ minutes for 2400 feet, millisecond start-stop, with 1/2" tape.

INTERCHANNEL TIME DISPLACEMENT
±2 microseconds at 100 ips from center clock to outside track on 1/2" tape.

COMPUTER INPUTS
All functions including speed selection, FWD, REV, FAST FWD, FAST REV, controlled with 0 volt "OFF," −5 volt "ON," level type signal. Other level or pulse control signals can be accommodated on special order.

BLOCK FEED REP RATE
200 blocks/second maximum.

TAPE TENSION
3 oz. nominal, 1/2" tape. Maximum tension in guide system, approximately 6 oz.

SIZE
24½" high swing-out panel for 19" rack mount. Hinge mounts separately for ease of installation.

I.R.E. SHOW—VISIT US AT BOOTHS 3407-09

POTTER INSTRUMENT CO., INC. Potter **Sunnyside Boulevard, Plainview, L. I., N.Y.**
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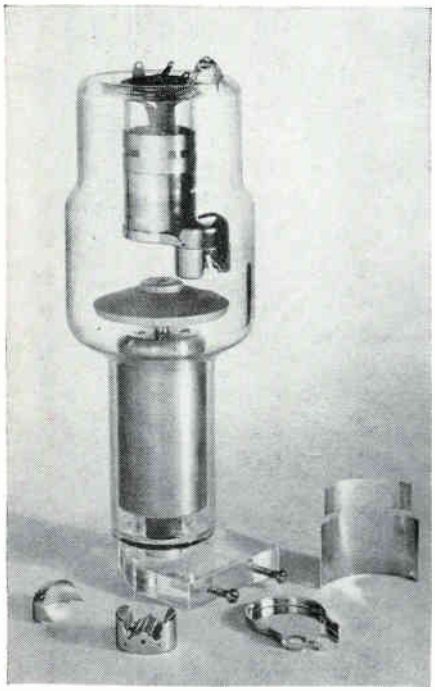
Why Electronic Grade "A" Nickel is used in X-ray tube cathode head and nearly 400 other tube parts

SPRINGDALE, CONN. — Resistance to elevated temperatures and retention of critical dimensions and position of parts are important reasons why Machlett Laboratories specify Electronic Grade "A" Nickel for the cathode head of their Dynamax 20-DF X-ray tube.

The sharp focus of this tube, says Machlett Laboratories, depends largely upon accuracy of the contours and dimensions of the nickel cathode head, as well as on positioning of the filament within the focusing slots. On every exposure, millions of electrons are focused at the nickel cathode head, then slammed against a tungsten anode target spinning in a vacuum. The heat is so intense that the target material would vaporize if it were not spinning.



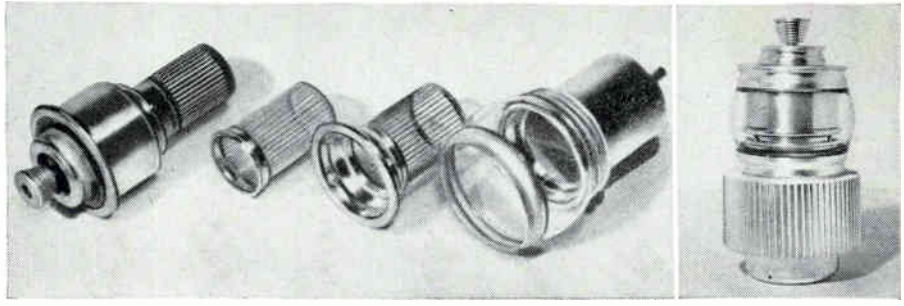
Nickel undistorted

Machlett's tube designers know how much Nickel contributes to longer tube life. For Nickel resists distortion at elevated temperatures, and its low vapor pressure plays an essential role in maintaining a high vacuum over a wide range of temperatures. Resistance to oxidation and ready fabrication are further aids to processing. The outstanding characteristics of Nickel reduce the problems of quality control.

Pertinent Literature: Write for Technical Bulletin T-15, "Engineering Properties of Nickel."

ELECTRONIC GRADE "A" NICKEL SOLVES 4 PROBLEMS IN NEW PULSE-MODULATOR 'HARD' TUBE

SPRINGDALE, CONN. — A high vacuum tube to pulse-modulate radio frequency generators for radar provides 1 megawatt output pulses with a peak driving power of 8 kilowatts. Developed for use in missile control equipment, and designated as the ML-6544, the new tube is being offered by Machlett Laboratories.



The tube design features a beamed oxide coated cathode structure, a rigid squirrel cage control grid, a shield grid internally connected to the cathode and a forced-air cooled anode. It operates with 18 KV D.C. on the anode, has a *mu* of 90, and develops 65 amps of plate current with a positive grid drive of 1200 volts.

The new tube, it is felt, reduces the shortcomings of older tetrode designs. The structure is radically different and quite rugged. The tube operates with stability at high voltages, and the amplification factor is high, therefore only a modest negative control grid voltage is needed for cutoff.

Grid and cathode supports of the ML-6544 are made of Electronic Grade "A" Nickel. Several other materials were considered before Nickel was finally selected, according to a spokesman for Machlett. One was rejected, he said, because it was costly, difficult to draw and too brittle. Another was too soft, and still another excessively expensive. Only Electronic Grade "A" Nickel was found to offer all of the desired properties as well as low cost. And Nickel is easily fabricated, joined, and outgassed. It has excellent mechanical properties and is highly resistant to oxidation and corrosion.

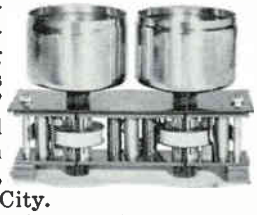
Pertinent Literature: Electronic grades of Nickel and Nickel Alloys — with their characteristics and uses — are fully described in our booklet, *Nickel Alloys for Electronic Uses*. Write us for a copy.

High magnetostrictive effect of Nickel proves useful in ultrasonic cleaners

NEW YORK, N. Y.: — Because Nickel has a large magnetostrictive effect, it's used to energize many varieties of ultrasonic cleaners. In atomic energy installations, for example, these cleaners remove radioactive particles from equipment. They clean surgical instruments; even entire jet engines!

An ultrasonic cleaner, developed by American Time Products, is used to clean tiny parts for electronic equipment.

Grade "A" Nickel laminations are used in the transducer to produce high-frequency cavitation in cleaning and rinsing pots of this "Watchmaster" unit, developed by American Time Products, Inc., New York City.

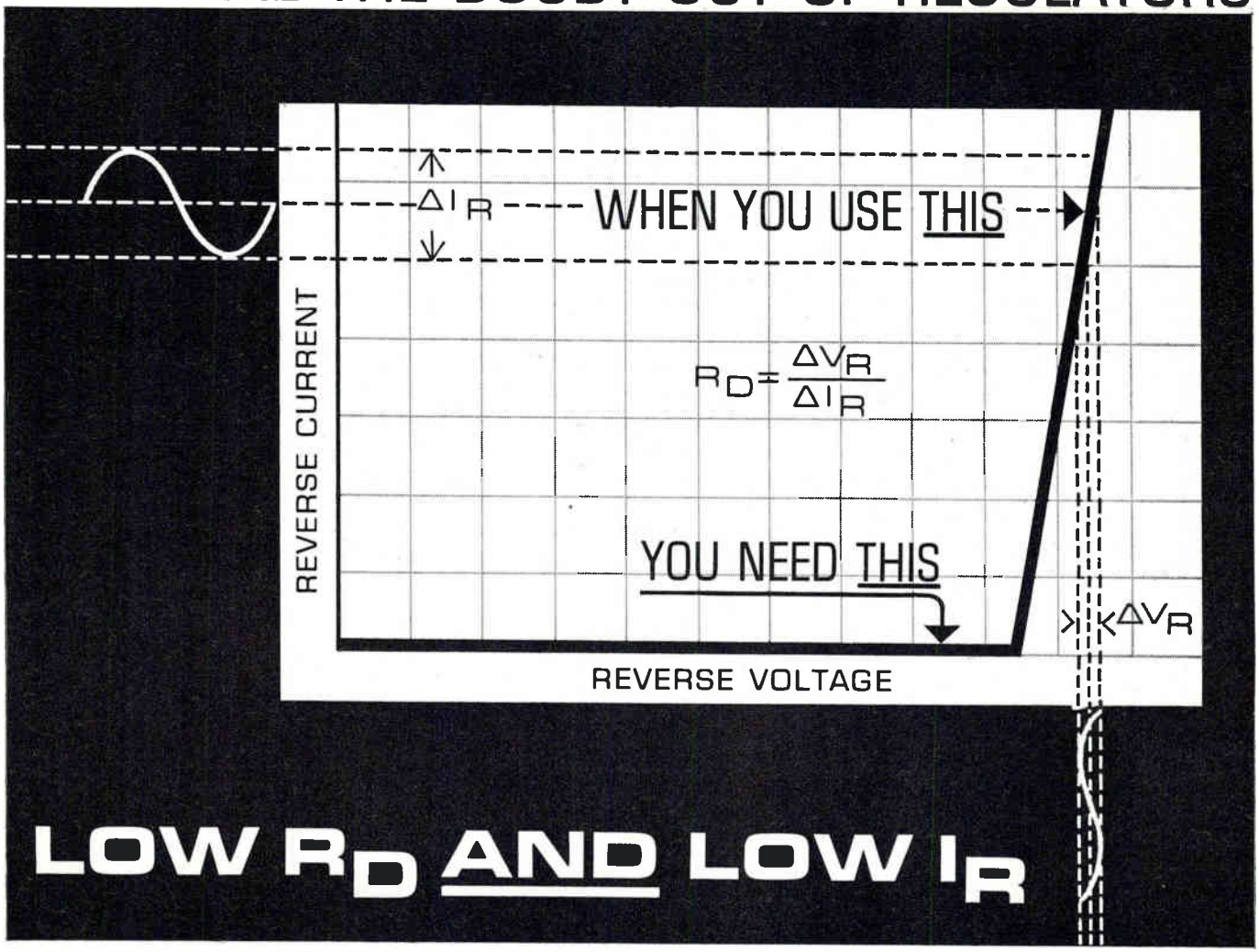


ATP's chief engineer writes: "Grade "A" Nickel enables us to produce a simple, economical transducer for converting electrical energy into high frequency vibration. The nickel transducer operates at elevated temperatures and withstands mechanical abuse and corrosive solutions, providing a long, stable life."

Nickel transducers operate up to 100 kilocycles per second, driving high impedance loads such as process liquids and cleaning solutions.

Pertinent Literature: "Design of Nickel Magnetostriction Transducers." Write for a copy.

LET'S TAKE THE DOUBT OUT OF REGULATORS



CONTINENTAL HIGH PERFORMANCE VOLTAGE REGULATOR (ZENER) DIODES

LOW DYNAMIC RESISTANCE, R_D, gives a direct measure of effectiveness of the diode as a regulator. The lower the value, the steeper the slope of the characteristic, and the better the regulator action.

LOW REVERSE CURRENT, I_R, near the knee of the characteristic assures a "hardness" which provides good regulator action down to low current values. It also indicates freedom from a film of contaminants on the crystal surface which can change with age and produce an apparent shift in operating voltage or complete failure.

200°C "BURN-IN" FOR 200 HOURS, applied to all Continental diodes, assures stability and consequent reliability by establishing environmental equilibrium for the junction within its hermetically sealed envelope.

The result is that Continental High Performance Voltage Regulators will provide the best performance, stability, and reliability available. If your circuit requires voltage regulation, good engineering demands that you specify the best regulators.

Type	Voltage ± 5%	Max. Dyn. Res. R_D at I_R (mA)		Max. Rev. Cur. I_R (μA) at V_R	
CD3133	3.9	20	20	.4	1
CD3139	6.8	3	20	1	5
CD3144	10.0	7	10	.010	8
CD3148	15.0	14	5	.010	13
CD3152	20.0	20	5	.010	18

The table lists several types with their important parameters. These are part of a complete ± 5% series covering from 3 to 20 volts which is tabulated, together with full specifications, on Data Sheets available upon request.

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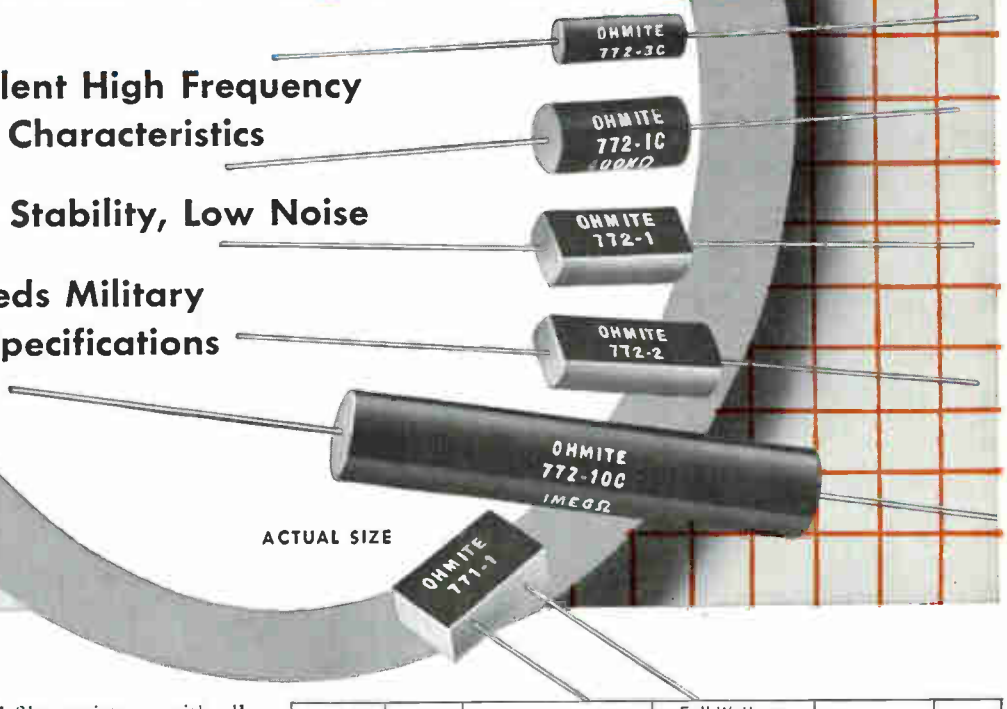
OHMITE Series 77

PRECISION METAL FILM RESISTORS

Excellent High Frequency Characteristics

High Stability, Low Noise

Exceeds Military Specifications



ACTUAL SIZE

At last you can get quality metal film resistors, with all their advantages, at prices competitive with precision wire-wound units. In fact, some values are actually priced lower.

EXCEEDS MILITARY SPECIFICATIONS—Ohmite metal film precision resistors exhibit great stability under load at ambient temperatures of 150°C and higher, as well as in high humidity. Stability in storage is also excellent. A shelf-life test (covering a period of 4½ years) of 93 units in the 60 to 300 K-ohms range showed less than 0.05% maximum change in resistance. This stability together with low temperature co-efficient, low noise level, and unexcelled high frequency characteristics, are the reasons why Series 77 metal film resistors are demanded for both military and industrial applications.

Write for Bulletin 155

Ohmite Basic Style	MIL Sizes	Dimensions (Inches)		Full Wattage Rating at		Min—Max Ohms	Max Rated Volts
		Length	Diameter	125°C Amb.	150°C Amb.		
771-1	—	11/16	.400	½	¼	25-250K	350
771-2	—	⅞	.600	½	¼	251K-400K	350
772-3C	RN65* RI92†	⅝	15/64	¼	⅛	50-125K	300
772-3CJ	RI92†	⅝	15/64	½	¼	50-85K	300
772-1	—	⅝	21/64	½	¼	25-250K	350
772-1C	—	⅝	21/64	½	¼	25-250K	350
772-2	RN72* RI94†	13/16	21/64	½	¼	25-400K	350
772-2C	RI94†	13/16	21/64	½	¼	25-400K	350
772-2CS	RN70* RI94†	13/16	19/64	½	¼	25-350K	350
772-2J	RI94†	13/16	21/64	1	—	25-400K	350
		13/16	21/64	—	½	25-150K	350
772-2CJ	RI94†	13/16	21/64	1	—	25-400K	350
		13/16	21/64	—	½	25-150K	350
772-8	RI96†	1 3/32	13/32	1	½	100-1 meg	500
772-8C	RN75* RI96†	1 3/32	13/32	1	½	100-1 meg	500
772-10	—	2 7/32	27/64	2	—	200-2.5 meg	750
772-10C	RN80*	2 7/32	27/64	2	—	200-2.5 meg	750

NEW 2-WATT SIZE

*MIL-R-10509C †MIL-R-19074B

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RHEOSTATS RESISTORS RELAYS TANTALUM CAPACITORS TAP SWITCHES VARIABLE TRANSFORMERS R. F. CHOKES GERMANIUM DIODES

CIRCLE 35 ON READER SERVICE CARD

IRE Show: Clue to Imports

Next week's international convention gives U. S. firms a good chance to check activities of foreign companies. Here's an advance peek

FOREIGN EXHIBITS at next week's 1960 International IRE show—modest in number as usual despite the use of the "international" label this year for the first time—will nevertheless underscore the basic electronics import trend that has been developing for the last few years.

The trend is this: Products from abroad—whether components, instruments, communications products or computers—can only compete successfully in the American market if they are substantially cheaper than comparable U. S. products, or if they are a considerable technical jump ahead of American hardware in the field.

In some cases foreign companies make their mark in the U. S. with specialty products that are well within the American state-of-the-art but offer particularly ingenious design.

These products—perhaps a type of klystron tube or a laboratory instrument—are often low-quantity, high-cost items that are cheaper for an American company to buy abroad than make itself. If a broader market for the product develops in the U. S., American companies often will put their mass-production techniques to work and force a cutback in the foreign import.

To hold its own in the U. S. market, the foreign firm that finds itself in this situation must then be able to offer a new product to satisfy another modest but ready market. With this cyclical marketing situation in mind, many foreign companies use the IRE convention to probe American markets and engineering minds.

British Array Largest

British electronics companies have probably had much more experience in U. S. marketing and in communicating with American engineers at shows than other foreign firms. Pre-show intelligence available this week indicates they will have, by far, the most impressive array of engineering exhibits among the countries that lend an international flavor to the IRE show.

A British observer says many exhibitors from the United Kingdom with five or more years of IRE show experience find the show is "a good opportunity to exchange ideas with American customers—a chance to learn what U. S. companies need and to influence American thinking on government procurement overseas."

Related to these exchanges—and sometimes resulting from them—is a continuing standardization of parts and components in both countries, with British manufacturers often conforming to U. S. mass market requirements.

That is why some foreign manufacturers — including makers of small components, such as connectors, plugs, sockets, resistors and switches—find it profitable to exhibit at the IRE show.

A number of large and medium-size British companies operate their U. S. marketing and show activities through American subsidiaries. The Wayne Kerr Corp., Philadelphia, for example, will display the British Wayne Kerr's impedance bridges, oscillators, meters and test equipment. Muirhead & Co., New York, is expected to exhibit Weston cells and instruments, such as the transfer function analyzer of its British parent.

American Agents

Other British firms are represented in the U. S. either by reps or sales organizations of American manufacturers. British Radio Electronics, Washington, D. C., for example, will represent a number of companies, including: Ardente Acoustic Laboratories, Colvern Ltd., Oxley Developments Co., Stability Capacitors Ltd. and Stratton & Co.

Microwave link equipment of Marconi's Wireless will be shown at the exhibit of Hermes Electronics Corp., Cambridge, Mass., while U. S.-based Marconi Instruments will have its own booth which will stress test gear, industrial and medical X-ray equipment and nuclear instruments. Ampex handles marketing of Marconi tv broad-

Expands Marketing in U. S.

FIRST results of a marketing agreement announced last month between Fairbanks Whitney Corp., New York, and EMI Electronics, a member of the Electrical and Musical Industries Group of Hayes, England, will be the installation of two EMI computers in the U. S.

Transistorized EMIDEC 1100 machines will be installed at Fairbanks Morse, Beloit, Wis., and Pratt and Whitney, West Hartford, Conn.

The British company described the agreement as one "aimed at greatly increasing the sale of British-designed electronic equipment in the United States." The agreement presages a "full-scale sale drive" of EMI computers and data-processing systems, analog computers, scientific and industrial instruments, electronic control and automation systems, and closed-circuit tv.

The announcement says U. S. rep H. L. Hoffman & Co., Westbury, N. Y., will continue to promote the sales of certain EMI products and will cooperate closely with Fairbanks Whitney in the future

British Output Up

LONDON — Britain's electronics boom continues with 1959 total production worth an estimated $1.33 billion, according to Industrial Review, published by the Electronic Engineering Association.

The industry now employes 350,000 people and is reportedly expanding at an estimated rate of $84 million a year. The report says 10 percent of annual sales of the British electronics industry is absorbed in research. This is claimed to be the highest proportion in any U. K. industry apart from aviation.

cast gear and will display it at the show.

Avo test equipment and receiving tubes of the M. O. Valve Co. will be among products shown by rep British Industries Corp. Another rep, Herman H. Sticht, will exhibit high-accuracy meters and a variety of measuring and test equipment. Ercona, a rep, will feature Belling & Lee components.

British activity in the entertainment electronics field will not be in evidence at the IRE show, but it will be apparent at the British Exhibition in New York's Coliseum June 10-26. The U. S. is Britain's best customer for sound reproduction equipment. Sales last year amounted to $12 million.

The recently-organized Audio Manufacturers' Group of the British Radio Equipment Manufacturers' Association will in June show the audio equipment of Birmingham Sound Reproducers, Brenell Engineering Co., Beam Echo, Bush Radio, Clarke & Smith Manufacturing Co., E.M.I. Sales & Service, Lowther Manufacturing Co. and Truvox. Pye, Ferranti and Associated Electrical Industries will be among the other electronics exhibitors at the British Exhibition in June.

Japanese Exhibitors

Japan will be represented at the IRE show by four exhibitors—two more than last year. Yokogawa Electrical Works will show a variety of portable precision test equipment. Sony is expected to display its Esaki tunnel diodes and other semiconductors, and possibly its new transistorized tv set.

Murata Manufacturing Co., Kyoto, will show subminiature tuners, filters, ceramic capacitors and other components. Japan Electrical Industry, representing Tokyo Shibaura Electric and Toko Coil Laboratories, will exhibit semiconductors, ceramic variable capacitors, oscillators and antenna coils.

Ericsson of Sweden will be among the foreign stalwarts at the New York show again this year, and will play up its ruggedized long-life electron tubes, microwave planar triode and amplifier tetrode.

Two Swiss companies, Ebauches, S. A. and Sodeco, will exhibit. Ebauches will show its precision quartz clock and a variety of instruments and test equipment. Sodeco will feature an electromagnetic impulse counter, high-speed predetermining counters and a number of other types of counters and instruments.

From West Germany Richard Hirschmann Radiotechnisches Werk will bring its plugs, sockets, terminals, connectors and other components.

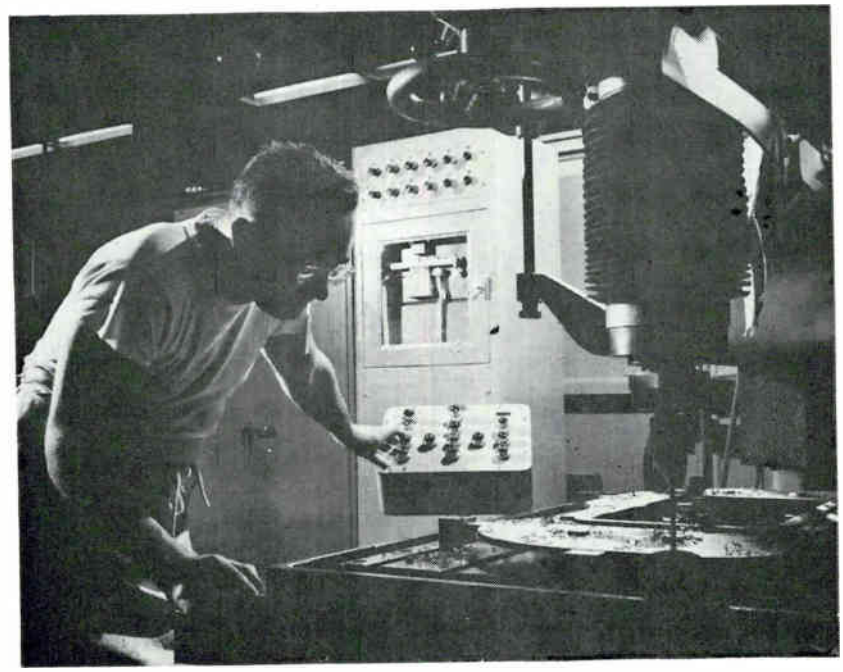
East Germans Aim For Sales in West

EAST GERMANY's annual Leipzig trade fair held recently pointed up industrial electronic developments in the Communist states and was expected by the East Germans to bring them sales of $175 million from Western customers.

The East Germans claim they supply the Soviet Union with 44 percent of all tools, precision apparatus and equipment the Soviets import. Principal exhibit of the East Germans was a power distribution control system. It was described as complying with the standardization requirements of the Socialist states.

Several types of manufacturing process controls which have been emphasized in the economic plans of the Communist states, were shown by the East Germans. One instrument shown and widely publicized was an a-c voltage meter ranging from 6 mv to 600 mv. The East Germans also showed their Robotron R 12 "electronic multiplication machine," claimed to be the first electronic computer of its kind.

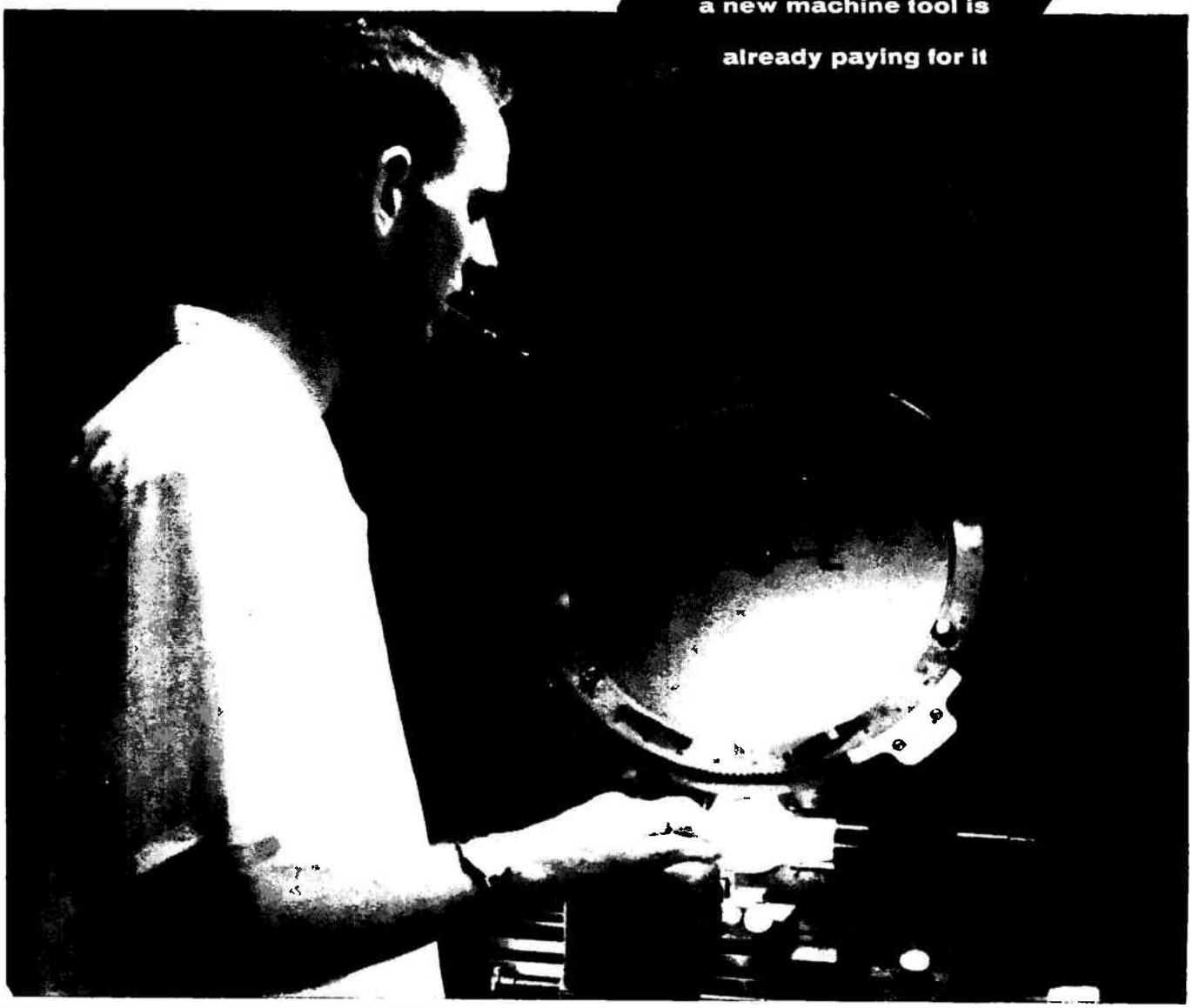
Push-Button Production



Numerical machine tool control equipment automatically directs positioning, drilling, reaming, boring and tapping operations by pre-punched tape. Production time for parts handled by this equipment has been cut by a third, says developer Sperry Gyroscope of Canada

JONES & LAMSON OPTICAL COMPARATORS

the man who needs a new machine tool is already paying for it



This Comparator Paid for itself in less than a week!

At Ace Electronics Associates, Inc., Somerville, Mass., an alert management cut costs, increased production and improved product quality through speedy, precise inspection methods using a J & L Optical Comparator.

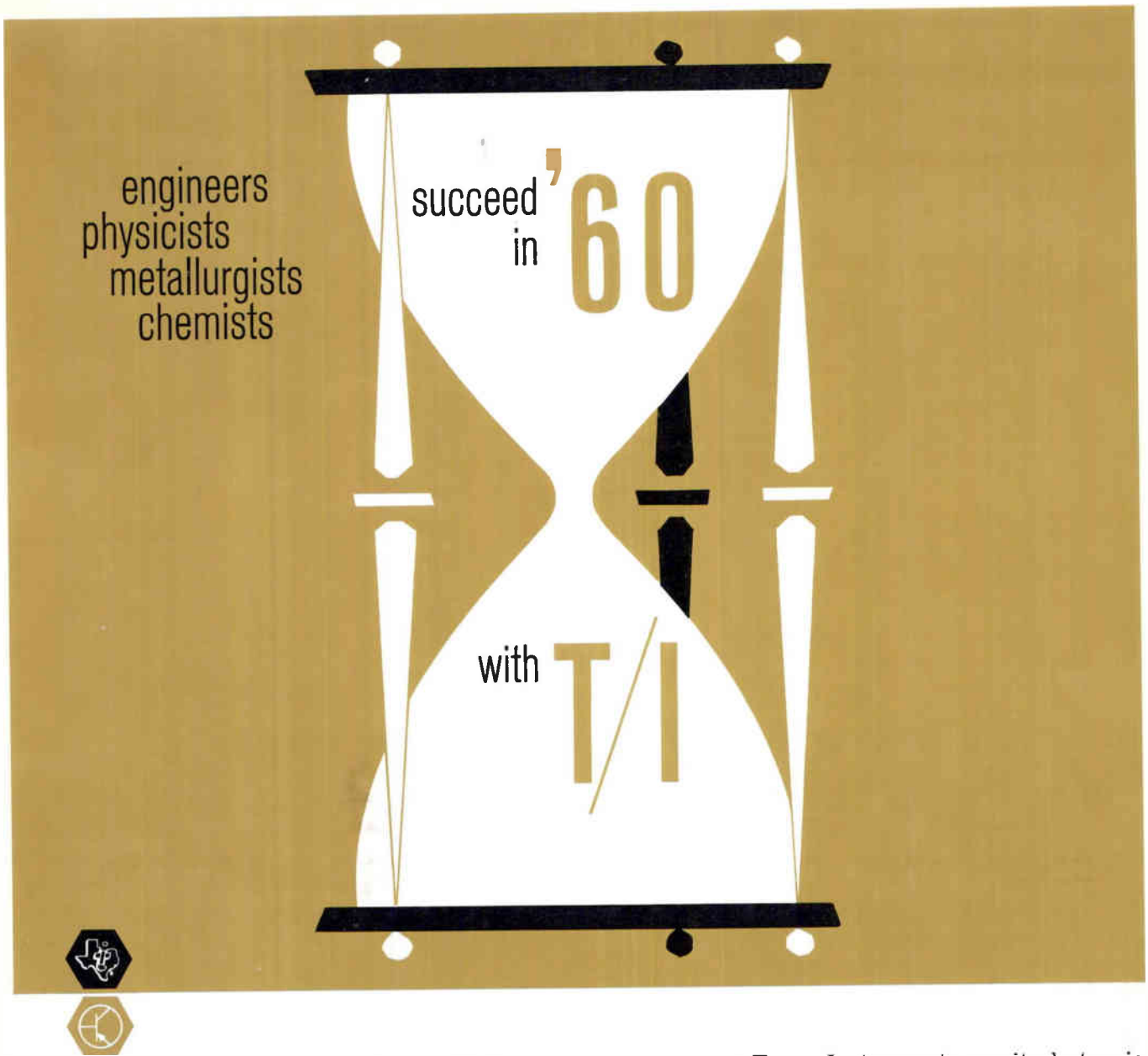
At Ace, precision of manufacture is of paramount importance. This young, progressive company, manufacturer of linear and non-linear potentiometers and electromechanical devices, including Acepot and Acetrim, insists that each and every product made in its plant give 100% reliability in the field. The aim is to not only meet, but to surpass its customers' most exacting specifications. This is being done consistently on every piece, every day.

Through stringent quality control procedures tailored to meet unique tolerance problems, manufacturing methods have been constantly improved, costs have been cut to the bone, production has reached new high levels, and product reliability is superb.

Ace gives much of the credit for this record to the Jones & Lamson Optical Comparator, which is their most important measuring and inspecting tool.

Write for new Comparator literature. Jones & Lamson Machine Company, 539 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



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If you qualify for these positions, please send resume immediately to C. A. BESIO, Dept. 101. Whether or not you apply now, send for TIPS and get acquainted with T/I's Semiconductor-Components Division.

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High Quality
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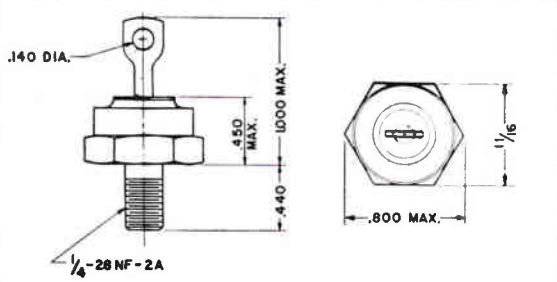
Extreme Reliability

From the leading manufacturer of power transistors, new Silicon Power Rectifiers to meet your most exacting requirements. Even under conditions of extreme temperatures, humidity and mechanical shock, these diffused junction rectifiers continue to function at maximum capacity! Thoroughly dependable, completely reliable—new Delco Rectifiers are an important addition to Delco Radio's high quality semiconductor line.

Conservatively rated at 40 and 22 amperes for continuous duty up to case temperatures of 150°C.



TYPE	AVG. DC CURRENT	PIV	NORMAL MAX. TEMP.	MAX. FORWARD DROP	MAX. REVERSE CURRENT
1N1191A	22A	50V	150°C	1.2V at 60 amps.	5.0 MA
1N1192A	22A	100V	150°C	1.2V at 60 amps.	5.0 MA
1N1193A	22A	150V	150°C	1.2V at 60 amps.	5.0 MA
1N1194A	22A	200V	150°C	1.2V at 60 amps.	5.0 MA
1N1183A	40A	50V	150°C	1.1V at 100 amps.	5.0 MA
1N1184A	40A	100V	150°C	1.1V at 100 amps.	5.0 MA
1N1185A	40A	150V	150°C	1.1V at 100 amps.	5.0 MA
1N1186A	40A	200V	150°C	1.1V at 100 amps.	5.0 MA at 150° C case temperature and rated PIV

For full information and applications assistance, contact your Delco Radio representative.

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Tel: Mitchell 2-6165

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For standard and sub-miniature applications—From stock or to your specifications—it's CENTRALAB for electronic components.

VARIABLE RESISTORS

1/10W. Micro-miniature—For transistor circuits, hearing aids. 0.286" diam. 500 ohms to 10 megs.

1/10W. Ultra-miniature—For computers, hearing aids, transistor circuits. 0.502" diam. 500 ohms to 10 megs.

1/10W. Sub-miniature—For military, communications, computer use. 5/8" diam. 500 ohms to 10 megs.

1/4W. and 1/2W. Sub-miniature—For instruments and military. 43/64" diam. 500 ohms to 2.5 megs.

1/4W. Multiple-miniature—Up to 4 variable and 9 fixed resistors on a 3/4" x 2-1/4" steatite plate. 1000 ohms to 5 megs.

1/2W. Standard—For radio, TV. Single, Twin or dual-concentric. 15/16" diam. 250 ohms to 10 megs.

2-5W. Wirewound—For instruments and TV. Single or dual-concentric. 1-5/32" diam. 1 ohm thru 15K ohms.

Write for Group B bulletins.

RELIABILITY

ELECTRONIC SWITCHES

Sub-miniature rotary—15/16" diam. for military and high reliability applications. Rating 0.5 amp. at 6VDC, 100 ma. at 110VAC. Laminated phenolic, steatite, single or multiple sections.

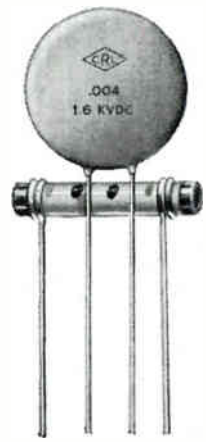
Standard rotary—1-5/16" diam. laminated phenolic or steatite insulation, single or multiple sections. Rating 2 amps. at 15VDC. 150 ma. at 110VAC. (Resistive load.)

Heavy-duty power—For transmitter, industrial control, laboratory testing, military, commercial. 2-13/16" diam. 7-1/2 amp. rating at 110VAC. 25,000 cycles minimum.

Spring return—1-5/16" diam., coil or C-type springs, phenolic, steatite, single or multiple sections.

Specialized—Lever, slide, tone, tuner sections, others.

Write for Group P bulletins.



CERAMIC CAPACITORS

Ultra-miniature—3 to 12 VDC, 0.22—2.2 mfd.—for low power factor transistor applications.

Temperature compensating—Discs, tubulars, 150 v to 6,000 VDCW, 1 mmf.—0.1 mf. Capacitance +100 to —5250 ppm.

Bypass—Coupling—Discs, tubulars, 150 v to 6,000 VDCW, 1 mmf.—0.1 mf.

High Voltage—High Accuracy—High Voltage types, up to 30,000 VDCW. High Accuracy types, ± 1% tolerance, 500 VDCW, up to 2,500 mmf.

Trimmer—Tubular or flat. Meet JAN-C-81 specifications. 1 mmf. to 400 mmf. 500 VDCW.

Feed-thru—10—5000 mmf., 500—1,500 VDCW, bushing, shoulder, ring, eyelet, resistor-capacitor combinations.

Specialties—Stand-off, button-shape, potted, other capacitors.

Write for Group D bulletins.

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PACKAGED CIRCUITS

Complete computer and Radio-TV circuits, amplifiers, oscillators, detector networks, resistor networks—including transistors, capacitors, resistors, wiring and inductance, manufactured to your specific performance limits.

PEC* circuits result in substantial savings in assembly costs. These high reliability packaged circuits can be supplied in a wide variety of terminals for printed circuit board applications.

1/2W. resistors meet applicable MIL-R-11 specifications, 50 ohms to 50 megs. Capacitors up to .01 mmf.

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High alumina—85%, 95%, 99%—for high frequency, high temperature applications, close tolerance (± .00025") designs. Jan I-10-L6A grade.

Grade Jan I-10-L5A steatite, Grade L2A Corderite, and Grade L2A Electrical Porcelain. For applications where high dielectric and compressive strength, high dimensional stability, low loss and low power factor are required, there is a CENTRALAB ceramic material for the job.

CENTRALAB also specializes in metalizing of ceramics, for hermetic seals or mechanical attachment of other ceramic or metal parts.

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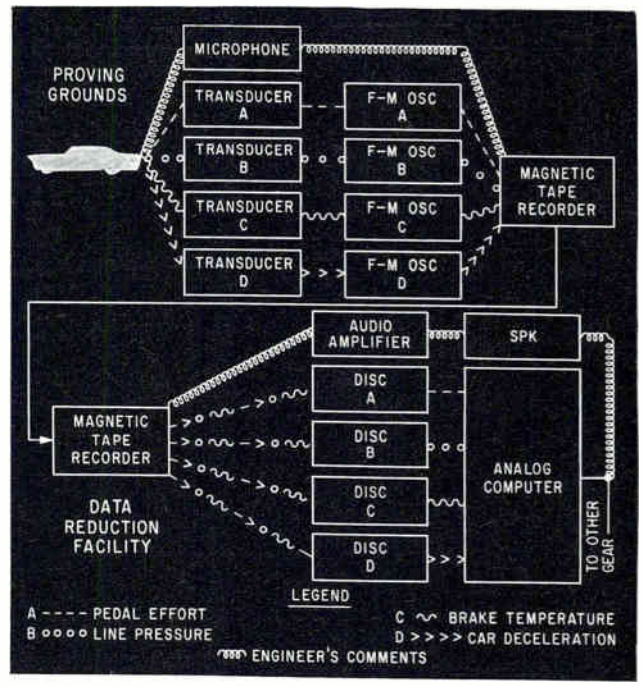


GM Research Labs' cadmium sulfide transistor (insert left) acts as audio amplifier when struck by light beam. Right: Chrysler's telemetry system records results of dynamic tests on new brake design for later evaluation and analysis

Motor City Enters Electronics Derby

Detroit area is fast becoming important to our industry, particularly in R&D

By **WILLIAM E. BUSHOR,** Associate Editor

DETROIT—Six years ago metropolitan Detroit would not have been counted a significant breeder of electronic ideas and developments. Today, a portion of the gigantic energy and know-how used to build automobiles and machinery is being redirected toward a broad spectrum of our industry's products. With the money and organization represented by the motor firms and a strong desire to develop new business to give stability to an automobile-dependent economy, a formidable competitor for electronic markets could be spawning.

Solid State Physics

Example of the auto makers' interest in electronics is the recent announcement by GM Research Labs of a cadmium sulfide (CdS) field-effect transistor. This device has the size, high-efficiency and ruggedness characteristic of other semiconductor components (see ELECTRONICS, p 11, Feb. 26).

As contrasted with single-atomed elemental semiconductors (germanium or silicon), CdS is a compound semiconductor having two kinds of atoms. Electrical properties are greatly affected by light—carriers being generated inside the crystal by absorption of light. The crystal interior remains electrically neutral and the carriers drift with constant velocity under the influence of the applied electric field which is uniform between contacts.

The photoconducting properties of CdS provide interesting circuit applications. For example, amplification can be controlled by changing the color or intensity of incident light. The device has been used experimentally in oscillator, multivibrator, amplifier and radiation detector circuits. Unique properties of CdS provide new and combined circuit functions not practicable with conventional devices.

Telemetry Techniques

An indication of the closeness with which developments in other areas are watched is Chrysler's use of advanced telemetry techniques for studying car behavior under dynamic conditions. This approach increases the amount of information obtained during a test run.

Previous methods of studying car behavior suffered from two major limitations: only a few measurements could be made simultaneously and test data were recorded in forms unsuitable for direct evaluation. The new system translates information required by engineers into electrical pulses which are stored on magnetic tape in the car.

After completion of the test run, data on the tape is recovered in the laboratory by a separate electrical system. System output can be recorded or fed directly to a computer where information is rearranged and presented in usable form.

A typical system (above) uses transducers to convert the physical changes into electrical signals. Output of each transducer is then fed into a separate subcarrier oscil-

lator where it is converted into an f-m signal. Also, engineer's comments on conditions such as brake squeal, burning odors or steering wheel pull can be recorded on a separate microphone channel.

Using the telemetry system, human engineers have found that a typical car driver can detect steering wheel vibrations of forty millionths of an inch in amplitude.

Ultrafast Spectrometer

Detroit's diversified interest in electronics is exemplified by Bendix Research's development of a spectrometer for analyzing chemical reactions occurring in 0.1 millisecond. Called a time-of-flight mass spectrometer, it is being used at Sweden's University of Uppsala in a research program to determine unknown factors in physics and chemistry of combustion.

Speed of analysis comes from ability of instrument to identity vaporized gases, liquids and solids by revealing their respective molecular mass. Heart of the spectrometer is a four-foot metal vacuum tube ion gun. Ionized molecules of the elements being analyzed are fired from one end of the tube to the other, and their time-of-flight is measured electronically and appears as a wave pattern on an oscilloscope.

The instrument can analyze an instantaneous sequence of chemical reactions such as takes place in flames and explosions. It can also analyze products of the bombardment of gases by atomic nuclei.

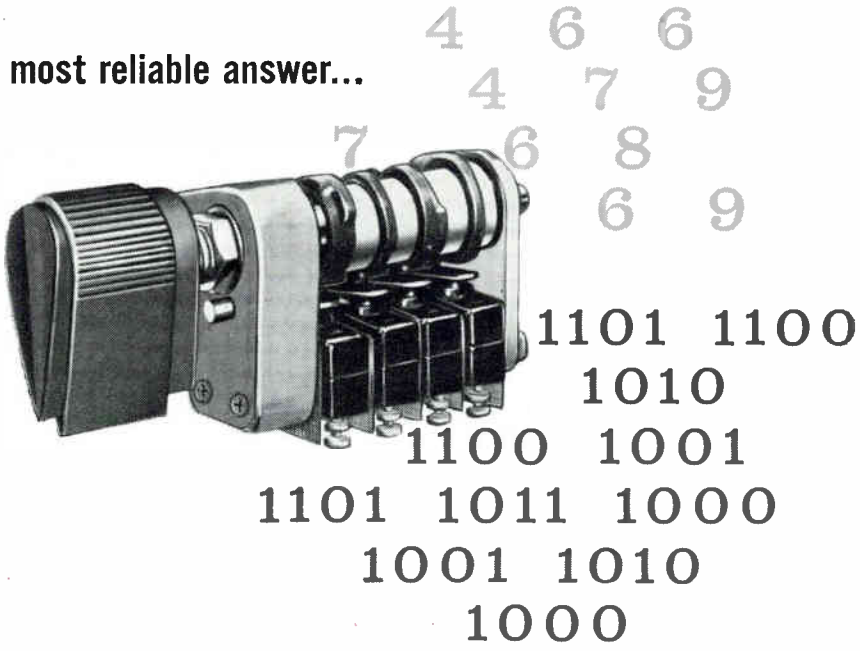
Low-Energy Radioisotope

Experimental use of low-energy short-lived radioisotope samarium-153 to produce radiograms of diagnostic quality comparable with conventional x-rays was recently announced by GM Research Labs. Originally developed at the Labs a year ago for industrial radiography of thin aluminum and steel castings, Sm-153 has now been used to make an x-ray of a patient's chest.

Value of this technique is that it can be used where operation of x-ray machines would be impossible —in the field during emergencies.

The complete energy source is small enough to hold in one hand. Half-life is only 2½ days, but it can be used effectively for a week or two and then reactivated.

for the most reliable answer...



New Decimal-to-Binary Switch for Computing Applications

This new Decimal-to-Binary Rotary Input Switch is the most reliable ever designed for use on computers. It saves space in the control console, requires only 1.3 square inches of mounting surface. All operating positions are detented to give the operator positive feel of the switching action. Important design differences make this MICRO SWITCH Decimal-to-Binary a better answer than ordinary wafer-type rotaries. Here is a convincing comparison of the two types:

MICRO SWITCH Decimal-to-Binary	Wafer-Type Rotary
1 Switching elements are enclosed.	1 Switching elements are open, unprotected.
2 Contact is made by snap-action gold contact.	2 Contact is made by sliding contact.
3 Wiring requires only 8 connections to 8 terminals.	3 Wiring requires making 26 connections to 15 terminals.
4 Wiring is done in just one plane.	4 Wires must be radially attached.
5 Virtually tamper proof.	5 Easily subject to tampering.

Write to MICRO SWITCH for Data Sheet 170 on this new Decimal-to-Binary Rotary Input Switch, or call the nearby branch office listed in the Yellow Pages.

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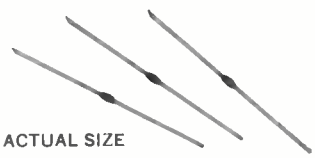
VERY LOW LEAKAGE • 250 mW DISSIPATION • RELIABILITY ≥ CONVENTIONAL DIODES

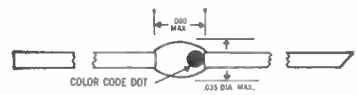


ACTUAL SIZE

ELECTRICAL SPECIFICATIONS

Type No.	Min. Sat. Voltage @ 100 μA (v)	Min. Fwd. Current @+1.0 V (mA)	Maximum Reverse Current (μA)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Res. (Ohms)	Max. Recov. Time (μS)
1N897	50	5	.025 (10V) .1 (40V)	5 (10V) 20 (40V)	100K	1.0
1N898	50	100	.025 (10V) .5 (40V)	5 (10V) 20 (40V)	100K	0.3
1N899	100	5	.025 (10V) .1 (80V)	5 (10V) 20 (80V)	100K	0.3
1N900	100	50	.025 (10V) .1 (80V)	5 (10V) 20 (80V)	100K	0.3
1N901	100	100	.025 (10V) .5 (80V)	5 (10V) 20 (80V)	100K	0.3
1N902	200	10	.025 (10V) 1.0 (100V)	5 (10V) 15 (100V)	200K	0.3

Phone, wire or write for new low prices and delivery schedules on production quantities.



ENLARGED VIEW

Announcement of these new low leakage Micro-Diode types coincides with a general price reduction of up to 20% on the current PD-100 Micro-Diode series.

Excellent delivery is being made on both the original PD-100 series and this new EIA series of Micro-Diodes. A large number of manufacturers are already designing Micro-Diodes into highly advanced micro-miniaturized systems.

Exhaustive reliability and life tests have been completed on the PSI Micro-Diode. Write for this valuable new information!

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printed circuit laminate

Here's an end to circuit unreliability caused by "leaking" printed circuitry. Unique bonding methods, developed by Shamban, bond insulator to copper **without compromising** the electrical properties of either. Even in extreme environments, there is no breakdown of strengths.

*Tradename of W. S. Shamban & Co.

A new, complete line of hi-temperature hi-dielectric strength laminates featuring:

* Maximum electrical properties
* Unique, optimum-performance bonding methods
* Highest commercial peel strengths
* Availability in sheets and continuous lengths
* Full range of types of constructions, sizes

New Shamban KOP-R-KLAD laminate presents several distinct advantages to the users of printed circuitry. KOP-R-KLAD offers a *complete line*, the right constructions for every application; *optimum electrical properties through proper bonding*, best volume, surface and insulation resistivity, highest dielectric strength; *highest peel strength*, for sharp bends, rugged environments; *continuous lengths*, for convenience of user, for wider application. KOP-R-KLAD is available in twelve different types, including copper to Teflon, to Teflon-glass, to Kel-F, and to FEP-fluorocarbon. Each type has specific advantages, all types have the advantage of absolute dependability and predictability within the limitations of the materials specified. KOP-R-KLAD is immediately available, dependent upon type, in widths up to 36", in lengths from 2" to continuous rolls. *Write or wire factory for complete data.*

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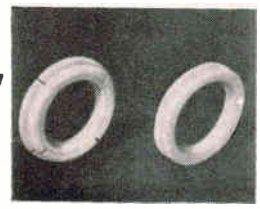
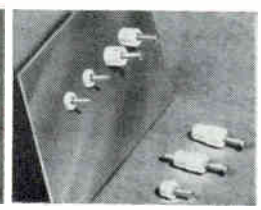
SHAMCO

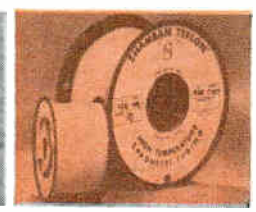
SHAMBAN PRODUCTS FOR ELECTRONICS



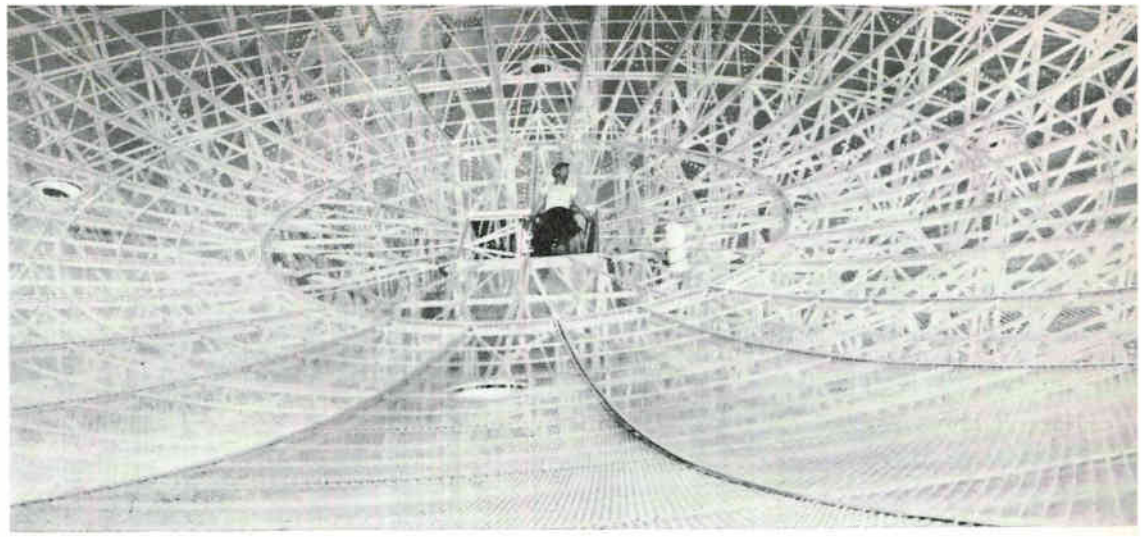
Snag-proof Teflon grommets. Non-abrasive, chemical resistant and very durable, Shamban snap-in and channel type grommets provide secure holding device.



Stand-off and feed-thru insulators. Absolute insulation for critical circuit tiepoints. Resists high frequency and voltage breakdowns.



Teflon and Nylon spaghetti tubing, standard and Microthin wall sizes. Available in all sizes, to meet every tubing need. Consistent quality.



Prototype of 84-ft tracking radar dish for Ballistic Missile Early Warning System's Site III in England is housed in paper-fiberglass radome. Photo shows worker in center during construction stage

New Missile-Warning Radar Site

Maneuverable dish radar will scan and track ballistic missiles in the northern polar region from new site in England

MOORESTOWN, N. J.—Site III of the Ballistic Missile Early Warning System (BMEWS), recently announced for Fylingside Moor, Yorkshire, England, will operate three tracking radar systems, designated AN/FPS-49, like the prototype (see photo) undergoing tests here at RCA's Missile and Surface Radar Div.

Since the highly maneuverable 84-ft parabolic reflector can scan as well as track, it is doubtful that GE's AN/FPS-50 surveillance radars—the 400-ft-wide by 165-ft-high fixed reflectors now being installed at Site I, Thule, Greenland, and Site II, Clear, Alaska—will ever get to the Site III complex.

Conversely, whether tracking radars will be added to the surveillance radar equipment at Sites I and II has not been decided. No money has been appropriated for the tracking radars themselves for these two sites even though construction work, including pedestals, for trackers has been completed.

How System Works

Both radar systems have a range of about 3,000 nautical miles. The fixed surveillance radar sends out horizontal stationary fans. An object crossing two of the fans reveals the approximate trajectory, launching site and impact point.

The tracking radar detects by scanning, then locks on to the object, determines whether it is an ICBM or not, and calculates its trajectory, launching site and impact point.

Information from all radars is flashed immediately to the North American Air Defense Command headquarters, Colorado Spring, Colo. (ELECTRONICS, p 42, Feb. 5).

The 84-ft antenna is housed in a 140-ft-in.-diameter spherical radome constructed of 1,646 six-sided panels made of paper, faced with plastic-impregnated fiberglass. The radome is located on top of the transmitter-computer building. The structure will withstand gales.

The antenna and its pedestal weigh almost 375,000 lb, with the servo-driven rotating section accounting for more than half the total weight. The antenna revolves on ball bearings measuring 3½ in. in diameter. Goodyear Aircraft built the antenna, pedestals and radome.

Transmitters for the radars are being constructed by the Continental Electronic Manufacturing Co., Dallas.

To test the accuracy of the system, the prototype here is occasionally converted to a radio telescope and aligned with the known position of the constellation Cassiopeia.

Data take-off equipment (DTO), being supplied by Sylvania, transforms analog radar returns into digital data for processing by an IBM 7090 computer. The DTO also provides target discrimination by separating simultaneously observed objects so that target data may be recorded sequentially.

Performs Functions

Development of the tracking radar data take-off (TRDTO), which performs the intermediate data processing functions between each tracking radar and the missile impact prediction computer, utilized a portion of the RCA development work on the Wizard program.

The checkout and automatic monitoring (CAM) equipment, developed by RCA, improves reliability through its continuous monitoring process and its immediate detection of system trouble areas.

The AN/FPS-49 tracking radar for BMEWS is similar to the radar unit being developed by RCA for Project Defender — the Advanced Research Project Agency's program for devising an anti-ICBM system beyond the capabilities of Nike-Zeus (ELECTRONICS, p 42, Feb. 26).

360° of versatility

The precious metal ring shown above is the heart of a Gamewell style SG-270 Precision Rotary Switch. Cut into as many angular segments as required, it provides the precise basis for a highly versatile switching component.

Custom-designed, the SG-270 Switch is ideal for circuit sampling, sequencing, programming, digital generators, etc. Connections to the segments are made through terminals adjacent to the segments on the periphery of the housing. Precious metal rings and brushes provide smooth, trouble-free action with either Make-Before-Break (MBB) or Break-Before-Make (BBM) contacts. Multiple gangs can be assembled to provide multi-pole switches. Cased in special plastic, the SG-270 Switch is inherently fungus resistant . . . stable at high temperatures . . . sizes ⅝″ — 1¼″ — 1⅝″ — 2″ — 3″ — 5″ diameter in various mounting styles. It can be used with confidence over a wide range of environmental requirements.

Investigate their outstanding operating characteristics for use in *your* products. Write, stating requirements, to The Gamewell Company, 1385 Chestnut Street, Newton Upper Falls 64, Massachusetts.

GAMEWELL SG-270
Precision Rotary Switch

Gamewell®

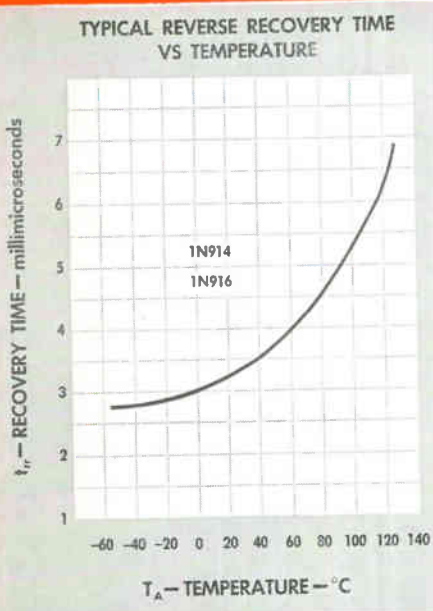
PRECISION POTENTIOMETERS

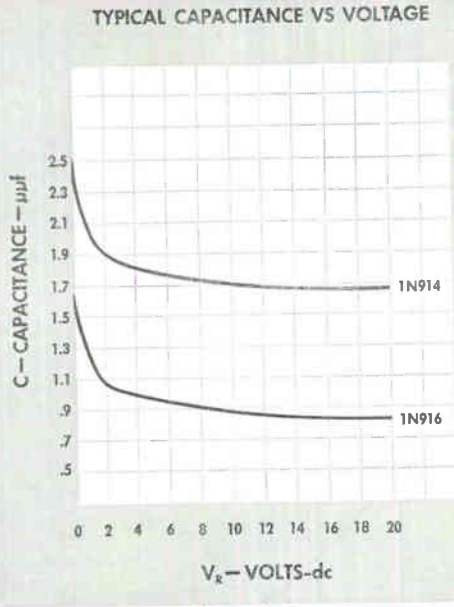
"INTEGRALS OF HIGH PERFORMANCE"

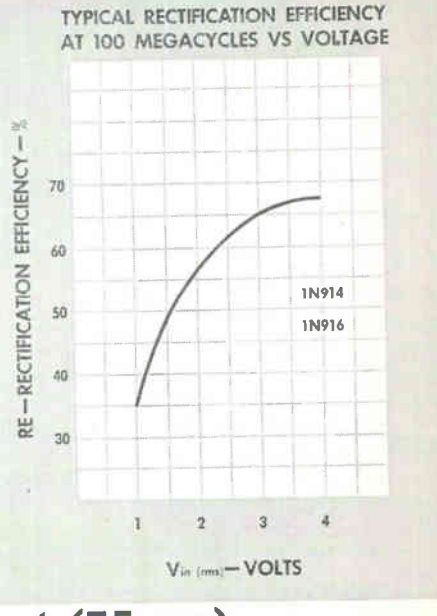
NEW FROM TI...

4-millimicrosec silicon mesa computer diodes

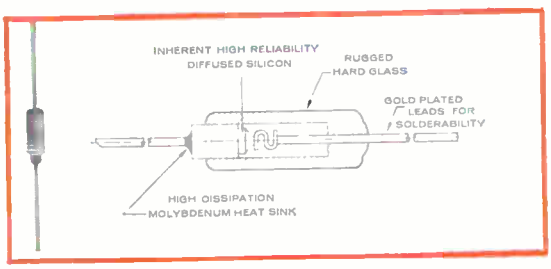
...INDUSTRY'S FASTEST!

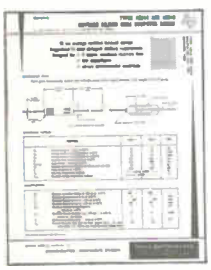






- **High maximum average rectified forward current (75 ma)**
- **Low maximum capacitance (2 µµf or 4 µµf at zero volts bias)**
- **High minimum forward conductance (10 ma at 1 v)**
- **Maximum reliability (TI mesa process, TI hard-glass case)**





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Design NOW with industry's *fastest* high-voltage computer diodes and benefit from the speed of 4-millimicrosecond switching* and the design safety provided by 75-v PIV.

TI 1N914 and TI 1N916 silicon mesa computer diodes also feature high rectification efficiency (45% at 100 mc), ruggedness and reliability through the combination of the TI mesa process and the TI hard-glass package. Both types meet or exceed MIL-S-19500B, withstanding acceleration of 20,000 G's, shock of 1,000 G's for 1.5 msec, and vibration of 30 G's.

Put them to work NOW in your high-speed computer circuitry for missiles and space vehicles. They are ready in production quantities through your nearest TI sales office, or in 1-999 quantities off-the-shelf at factory prices from your authorized TI distributor.

*10-ma forward, 6-v reverse, recover to 1-ma reverse

ANOTHER NEW DIODE/RECTIFIER PRODUCT FROM TI!

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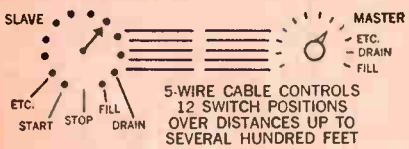
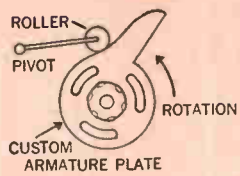
MODEL 5E
SHOWN ACTUAL SIZE

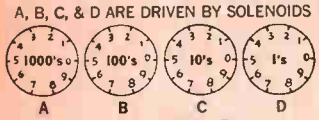
CUSTOM-BUILT FOR—



MASTER-SLAVE DEVICES
(Incremental Positioning)

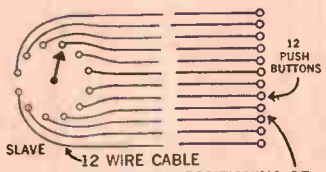


CAM LIFTS



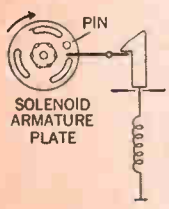
4 DECADE COUNTER
ADDED SWITCHING ALLOWS
PRESETTING A FUNCTION TO OCCUR
AT ANY COUNT SUCH AS SHUT OFF
WATER AT 397 COUNT, ETC.

PRESETTABLE COUNTING DEVICES

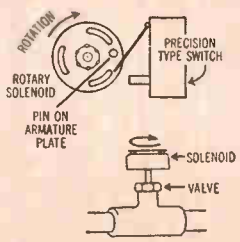


INSTANTANEOUS POSITIONING OF
SLAVE BY PUSHING A BUTTON

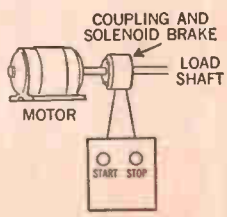
AUTOMATIC SWITCHING



TRIPPING DEVICES

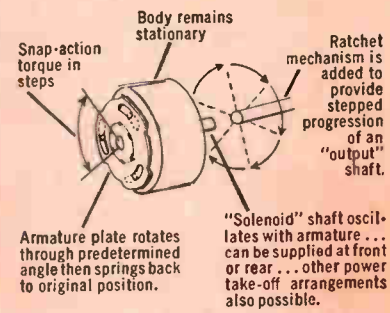


ACTUATORS



CLUTCHES and BRAKES
(When Modified for Straight Pull)

OPERATES IN ANY POSITION



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HERMETICALLY SEALED

ROTATES IN BOTH DIRECTIONS

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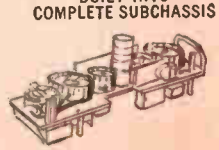

stepping torques from 6.4 to 64 inch-ounces

If you've been searching for an actuator that meets such specs as MIL-S-4040A, and is remarkably small for the amount of work it can do, investigate Oak Rotary Solenoids. They operate on DC and are designed for intermittent service. Standard models give steps of 25°, 35°, 45°, 67.5°, or 95° in either a left or right-hand direction. Self-stepping or externally pulsed units are also built. Oak Rotary Solenoids find wide use in both commercial and military equipment. Why not evaluate their unusual capabilities for your next project. We will be glad to help you engineer the job. Just send us a short description and sketch.

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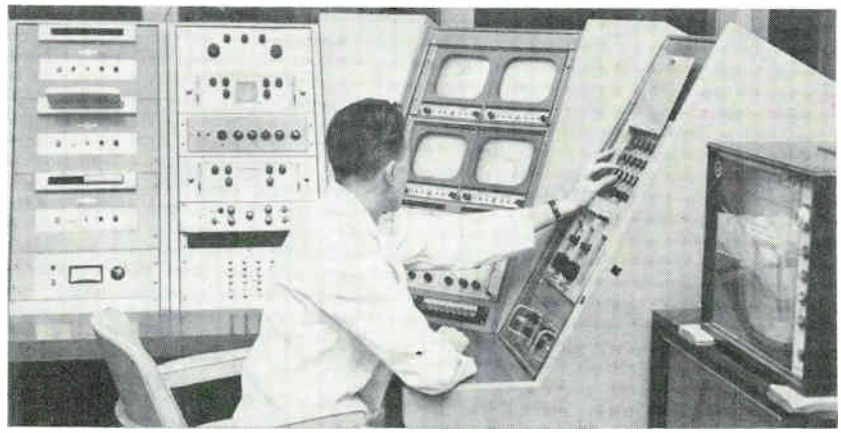
CIRCLE 51 ON READER SERVICE CARD 51

Pay Tv Starts in

New system uses direct wire to bring choice of three channels to Toronto viewers



Technician operates control panel of International Telemeter's new pay television system

TORONTO, CANADA—Pay television, storm center in U.S. during 1959, is now making its first appearance here.

The Canada system uses direct wire installed by Bell Telephone of Canada. Program fare is brought to the viewer's home and unscrambled by a coin box joined to receiver at antenna input terminals.

Some 93 miles of coaxial cable have been installed so far under the direction of Trans-Canada Ltd., a division of Famous Players Canadian Corp. The entire operation is run under franchise issued by International Telemeter Co., a division of Paramount Pictures.

A spokesman for the company says the Telemeter system has been under development since 1951. It was tested experimentally in Palm Springs, Calif., seven years ago. The test involved some 200 homes and used prototype gear.

In contrast, the Canadian system thus far has signed up about 3,000 families. To date, 1,000 homes have been equipped and more are being equipped at a rate of about 300 a week. System planners say they may eventually reach 40,000 homes.

Three Channels

The Toronto system operates three channels supplying first-run movies, sports events or live theater. The three can be sent out simultaneously. The viewer turns up a volume control on the coin box to hear announcements of what program fare is available. He then tunes his program selector to the desired channel. An indicator shows the price of the program chosen and activates the set when the proper amount is deposited.

Coins deposited beyond the amount required are registered as credits against future use. Prices vary according to programs and are set in 5-cent increments.

In addition to giving visual information to the viewer, the Telemeter unit records information on magnetic tape regarding program purchases made. The coin boxes are collected each 30 or 60 days and replaced by empty units with fresh rolls of tape.

The sealed boxes are brought to a processing center where the money is sorted and counted and the recorded tapes are fed through reading equipment, allowing the supplier of the program fare to be paid his percentage.

System developers tell ELECTRONICS the box also contains its own loudspeaker which is used to provide music at no cost during periods when no television programs are on. The Telemeter box costs about $50 per unit. The

Canada

viewer pays a $5 installation cost and makes no further payment for the box. Actual cost to system operators is estimated at about $100 per home.

Saving in Amplifiers

One result of research of past years in wire tv service is the development of a new amplifier made by Jerrold Electronics Corp. With these high-voltage units, system operation is possible with 14 amplifiers in an area that previously would have required from 175 to 200 amplifiers. The coaxial cable used is made of aluminum.

International Telemeter predicts more systems will be in use within the next 12 to 18 months. No pinpoint locations are being mentioned, but probes may be expected along the east coast of the United States, according to some observers.

Other Systems

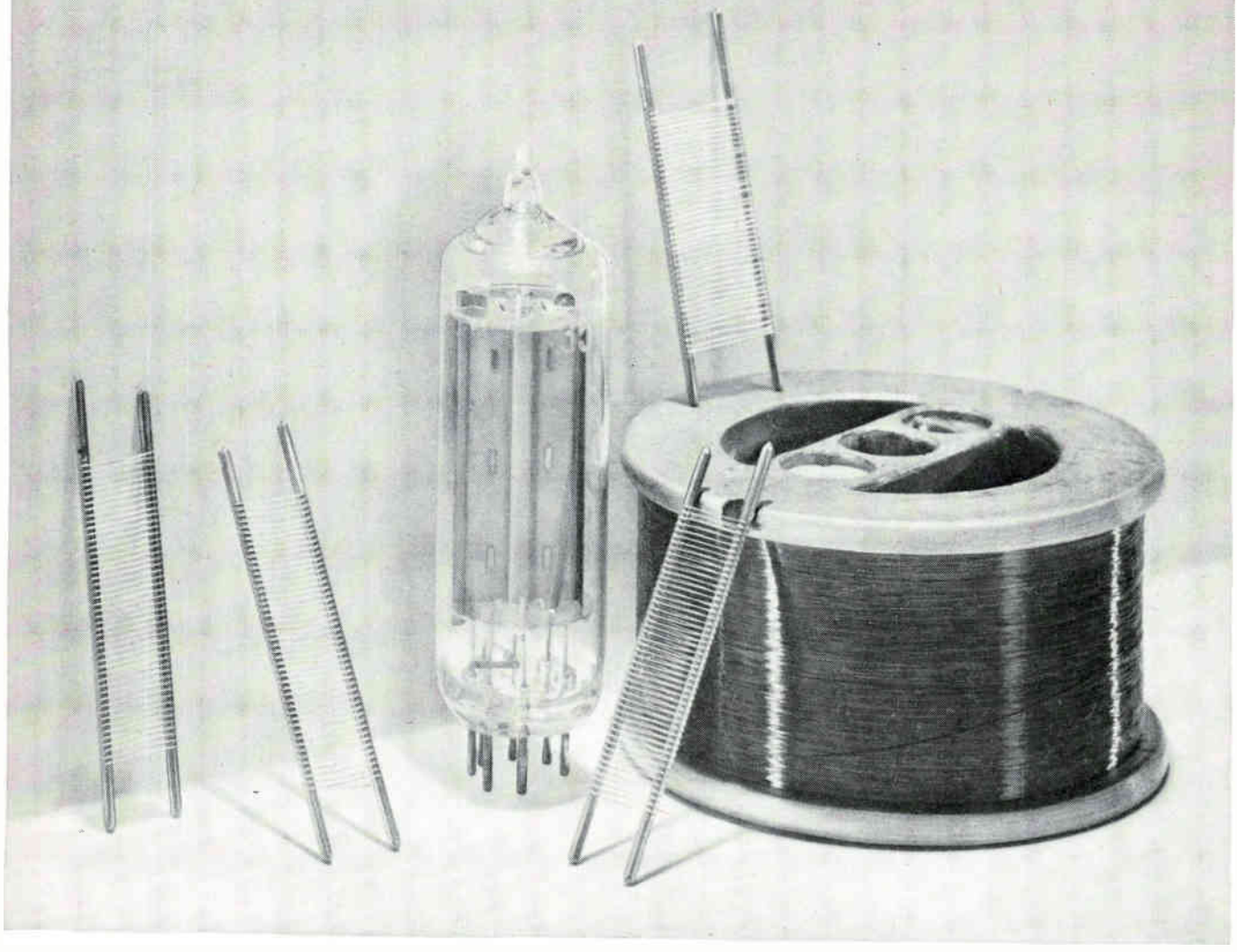
In April of 1959 Congressional leaders expressed a willingness to see pay tv tryouts in the U.S. (ELECTRONICS, p 32, Apr. 17, 1959). At that time, Zenith gave indications of readiness to apply for permission to conduct mid-western tests of a broadcast system using a coin box or punch card to unscramble the signal. Teleglobe Pay Tv System had plans at that time to transmit an unscrambled video signal accompanied by an audio signal sent by wire. Skiatron Electronics also discussed pay-tv plans.

In the intervening year, a watch-and-wait policy became the rule as one complication after another arose. The Toronto test, if it proves favorable, may break the ice.

One observer points out that wire systems would not come under FCC jurisdiction and might therefore be less complicated to establish. On the other hand, pay tv operators still look back at the attempts made with a wire system in Bartlesville, Okla., in the fall of 1957.

This system charged subscribers a flat monthly fee, later switched to a meter system. The test closed down in the spring of 1958 when money was being lost at a rate of about $10,000 a month.

SYLVANIA—BASIC SUPPLIER TO THE ELECTRONICS INDUSTRY



FIRST WORD IN GRID WIRE

—where tube quality is vital

Throughout the electronics industry, the word is "Sylvania" for grid wire.

For one thing, Sylvania has the capability to produce grid wires that meet precise specifications to comply with rigid winding and forming applications. This wire is available as large as required for such applications as super power tubes and as fine as .0003″ using tungsten, .0005″ with molybdenum.

For another, Sylvania can plate gold, nickel, silver, rhodium, palladium or copper on such wires as the various nickel types, Hastelloys, tungsten, and molybdenum.

Result: you have a steady source of supply for highest quality grid lateral wires using the proper materials to assure top quality tube performance.

The engineering accomplishments at Sylvania which have produced better grid wires demonstrate why Sylvania is the first word—*and the last word*—in basic supplies for the electronics industry. Sylvania, Chemical & Metallurgical Division, Towanda, Pa.

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Subsidiary of GENERAL TELEPHONE & ELECTRONICS

PERFORMANCE-PACKED 1½" PRECISION POTENTIOMETERS

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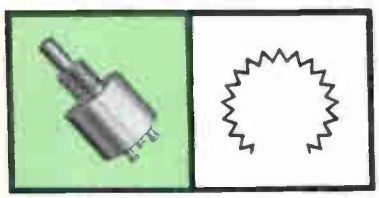
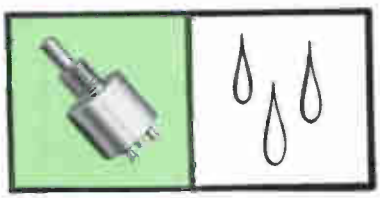


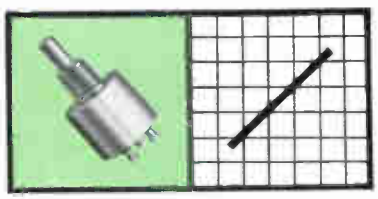
UP TO 50K OHMS

Resistance range: 50 ohms to 50,000 ohms ± 5%. 1.5 watts @ 40°C.



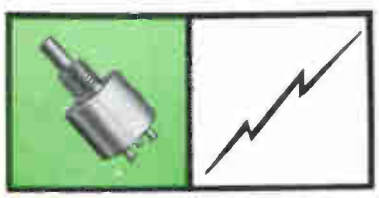
COMPLETELY SEALED

Meets and exceeds military moisture and humidity requirements.



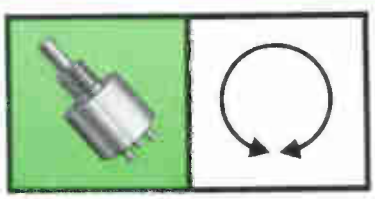
± 2% INDEPENDENT LINEARITY

± 2% deviation for actual angular displacements. Tops for ½" diameter potentiometers.



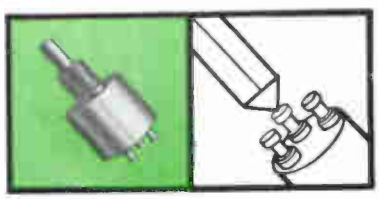
MINIMUM ELECTRICAL LEAKAGE

High dielectric materials employed throughout with nickel-silver body.



RESOLUTION

.08% resolution permits extreme accuracy in read-out and setting.



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Windings terminated with tapered-pins and electronic weld. Terminals molded in place.

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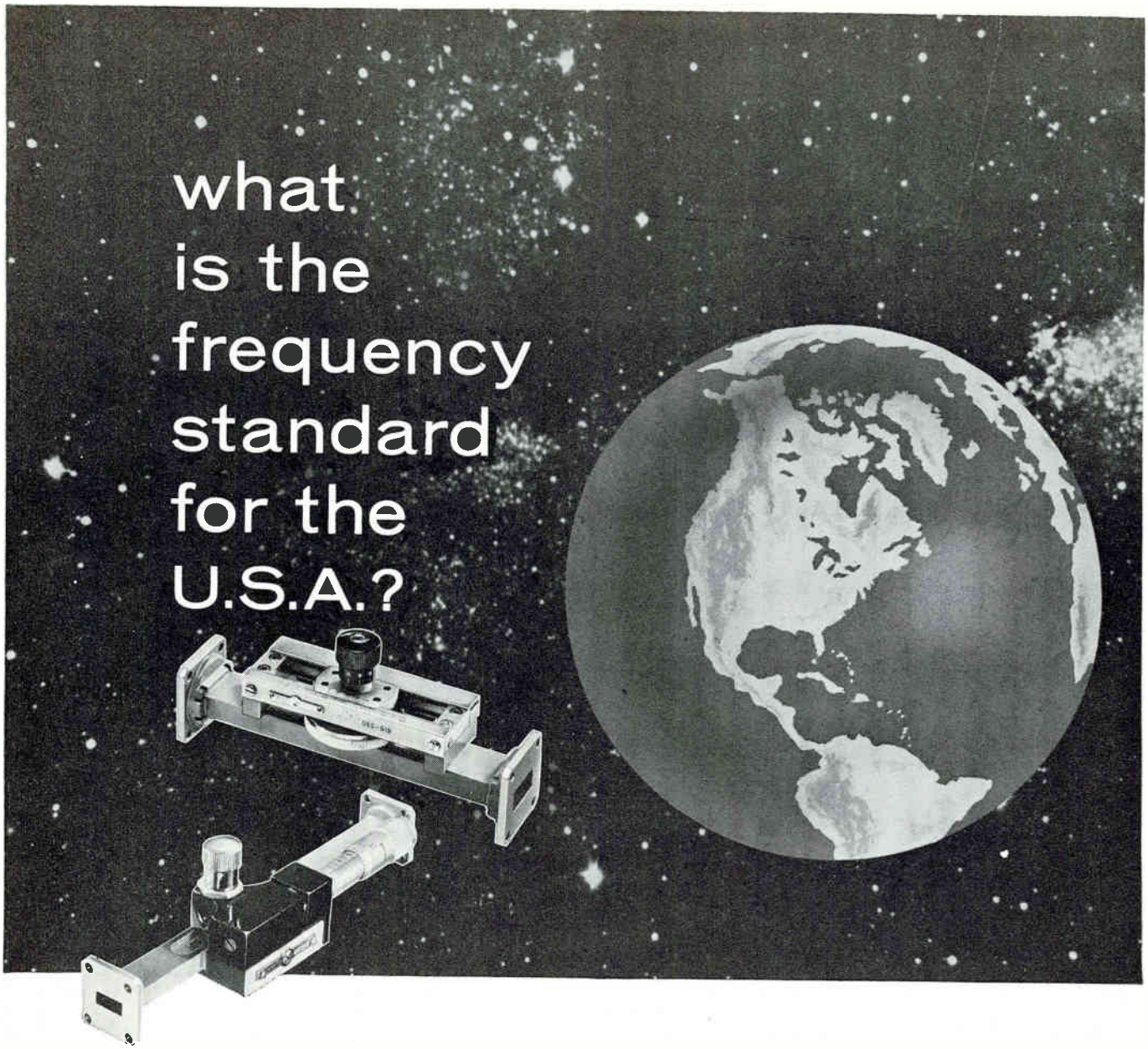

ANSWER: By act of Congress, the U.S. Bureau of Standards determines the primary standard, based on the revolution of the earth. All DeMornay-Bonardi microwave instruments are calibrated at frequencies which are verified by our secondary standard, which, in turn, is periodically calibrated, point for point, by the U.S. Bureau of Standards.

One way to properly match a microwave transmission line is by using a D-B Stub Tuner to reduce mismatch losses and utilize the total energy available.

D-B stub tuners in the 2.6 to 18 KMC range have a new scale and vernier that gives precise resettability in longitudinal travel. A new micrometer scale on the probe measures penetration with very high accuracy.

Probe wobble is eliminated, and no resonances can occur under any conditions. You can correct VSWR as high as 20:1 with amazing accuracy (1.02). You can tune with precision... reset to original settings with certainty that phase and magnitude have been duplicated.

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Write for data sheets—they detail all features, applications, dimensions, sizes. Bulletin DB-919.

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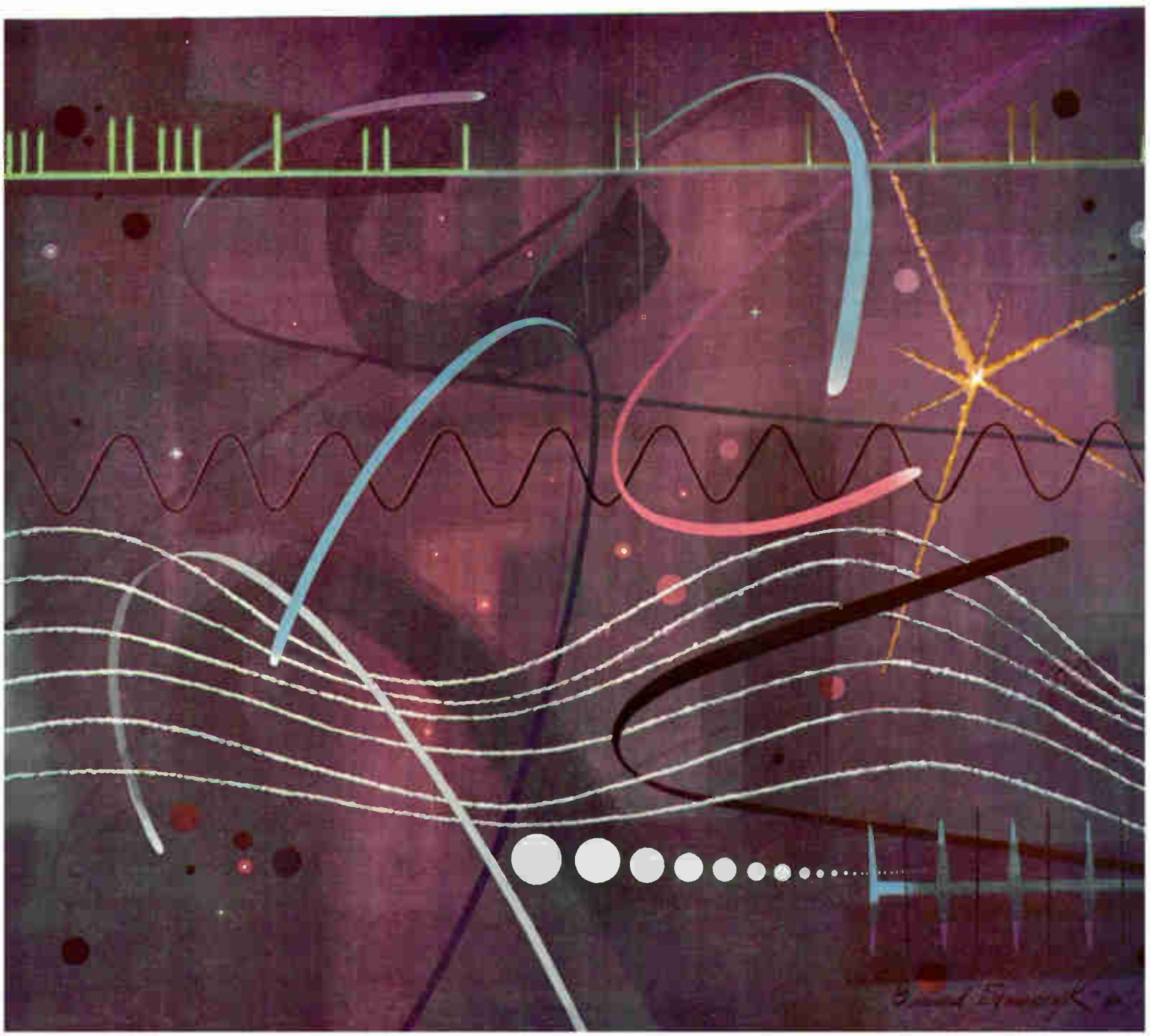

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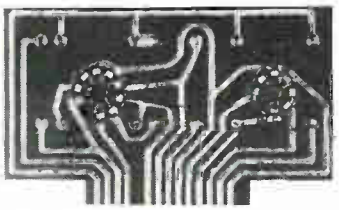
CDF DILECTO®
glass-base laminates

Teflon*, silicone, epoxy, melamine, and phenolic glass-fabric laminates. Polyester glass-mat laminates.

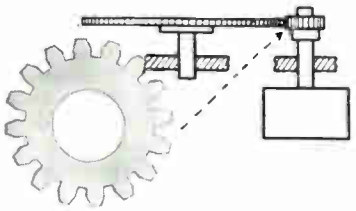
You can improve design, speed production, and save money by specifying one of the many C-D-F Dilecto grades. Whatever your application for these laminates — with fine- or medium-weave glass-cloth base — you'll find a better answer to your problem at C-D-F. (Melamine can also be made with glass-mat base.) And C-D-F offers modern machining and fabrication facilities to deliver production quantities of finished Dilecto parts to your specifications.

See our catalog in Sweet's Product Design File, where the phone number of your nearby C-D-F sales engineer is listed. For free trial samples of glass-base Dilecto, or of any other C-D-F plastics, mica, or fibre product, send us your print or your problem! Write for your free copy of C-D-F Technical Bulletin 64.

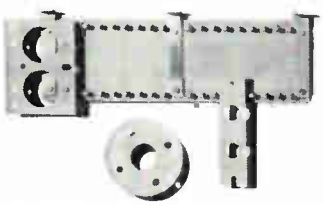
*DUPONT TRADEMARK FOR TETRAFLUOROETHYLENE RESIN



SPEED AUTOMATIC PRODUCTION of printed circuits with warp-resistant C-D-F metal-clad Teflon* and epoxy laminates. Other advantages: high bond strength of copper to laminate, superior blister-resistance in solder immersion.



HIGH-VOLTAGE (1800v.) RF ISOLATION is achieved by miniature C-D-F Dilecto gears in an aircraft receiver-transmitter switch. They also had to exhibit dimensional stability through a wide temperature range, resistance to fungus growth and thermal shock.



PRECISE MACHINING AND FABRICATION are standard benefits of Dilecto laminated plastics. These silicone glass-base parts (coil mountings, aircraft terminal board) were sawed, drilled, punched, and milled in production quantities by C-D-F and customer.

PROPERTIES OF SOME TYPICAL C-D-F DILECTO GLASS-BASE GRADES

Grade	Equivalent NEMA or ASTM grade	Flexural Strength Lengthwise (PSI)	Dissipation Factor at 10^{6} Cond. A	Dielectric Strength Parallel Step x step	Insulation Resistance Cond. C96/35/90	Arc Resistance (seconds)	Maximum Operating Temp. (°C.)
GB-112T (Teflon*)	None	14,000	0.0015	65	100,000	180 +	250
GB-12S (Silicone)	G-7	28,000	0.002	60	100,000	180+	200
GB-28E (Epoxy)	G-10	70,000	0.019	65	75,000	130	150
GB-28EFR (Flame-Retardant Epoxy)	G-11	68,000	0.010	65	100,000	180	150
GB-28M (Melamine)	G-5	50,000	0.014	50	100	185	135
GB-261D (Phenolic)	G-1 and G-2	22,000	0.020	55	10,000	5	150
GM-PE (Polyester)	GPO-1	35,000	0.020	70	200	130	150

These are typical grades for typical applications. To meet special requirements, C-D-F makes many other Dilecto grades, one of which may serve your purpose better than any of these listed here. Consult the C-D-F Technical Department for expert assistance with your design problem involving laminated plastics products.

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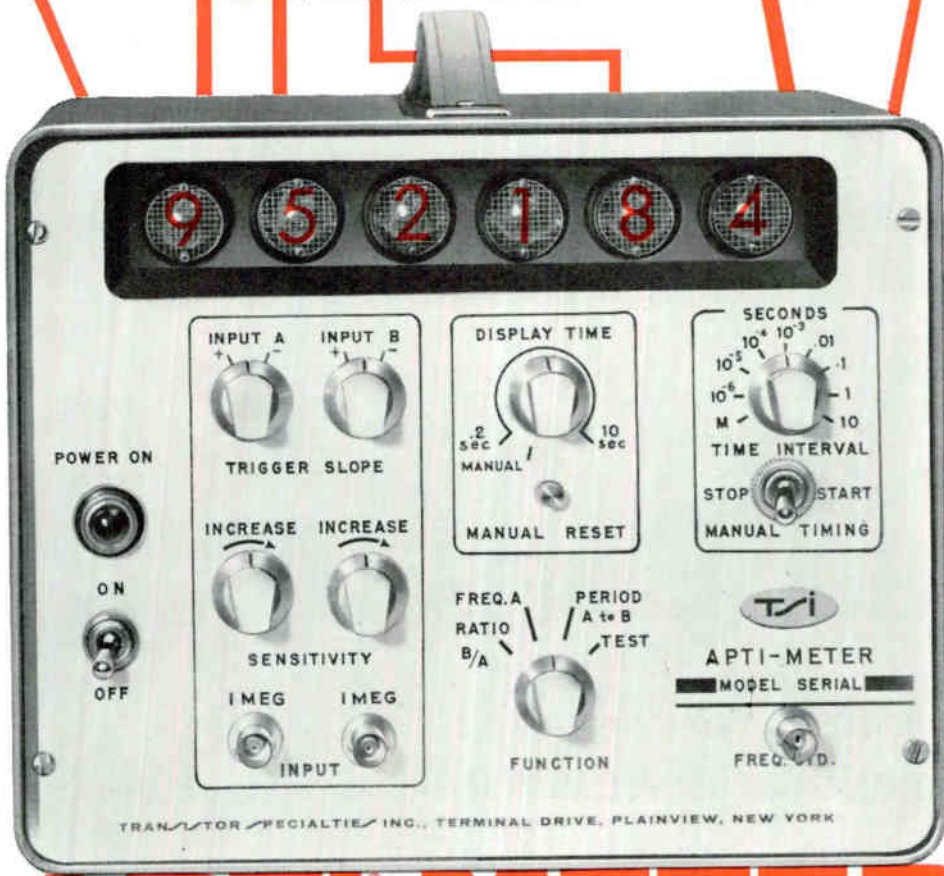

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Here it is—a 1 megacycle fully transistorized counter-timer that gives you all the advantages of solid state circuitry and in-line readout in a versatile, truly portable package! Designed for ultra-reliability in laboratory and plant—and fully environmental tested—the Model 361 Apti®-Meter provides all the functions of a precision counter, timer, frequency meter, and ratiometer—meets the most critical standards of accuracy for measurement, calibration, timing, and control. Conservative circuit design and ample component derating assures outstanding reliability under all operating conditions.

■ **COUNT RATE:** to 1 mc. ■ **TIME INTERVAL:** 1 u sec. to 10 sec., decade steps. ■ **ACCURACY:** ±1 count ±3 parts in 10^7 per week. ■ **INPUT IMPEDANCE:** 1 megohm. ■ **SENSITIVITY:** 10 mv. ■ **DISPLAY TIME:** 0.2 sec. to 10 sec., and manual. ■ **POWER INPUT:** 19 watts. ■ **DIMENSIONS:** 8″ h x 10″ w x 8″ d. ■ **WEIGHT:** 11 lbs. ■ **RESOLUTION:** 1 u sec. ■ **OPTIONS:** printer readout connections; rack mounting; full Mil. Spec. compliance.

The Model 361 Apti®-Meter is one of TSI's family of fully transistorized 100 kc to 10 mc counter-timers for precise laboratory and industrial applications. *Write today for complete data.*

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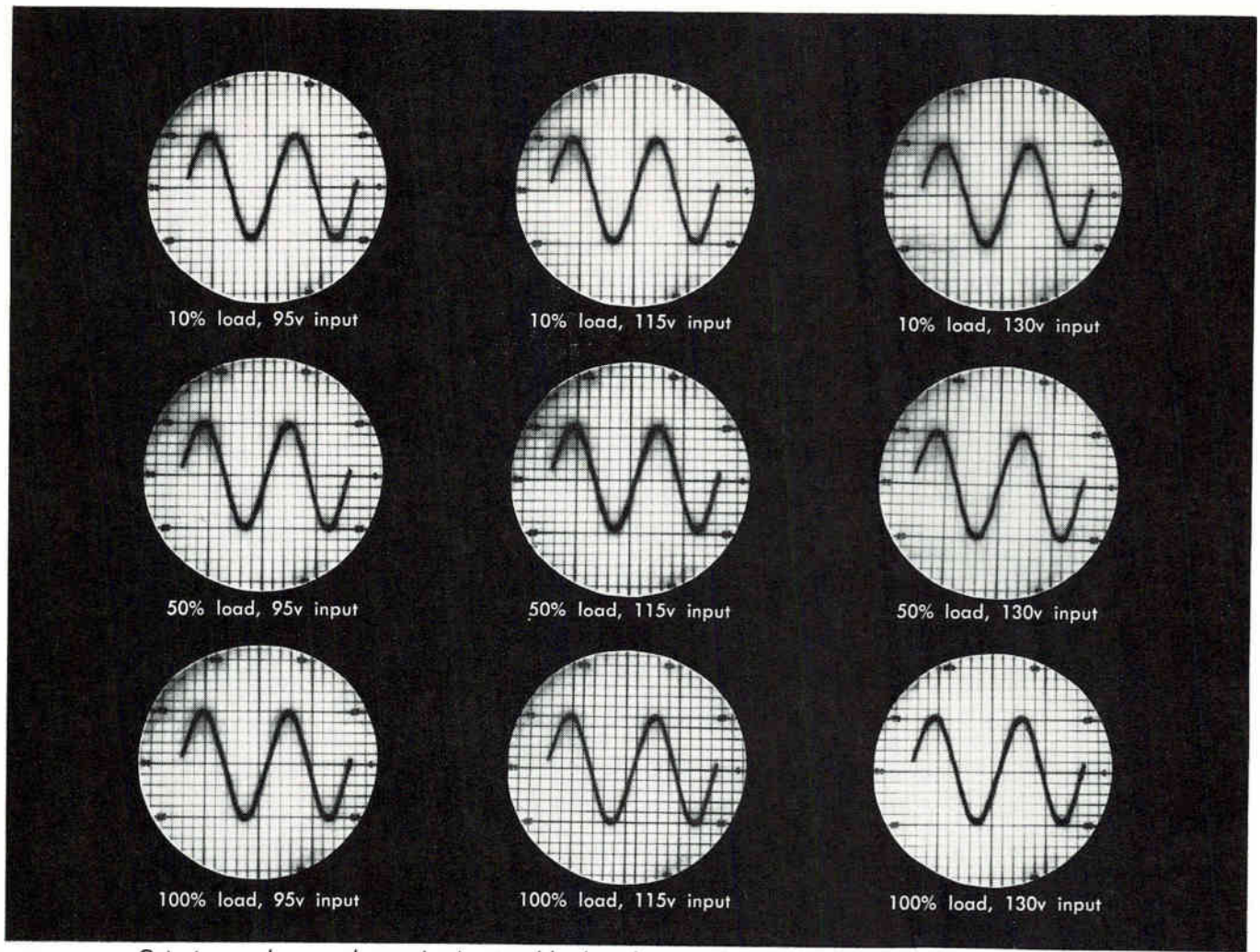


Output wave shapes under varying input and load conditions. Sola Catalog No. 23-13-150 used in this test.

Sola's moderate-cost static-magnetic voltage regulator has sine-wave output

Sola now offers sinusoidal output in every standard-type regulator *with no price premium.* This development — a result of major design and production innovations — greatly widens the field of use for static-magnetic voltage regulation. The new standard sinusoidal design is now ideal for use with electrical and electronic equipment requiring a regulated input voltage with commercial sine wave shape — especially where harmonic-free supply had previously been too costly. The sinusoidal output also contributes to ease of selection and ordering, since this Sola stabilizer is virtually universal in application.

The Sola Standard Sinusoidal Constant Voltage Transformer provides output with less than 3% rms harmonic content. It automatically and continuously regulates output voltage within ±1% for line voltage variations of ±15%. Average response time is 1.5 cycles or less. The new line includes nine stock output ratings from 60va to 7500va.

Besides the improved electrical characteristics, these units are substantially smaller and lighter than previous models. Size and weight reductions were accomplished without any loss of performance or dependability.

With the Sola Standard Sinusoidal Constant Voltage Transformer you also get all the proved benefits of a static-magnetic regulator. It is simple and rugged. There are no tubes . . . no moving parts . . . no replaceable parts. Maintenance and manual adjustment are not necessary.

Its current-limiting characteristic protects against shorts on the load circuit. It is available in step-up and step-down ratios, allowing substitution for conventional, non-regulating transformers. These units can be used in any electronic or electrical application requiring a regulated sinusoidal power source where the peak power demand does not exceed the capacity of the constant voltage transformer. Circuit design formulae based on sinusoidal wave shape are directly applicable. Custom units to specific requirements are available in production quantities.

SOLA

Write for Bulletin 7C-CVS

BPC

A Division of Basic Products Corporation

SOLA ELECTRIC CO.

4633 West 16th Street Chicago 50, Illinois

Nations Merge Satellite Efforts

U. S. and Canada are pooling talents to launch Canada's first satellite late next year

CANADA'S first satellite will be launched into a 700-mi-high, near-polar orbit from Vandenburg Air Force Base, Calif., late in 1961 under an arrangement made between Canada's Defence Research Board and the U. S. National Aeronautics and Space Administration.

Four satellites and instrumentation will be constructed by Canada's Defence Research Telecommunications Establishment (DRTE). NASA will provide three-stage Thor-Delta rockets.

Two Objectives

The experiment will be designed to achieve two objectives: get scientific information about the structure of upper levels of the ionosphere by using a radio sounder above the ionized layers; and secondly, to provide information about galactic noise or the radio signals which emanate from outer space.

This information is needed both by Canada and the U. S. as a phase of their research programs aimed at improving long distance telecommunications.

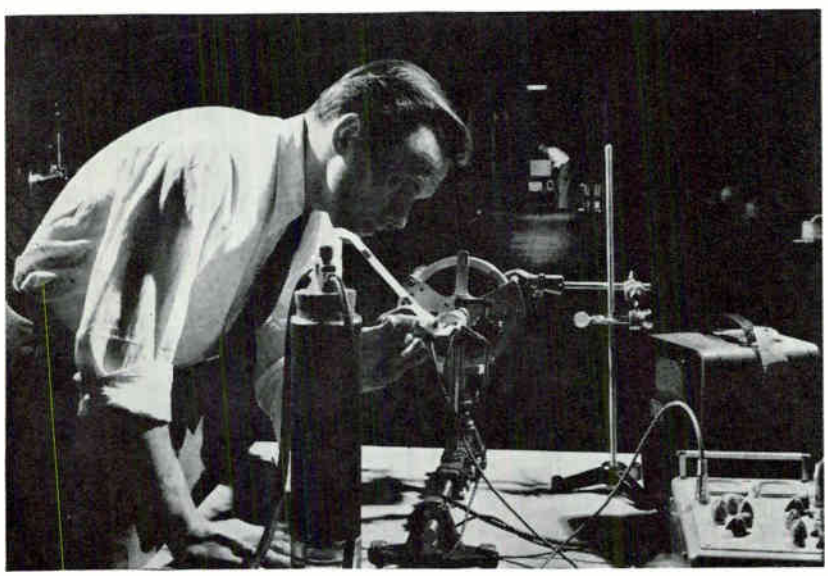
The "sweet frequency top-side sounding technique" will be used to investigate the structure of the ionosphere's upper levels.

The satellites will be constructed of aluminum and fiberglass, nearly round in shape and girdled by banks of solar cells. Diameter will be 42 in. and they will weigh 200 lb.

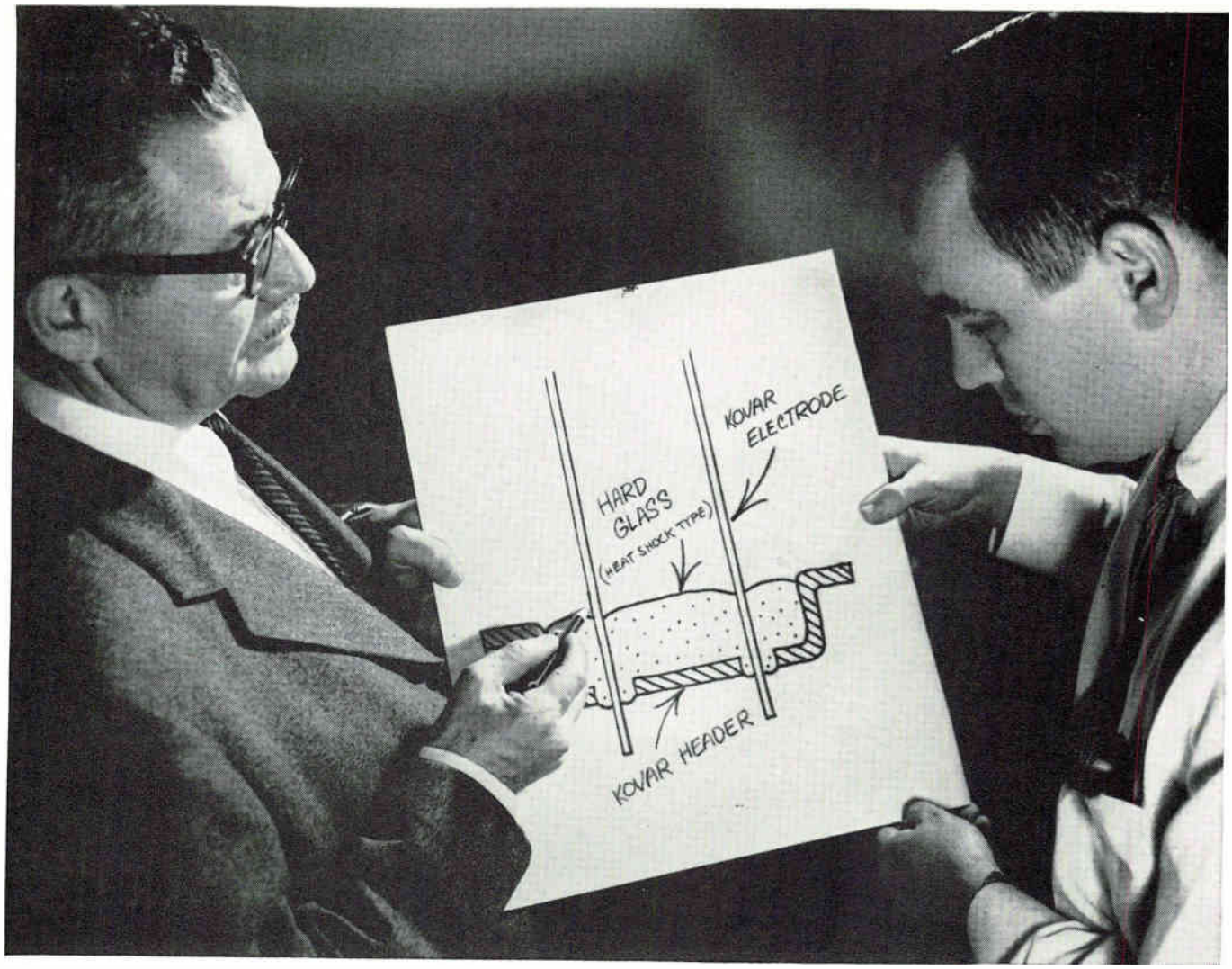
Long wavelengths used for sounding the ionosphere will be sent from two 30-ft, steel antennas. The antennas, coiled within the vehicle during launching, will extend like a carpenter's rule when the satellite achieves orbit.

DRTE will operate four receiving stations in Canada. Besides the rocket vehicles, NASA will provide launching services and ground receiving stations outside Canada. It is hoped that the satellite will continue to transmit data for about a year.

Precise Infrared Studies



Controlled environment for infrared studies is possible in this 86-ft tunnel at Sperry Gyroscope, Great Neck, N. Y. Man in foreground makes adjustments in black body source for pickup by detector in background



Engineering hints from Carborundum

Why use KOVAR® Alloy in Semi-Conductors?

KOVAR, an iron-nickel-cobalt alloy, has a thermal expansion curve that matches almost perfectly that of several hard glasses—making an ideal glass-to-metal seal. For years, it has been used to make vacuum and pressure tight seals for large size electron tubes.

But why use KOVAR for less exacting requirements of semiconductors? Wouldn't less expensive alloys serve as well? Actually, three reasons justify KOVAR alloy's use:

1. Only an oxide-bonded seal of the matched type, such as you get with KOVAR, gives vacuum tightness over so wide a temperature range—minus 80C to over 200C.
2. Its thermal expansion not only matches certain high thermal shock glasses, but also matches the expansion of germanium and silicon—therefore insuring dimensional stability of the entire unit.
3. In KOVAR alloy you get *uniformity* of all required properties—such as expansion, freedom from phase transformation down to minus 80C, oxidation rate and plateability with other metals.

KOVAR can be welded, brazed or soldered—also plated with other metals—either by electrolytic or chemical methods. KOVAR, either oxide bonded to hard glass, or brazed to metallized ceramic insulators, makes a rugged permanent seal... even under the most severe conditions of temperature, vibration and handling. Technical service is available to help you solve processing and application problems. Contact The Carborundum Company, Refractories Division, Dept. E-30, Latrobe Plant, Latrobe, Pa.

FIND OUT ABOUT KOVAR

WHERE IT IS USED AND WHY

New book gives data on composition, fabrication techniques and applications. Send for your free copy today.

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

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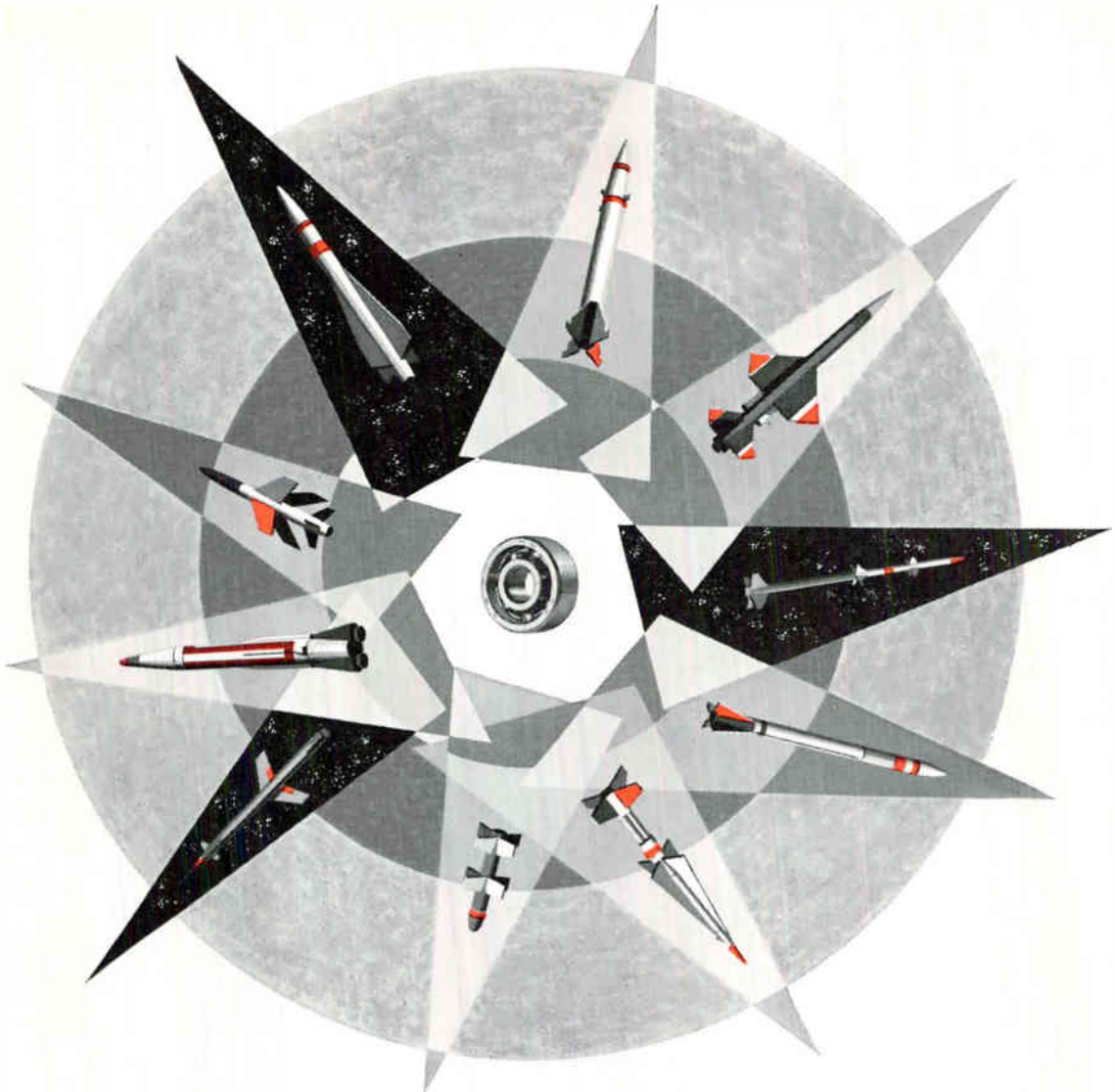

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proved reliability you can build around

MEETINGS AHEAD

Mar. 17-18: Synchro Design and Testing Symposium, Bureau of Naval Weapons, Dept. of Navy, Dept. of Commerce Auditorium, Wash., D. C.

Mar. 21-24: Institute of Radio Engineers, International Convention, Coliseum & Waldorf-Astoria Hotel, N. Y. C.

Mar. 24-25: Human Factors in Electronics, PGHF of IRE, Bell Labs Auditorium, N. Y. C.

Apr. 3-6: National Assoc. of Broadcasters, Engineering Conf. Committee, NAB, Conrad Hilton Hotel, Chicago.

Apr. 3-8: Nuclear Congress, EJC, PGNS of IRE, New York Coliseum, New York City.

Apr. 11-13: Space Conference, Engineering Technology, AIEE, Baker Hotel, Dallas.

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

Apr. 12-13: Protective Relay Engineers, Annual, A&M College of Texas, College Station, Texas.

Apr. 12-13: Electronic Data Processing, IRE, ARS, Hotel Alms, Cincinnati, O.

Apr. 12-13: Static Relay Symposium, U. S. A. Signal R&D Lab, Hexagon Auditorium, Ft. Monmouth, N. J.

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

Apr. 19-21: Active Networks & Feedback Systems, International Symposium, Department of Defense Research Agencies, IRE, Engineering Societies Bldg., N. Y. C.

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

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

There's more news in ON the MARKET, PLANTS and PEOPLE and other departments beginning on p 102.

Mars

Because its reddish glow may have suggested blood and violence to the ancients, Mars was named for the God of War. Of all the planets it is the only one we can readily observe. Mercury is too near the sun and heavy clouds veil the surfaces of the rest.

About once every two years you may see a bright star rising in the heavens as the sun sets. The ancients named Mars for the God of War, perhaps because to them its ruddy color suggested blood.

Of all the planets, we know Mars best. We see it most clearly. We study it most closely. Yet, Mars has always been a mystery to man. And so it is today.

Of course, we know something

...ing Concepts of the Cosmos

Reproduction of one of the finest, current drawings of Mars, showing the visible markings of the planet, and dust storm sweeping across its surface. The original is by Dr. de Vaucouleurs of Harvard College Obs

about Mars. It rotates on its axis with a day of 24 hours, 37 minutes. It has changing seasons, and a diameter about half that of the earth.

Through a large telescope Mars looks reddish-yellow with patches of grey or grey-green. What are these patches? Oceans, said early astronomers. Vegetation, we believe today.

We can see the polar caps of Mars: most likely thin layers of frozen water, for they vanish in summer and return in winter.

On Mars, you would find the atmosphere thin and probably composed of carbon dioxide and water vapor. There would be very little water. The Martian sky would be nearly black, and dotted with high-floating blue or violet clouds of fine ice powder.

You would face storms at times. And strong winds that sweep up large clouds of yellow dust as they drift across the planet.

Some observers have said they see a complex web of fine lines on Mars. Other, equally reliable observers have seen nothing. Most astronomers now agree that these controversial "canals" may be only an optical illusion. But they are surely not artificial waterways.

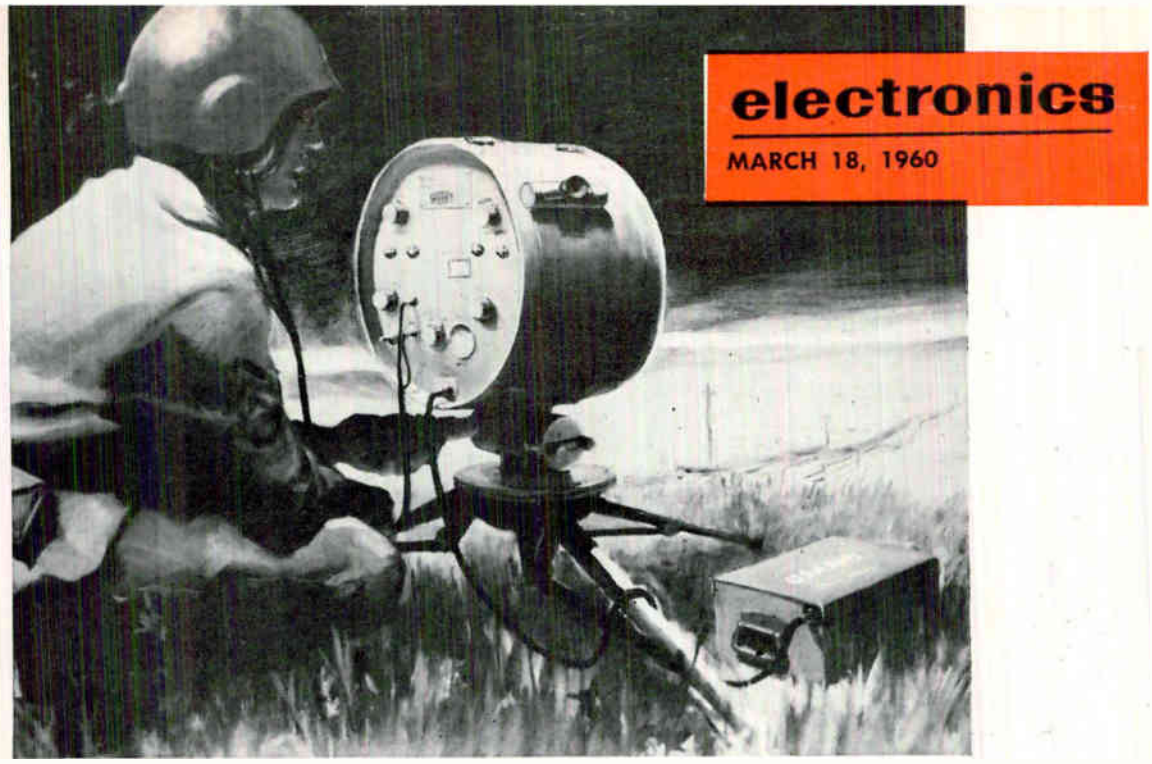
Where vegetation exists—and we believe it does on Mars—animal life is possible, too, though it is not likely that human-like life will be found. But here we have no relevant observations. Only exploration of the planet—first by probes and then by manned expeditions—can answer this question in a final way.

Because we believe that cosmography—the geography of the cosmos—will play a vital role in the future, McDonnell Aircraft has instituted important basic research in astronomy, solid-state physics, chemical kinetics and mathematics.

These research programs are oriented toward a fuller understanding of the universe: That men—men of all nations—may cooperate in the exploration of space, the moon, the sun, and the planets. That, through such adventure, men may better understand themselves and one another.

McDONNELL *Aircraft* St. Louis 66, Missouri

INVITE INQUIRIES FROM ENGINEERS & SCIENTISTS INTERESTED IN PARTICIPATING IN CURRENT SPACE PROGRAMS AT M...



THE FRONT COVER—Army's Silent Sentry radar can detect difference between a walking and running man

Portable Radar Traces Battlefield Deployment

Fifty-pound Doppler radar detects and accurately locates moving vehicles and men. Extensive transistorization permits silent operation through use of battery power

By J. SCOTT, D. RANDISE, R. P. LUKACOVIC,
Sperry Gyroscope Co., Division of Sperry Rand Corp., Great Neck, New York

SURVEILLANCE of enemy movement under cover of darkness, smoke or fog is a critical need in modern warfare. The lightweight Doppler radar described increases the capability and effectiveness of the combat infantryman by pinpointing the movements of tanks, trucks or troops.

Developed by Sperry Gyroscope Co. for the U. S. Army Signal Corps and known as the AN/PPS-4 Silent Sentry, the radar can be carried by one man. Maximum range of the radar is a mile for a walking man and four miles for a large moving vehicle. Minimum range is about 50 meters.

Primary output consists of distinctive sounds produced in a pair of headphones. A range counter, plus azimuth and elevation dials, give the target location.

The radar set, including tripod, weighs less than 50 pounds. It consists of a radome, center section and control panel. The radome consists of a parabolic reflector and protective dome; the center section contains the waveguide and transistorized electronic plug-in units; the control panel contains the controls, indicators, fuses, headset receptacles and power receptacle.

SYSTEM OPERATION—Operating principle of the radar is described with the aid of the block diagram shown in Fig. 1. A magnetron in the transmitter produces 0.2-μsec pulses of X-band r-f energy. A dipole antenna and parabolic reflector concentrate the energy into a 6-degree beam.

A crystal signal mixer, i-f amplifier and video amplifier produce usable signals from the returned echoes; a boxcar detector stretches the Doppler-modulated video; and an audio amplifier supplies the audible signals to the headphones. An afc circuit holds the klystron local oscillator 30 Mc above the

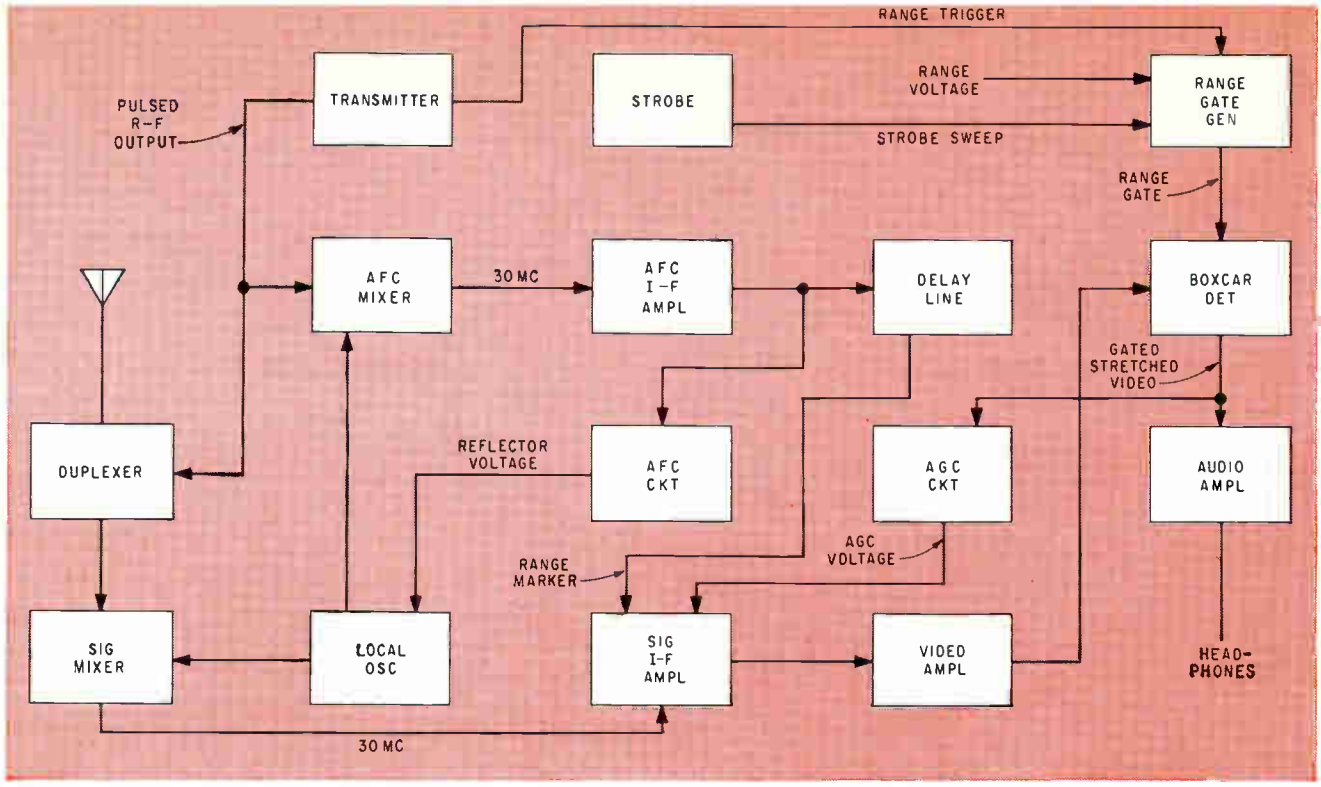


FIG. 1—Tube-transistor hybrid design cuts power requirement in half, eliminates need for gasoline generator

magnetron frequency.

A 0.2-μsec range gate controlled by a handwheel on the operator's panel determines the range location of the sounds being produced in the headphones. For range searching, a strobe circuit can be employed by the operator to sweep the range gate over any selected 200-meter or 500-meter range region.

A range mark circuit permits the operator to calibrate the range counter, thereby maintaining a range accuracy of $\pm$25 meters out to 8,000 meters. A power converter located within the radar enclosure provides all d-c and a-c voltage required by the circuits.

TRANSMITTER—Figure 2 shows the basic transmitter circuit. It consists of a relaxation oscillator, differentiator, resonant charging circuit, thyratron switch, line-type pulse forming network, pulse transformer and X-band magnetron.

The relaxation oscillator consists of an R-C charging circuit and a Shockley *pnpn*, four-layer transistor-diode. This circuit produces a sawtooth waveform having a 200-μsec period.

The differentiator forms a sharp 2-μsec pulse at the trailing edge of each sawtooth wave. This pulse triggers the thyratron switch which then discharges the pulse forming network. The network produces a 0.2-μsec pulse which is stepped up to 4,500 volts in the pulse transformer and fed to the magnetron.

Capacitors in the pulse network are charged during the 200-μsec period between triggers through coil L_c. A trigger pulse is also generated from the pulse transformer for synchronizing the ranging system.

I-F AND VIDEO AMPLIFIERS—A low noise two-stage vacuum tube preamplifier, five transistorized i-f gain stages and two transistorized video stages make up the i-f and video amplifiers (see Fig. 3). Center frequency is 30 Mc with 6-Mc bandwidth. Noise figure is less than 2.5 db and gain is sufficient to give a peak-to-peak noise output of one volt into a 1,000-ohm load with nominal *agc* setting.

The vacuum tube preamplifier is a conventional grounded-cathode grounded-grid amplifier designed to couple into a balanced r-f mixer. Jacks are provided at each crystal filter, not shown on the drawing, for monitoring crystal current.

Transistors in the i-f stages are 3N35 tetrodes. Automatic gain control is provided on all stages and is accomplished by varying base-2 current in all stages and emitter current in the first stage only.

Interstage coupling networks are single-tuned circuits, and are tuned somewhat between exact flat-staggered triple-tuning and synchronous tuning. The tuning network at the output of the preamplifier and the last i-f stage are tuned to 30 Mc; the second and fourth networks are tuned to 27 Mc; and the third and fifth are tuned to 33 Mc.

R-f output of the last i-f stage is detected by a diode detector, amplified by a common-emitter tetrode stage and then fed into a 2N338 triode emitter follower. Limiting is accomplished by setting the voltage of the video amplifier at the desired limit level and occurs when the positive signal into the base drives the collector into saturation.

A large amount of d-c degeneration is used in order to hold the appropriate limit level over the temperature range. Gain of the video amplifier is approximately 10; the detector plus amplifier has linear gain for output signals of 0.2 v to 2.5 v with saturation occurring at 3.5 v.

Blocking effects from large pulsed signals are minimized by use of r-f inductors as base returns in each i-f transistor stage. Bias levels are maintained constant for large pulse signals by adding 10-microfarad capacitors across the typical emitter bypass capacitors. In addition, the collector r-f decoupling

capacitors of the last two stages are bypassed with 10-microfarad capacitors to prevent ringing from large pulsed signals.

RANGE GATE GENERATOR—The range gate generator consists of a sweep gate circuit, bootstrap sweep generator, multiar comparator, and blocking oscillator. The sweep gate circuit is triggered by the transmitter to produce a 70-μsec gate. During this period, the sweep generator produces a linear 60-volt sawtooth waveform.

The multiar circuit compares the amplitude of this sawtooth to a d-c voltage from a potentiometer controlled by the range handwheel. At the instant of amplitude match the multiar fires, triggering the blocking oscillator which then produces the 0.2-μsec gate.

As shown in Fig. 4, the boxcar detector consists of the secondary of the blocking oscillator transformer, a bipolar diode switch, an R-C low-pass filtering and stretching circuit, and a double emitter follower. During the range gate interval of 0.2 μsec the diodes conduct, thereby connecting the video signal to the filter circuit.

The filter capacitor charges to a value that is a function of the video level present during the range gate interval and holds this charge until the next range gate occurs 200 μsec later. Thus, the output of this filter consists of a series of 200-μsec steps varying in level as a function of the variations in gated video level.

D-c level of this signal is used for age action and the a-c variations constitute the audio signal. The double emitter follower presents a high impedance to the filter to prevent charge leakage.

AUDIO AMPLIFIER—Figure 5 shows the audio amplifier which consists of two low-pass R-C filter networks, a gain stage containing amplitude and frequency sensitive feedback, a second gain stage and a complementary-symmetry emitter follower output stage driving an audio transformer. Low-pass filtering compensates for the poor low-frequency response of the human ear, thus permitting slow speed targets

DOPPLER PRINCIPLES INVOLVED

To understand the Doppler principle utilized by the radar, assume that the region to which the radar is sensitive—that is, the region within the 30-meter range gate and the 6-degree beam—contains a number of fixed targets such as rocks, buildings and trees, as well as one moving target.

Phase of the r-f return from each of the fixed targets depends on the target's distance, in wavelengths, from the radar antenna. Randomly spaced fixed targets produce a composite return having phase and energy dependent on the manner in which the targets are spaced in range. Thus, two fixed targets spaced an integral number of wavelengths apart in range produce r-f returns that are in-phase and the total energy received is equal to the sum of the energies. However, two targets spaced an integral number of wavelengths plus one-fourth wavelength apart in range produce returns that are out-of-phase and the total energy received is the difference between the two.

The moving target also contributes to the composite return. However, because the target is constantly changing in range, its r-f return goes through a 360-degree phase change with respect to the fixed return for each half wavelength that it moves. Thus, the total returned energy from both fixed and moving targets goes through a complete cycle from maximum to minimum to maximum for each half wavelength that the moving target travels. This amplitude modulation is detected in the radar and amplified as an audible signal.

Since the wavelength is 3 cm, a target moving at 1.5 cm/sec produces a tone of one cps. More practically, a target moving at 45 cm/sec (one mph) produces a tone of 30 cps, and a target moving 30 mph produces a tone of 900 cps.

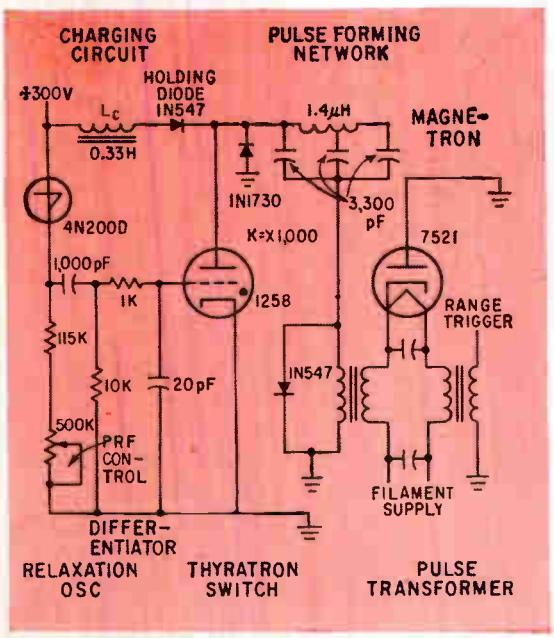


FIG. 2—Transmitter produces pulsed r-f energy in X-band

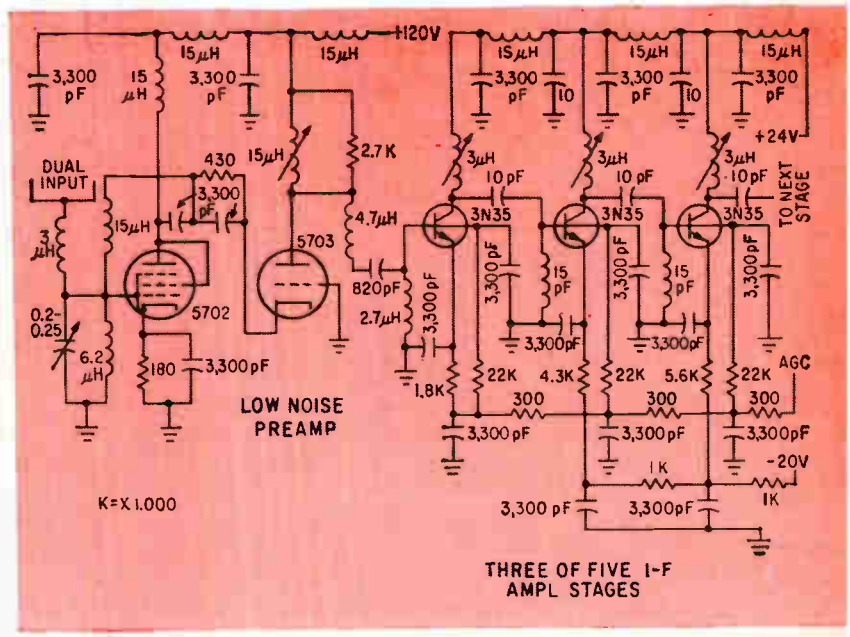


FIG. 3—Final two i-f amplifier stages are identical to those shown

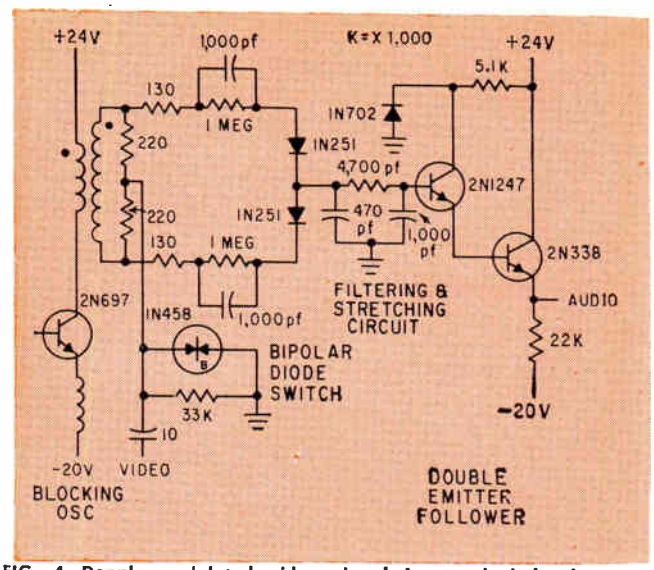


FIG. 4—Doppler-modulated video signal is stretched by boxcar detector and fed to audio amplifier

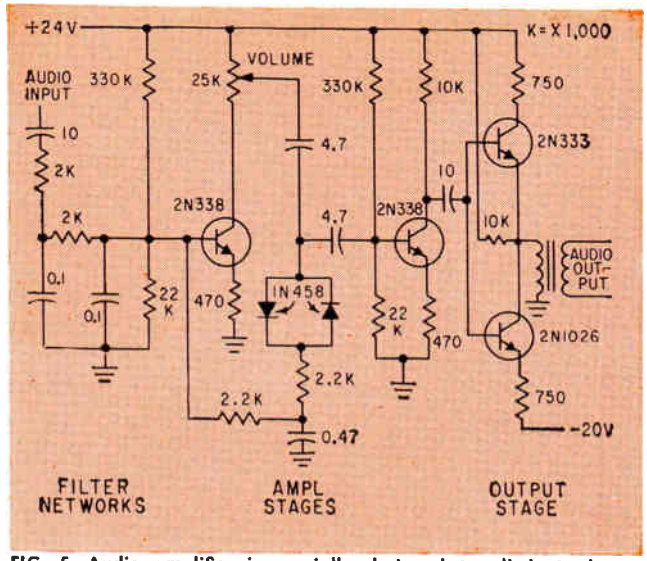


FIG. 5—Audio amplifier is specially designed to eliminate large-amplitude low-frequency noise

such as a walking man to be detected. The feedback circuit limits the amplitude of the low-frequency signals thus preventing large-amplitude low-frequency noise such as wind blown tree branches from masking vehicular target signals.

A diode-actuated threshold circuit, a d-c amplifier, and an emitter follower make up the agc circuits. The threshold circuit permits low-amplitude signals and normal receiver noise to be amplified without reduction in i-f amplifier gain. Larger signals are amplified and fed to the i-f amplifier agc line, reducing the i-f gain so that the signals remain below the video saturation level. This agc action permits detection of audio variations regardless of signal amplitude.

AFC CIRCUIT—Function of the afc circuit is to sample the frequency of the type 2K25 klystron local oscillator and the transmitter frequency, and to develop d-c signals which electronically control the local oscillator frequency so that it is always 30 Mc higher than the transmitter frequency. Essentially, the entire loop is a servo in which the local oscillator and transmitter track each other by 30 Mc plus a small error frequency depending on the loop gain. Components of the closed loop are the local oscillator, a mixer which samples the local oscillator and transmitter to produce the difference frequency, and the afc circuit which converts the frequency deviation to direct current for controlling the local oscillator frequency.

The afc circuit consists of two band-pass amplifiers tuned to 30 Mc, a frequency discriminator network made up of passive elements, three video amplifier stages that amplify the detected pulses from the discriminator, and two d-c amplifier stages which feed the klystron reflector. In addition, the afc circuit contains a unijunction transistor sweep circuit which causes the d-c output to sweep when either the local oscillator or the transmitter is not on frequency. This sweeping action varies the local oscillator frequency until it is 30 Mc above the magnetron at which time the error signal stops the sweeping action.

STROBE CIRCUIT—An R-C sweep circuit utilizing a Shockley pnpn 4-layer transistor diode to discharge the capacitor and a double emitter follower output feeding the range gate generator form the range strobe circuit. The period of the sawtooth output is four seconds for the 200-meter strobe and 10 seconds for the 500-meter strobe.

This slowly varying voltage is used as a reference in the comparator circuit of the range gate generator, thereby causing the range gate to move out in range during the strobe sawtooth period. Position of the range gate is indicated by a meter on front panel.

The r-f system consists of the hybrid sections, a dual TR tube, antenna and interconnecting waveguide. A directional coupler with approximately 16-db attenuation is for test purposes. The balanced r-f mixer and afe mixer outputs are connected by coaxial cable to the l-f amplifier and afe circuits.

POWER CONVERTER—A saturating-core multivibrator is used as the power converter. It utilizes two 2N174 germanium transistors and two transformers, one a saturating-core transformer and the other the power transformer.

Transistors are switched by the saturating-core transformer in ordinary multivibrator fashion while the other transformer carries the bulk of the current. This method gives the power supply an efficiency of better than 85 percent.

FUTURE SYSTEMS—Development of improved systems of this type utilizing latest state-of-the-art techniques such as semiconductor modulators, local oscillator switching, more efficient transmitter and local oscillator components, and advanced semiconductor components is continuing. These improved techniques are expected to result in small, lantern-sized self-contained radars which may radically change the tactics of the U. S. Army infantryman.

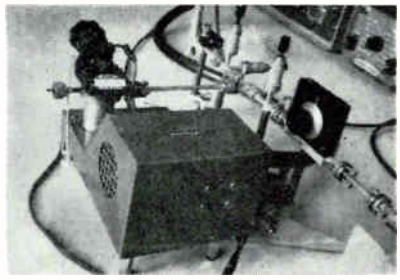
The authors wish to acknowledge the development work of all the engineers on the AN/PPS-4 project and their invaluable comments.

Using Reflex Klystrons as Millimeter-Wave Amplifiers

Although essentially an oscillator, the reflex klystron can be used as an amplifier by careful control of its parameters. Using reflex klystrons as amplifiers may help fill the gap in millimeter-wave technology

By **KORYU ISHII**, Dept. of Electrical Engineering, Marquette University, Milwaukee, Wisconsin

AT THE PRESENT state of the art of millimeter-wave engineering, there are no commercially available millimeter-wave receiving amplifier tubes. Very little research involving specially designed travelling-wave tubes and two-cavity klystrons has been done. Some initial laboratory tests, however, have been performed. At this extremely short wavelength, amplification is more difficult than the generation of the waves. Fortunately, in the M-band (50,000 to 75,000 Mc), some reflex klystrons are commercially available at present.



Experimental set-up for millimeter-wave klystron amplifier at left. H-plane tee, E-H tuners, crystal mount and variable attenuator on right

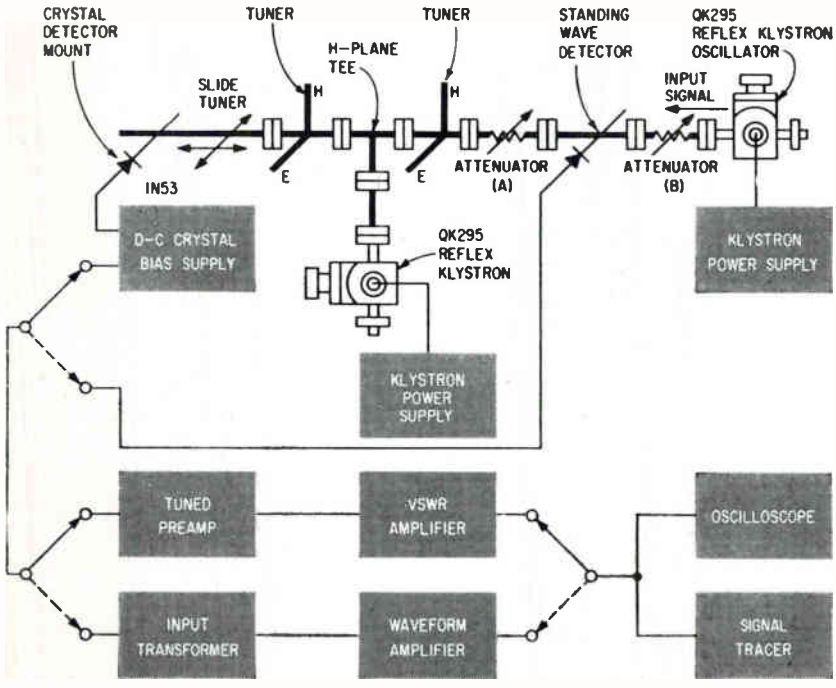


FIG. 1—Experimental circuit of millimeter-wave amplifier using reflex klystron

The reflex klystron is essentially an oscillator, but if the impedance of the output circuit is carefully adjusted, it can be used as a regenerative amplifier. Reflex klystrons have shown excellent amplification characteristics in the X-band vicinity (8,200 to 12,400 Mc).[1, 2, 3, 4, 5, 6] In line with this, the reflex klystron QK295 was studied in this investigation as a regenerative millimeter-wave receiving amplifier in the M-band.

A schematic diagram of the experimental circuit for the QK295

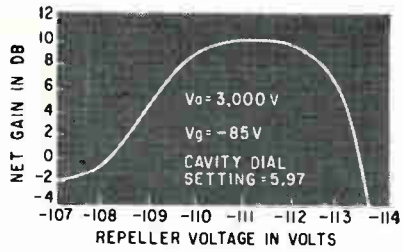


FIG. 2—Repeller voltage characteristic of QK295 reflex klystron amplifier

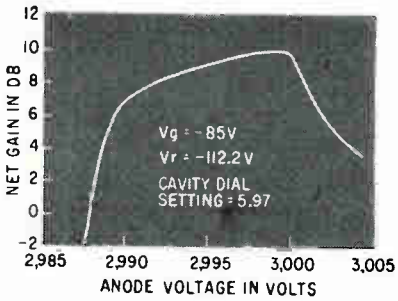


FIG. 3—Anode voltage characteristic of QK295 reflex klystron amplifier

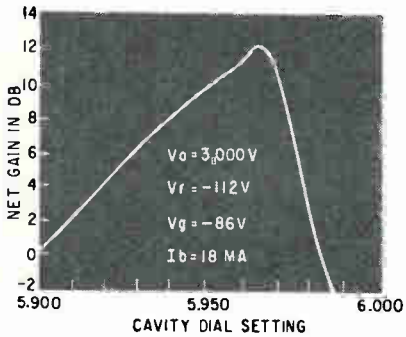


FIG. 4—Cavity tuning characteristic

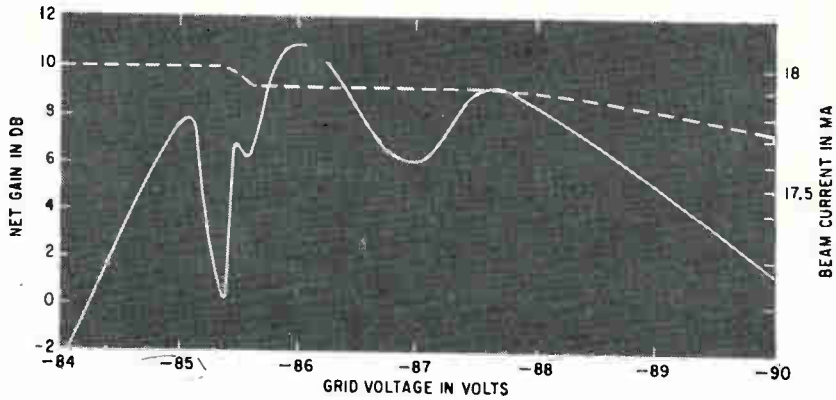


FIG. 5—Grid voltage characteristic of QK295 reflex klystron amplifier with V_a = 3,000 v, V_r = − 112 v and cavity dial setting of 5.96

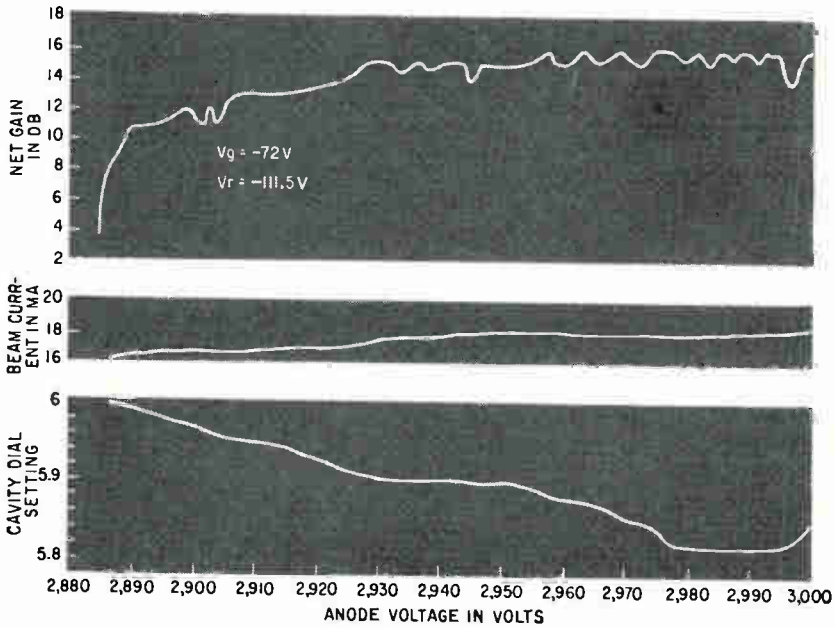


FIG. 6—Amplifier characteristics of QK295 reflex klystron

reflex klystron amplifier is shown in Fig. 1. The QK295 amplifier tube, shown in the middle of the figure, is connected to the H-arm of the H-plane tee. An EH-tuner is connected to each end of the co-linear arms of the H-plane tee to adjust the output impedance of the QK295 amplifier tube.

The input signal is fed through attenuators and a standing-wave detector from a QK295 reflex klystron oscillator. The power supply modulates the oscillator with either 1,000-cps square waves or pulses.

The output of the QK295 amplifier is taken from the left side of the E-H tuner and detected by the 1N53 crystal. The detector crystal is d-c biased to obtain maximum detector sensitivity.

The detected output is measured using the relative power level scale of the vswr amplifier. The relative value of the input power is measured in the same way by connecting the crystal mount directly to the output of the attenuator (A) in Fig. 1. The gain is the difference in db of the two indicator readings.

The waveform amplifier in Fig. 1 is used to observe the amplified waveform. The amplifier output is observed on an oscilloscope and monitored by the signal tracer which includes a loudspeaker.

Square Wave Characteristics

The test oscillator operates at 58,000 Mc modulated by square waves of 1,000 cps. The output signal is fed into the QK295 reflex klystron amplifier whose gain-versus-repeller voltage characteristic is shown in Fig. 2.

In this case, the repeller voltage alone is varied while the other supply voltages and circuit conditions are kept constant. A maximum gain of 10 db and a repeller voltage margin of 3.3 volts are obtained. The repeller voltage margin is the amount of repeller voltage variation possible if the gain is to remain within 3 db of its maximum value. Input signals are attenuated when the electronic tuning is poor.

Net gain is plotted against the anode voltage in Fig. 3. Maximum gain is again 10 db and an anode

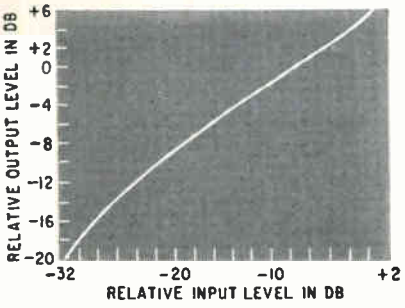


FIG. 7—Good linearity of klystron amplifier is indicated by data

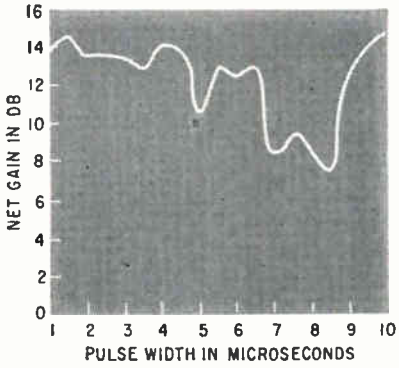


FIG. 9—Pulse characteristics of amplifier

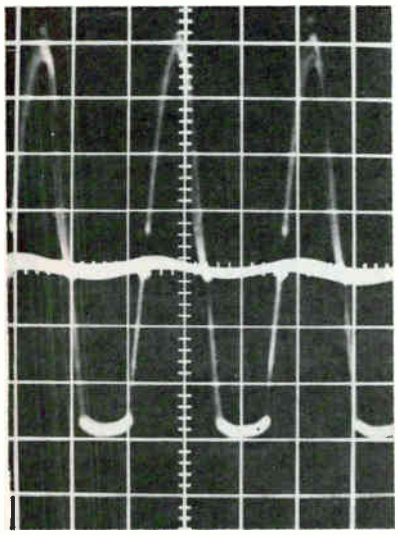


FIG. 8—Output of reflex klystron amplifier seen through tuned preamplifier. Small waveform is output with amplifier inoperative. Large waveform is with amplifier operative

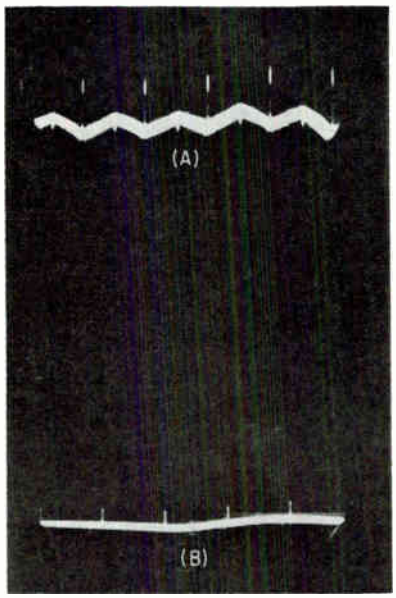


FIG. 10—Output of amplifier with pulse of 4 μsecs. (A) indicates when tube is ON, lower pattern (B) when tube is OFF

voltage margin of 11 volts is obtained. The electronic tuning is obtained by varying only the anode voltage in this case.

Gain

Net gain is plotted against grid voltage in Fig. 5. The grid voltage controls beam current and conductance; it can also be used to achieve electronic tuning, although this method of tuning is critical. The grid voltage margin is 0.8 volts and a maximum gain of 11 db is obtained. Beam current is also plotted in Fig. 5 (broken-line curve). The effect of beam current on the gain is less than the electronic tuning effect of the grid voltage. Net gain is plotted against the cavity dial setting of the QK295 reflex klystron amplifier tube, in Fig. 4. Mechanically changing the cavity size controls the circuit impedance adjustment and tuning. A maximum gain of 12.5 db is obtained.

Higher gain can be obtained if various parameters, such as the supply voltage to the individual electrode of the klystron tube, the cavity dial setting and the settings of many shorting plungers of the E-H tuners are adjusted simultaneously to obtain the maximum gain. An example is shown in Fig. 6. In this case, the repeller voltage and grid voltage are fixed. Adjustments of the cavity dial setting and shorting plungers of the E-H tuners are used to obtain the maximum gain for individual anode voltage settings. A maximum gain of 16 db is obtained over a wide range of anode voltage settings. The role of the E-H tuners in this arrangement is very important. When the amplifier was tested without the E-H tuners, the maximum gain was only 1.5 db. The linearity of the QK295 amplifier is good as shown in Fig. 7. The relative output power levels are plotted against the relative input power levels in db.

Output

An example of the output signal of the tuned amplifier is shown in Fig. 8. The low-level sinusoid in the center of the photograph is the output with QK295 amplifier inoperative, and the high-amplitude wave is the output with the QK295 active. Insertion loss of the amplifier section, including the E-H tuners, is 3 db.

Pulse Characteristics

When the oscillator signal of 58,000 Mc is modulated by pulses of 1 to 10 μsec width, and fed to the QK295 amplifier, net gains may be plotted against various values of the pulse widths (Fig. 9). The gain does not drop with short pulse widths.

An example of the detected modulating envelope of the amplifier output is shown in Fig. 10. In this case the 58,000 Mc signal is modulated by 4 μsec pulses.

The author wishes to thank the Raytheon Company for contributing the klystron tubes. The author also extends his thanks to J. Tsui, K. Heiting, S. Krupnik, W. Hirthe, J. A. Stefancin, J. E. Billo and Dr. J. D. Horgan, Marquette University, for their assistance and to the University Committee on Research for their support.

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Measuring Radiation

Glass dosimetry needle fluoresces in proportion to radiation received. Photomultiplier and electrometer measure degree of fluorescence

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Radiophysics Research Section, Radiotherapy Service, Bronx Veterans Administration Hospital, Bronx, N. Y.

IN evaluating the medical and biological applications of penetrating radiations, it is of prime importance to measure the radiation received by the human system. To accomplish this measurement, it is necessary to implant a radiation detector within the body undergoing radiation. Present detectors are adequate for the air and phantom (simulated human) systems, but limited for live-human measurement. This unit is a completely assembled miniature glass rod dosimeter in a gold jacket. The gold jacket corrects for energy dependence in the photon energy range 0.25 to 1.33 mev. The bare glass rod dosimeter is in the form of a right cylinder, 1 mm in diameter and 6 mm in height. Basic criteria for an in-vivo (living body) dosimeter are: linearity, energy independence (with suitable shield), ease in handling, reproducibility of readings and independence of dose rate, minimum dimensions, permanency of readings and absence of adverse effects upon the human system. All these conditions are favorably included in the miniature glass rod system which functions on the principle of radiophotoluminescence[1 to 4].

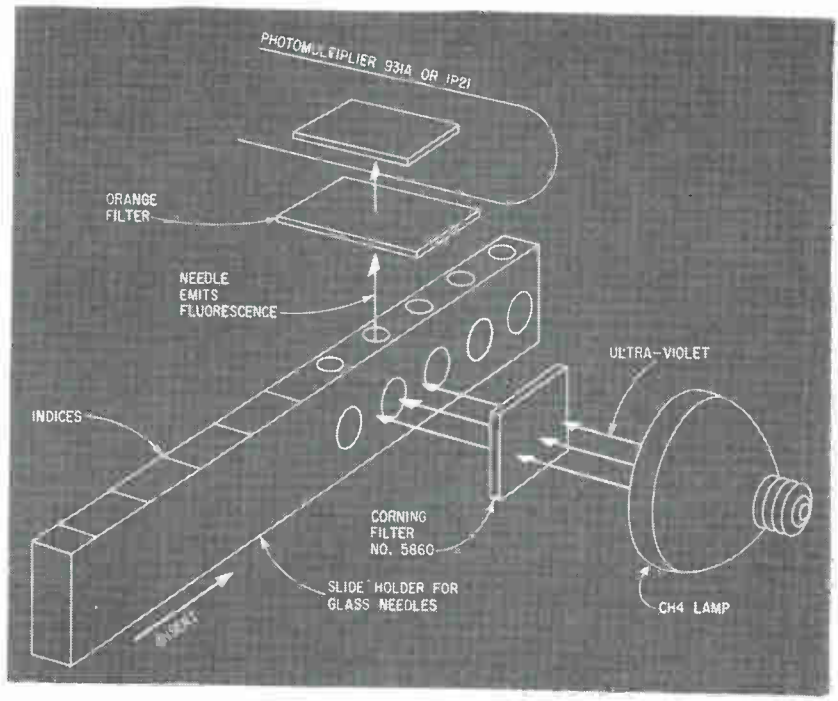

FIG. 1—Photomultiplier detects fluorescence of dosimeter needle when it is excited by ultra-violet light. Fluorescence of needle is proportional to exposure to radiation

Theory

Theory is based on a phenomenon whereby a material, originally nonluminescent under visible or ultraviolet light, is made responsive to such light excitation by exposure to X or gamma radiation.

Metallic silver upon absorbing UV light subsequently emits an orange-yellow fluorescence which is a measure of the quantity of radiation received. In the glass matrix, after exposure, the orbital electrons (which serve as the luminescent centers) absorb the UV light energy and rise to an excited state. They attempt to return to their ground state by radiating the absorbed energy in the form of visible light.

Since the electrons forming the luminescent centers are tightly bound, absorption of the ultraviolet light energy does not liberate the electrons and the effect can be repeated which allows for a permanent record with subsequent radiation doses to be added. The intensity of the fluorescence is directly proportional to the radiation dose, so a relative dosimetry system can be developed with proper calibration procedures.

It is necessary to interpret the intensity of fluorescence of a dosimeter needle in terms of the radiation it has received. This is done by comparing its fluorescence with the light emitted by accurately calibrated standards. Apparatus in Fig. 1 uses X-rays for calibrating the standard needles. An important feature of the measuring system is that the comparison of dosimeter needle and standard is not invalidated by their having been subjected to different forms of radiation. Thus, a gamma-irradiated needle is compared to a standard that has been produced by the X-ray technique of Fig. 1 to give results accurate to within five percent.

Reader System

The basic operation of the reader circuit is simple but not purely electrical in nature. Figure 2 presents

Within Human Body

the non-electrical section of the dosimeter reader. The light from the ultraviolet lamp passes through an ultraviolet filter (Corning 5860), and impinges upon the glass dosimeter, which is mounted vertically. Fluorescence is induced in the glass and transmitted through another filter (Corning 3482) to the photomultiplier tube.

Since the output of the photomultiplier tube is of the order of 10^{-8} amperes, the current of the photo tube is fed into a balanced bridge electrometer as shown in Fig. 3. The electrometer is basically a cascaded amplifier and bridge arrangement with a resistive network controlling the amplitude of the input signal. The source impedance of the phototube is considerably larger than the 0.5, 5 or 50 Megohm resistors; therefore a scale multiplication of ten between the positions is obtained with less than 5 percent error. Added to the input of the circuit is a 0.03 μf capacitor, to ground any a-c signal.

An unbalance potential between the plate of the first tube and the balancing potentiometer arm is noted when a signal is placed in the input of the electrometer. This unbalance is due to a slightly different amplification factor in each tube arrangement.

The unbalance is proportional to the signal and is indicated by the microammeter. A glass rod dosimeter of known radiation dose is employed as a standard and the system is verified against this reference glass rod.

Physical Characteristics

The bare glass dosimeter is energy dependent, for photon energies. Below 120 Kev, the glass fluorescence will saturate at approximately 1,000 roentgens. Saturation will occur at higher values as the photon energies increase. With proper wall shield thickness and four size no. 80 holes (to allow a portion of the softer photon energies to enter), it is possible to have a limited energy independence from 0.25 to 1.33 Mev.[5]

Accuracy of the glass dosimeter with the gold shield over the limited photon energies is 4 to 5 percent. The linearity of this system extends to 10,000 Rads. Well beyond this point, a definite discoloration takes place and saturation once again limits the range.[6]

Orientation of the glass in air presents a problem if the long axis of the glass rod is parallel to the source of radiation. With care in positioning, this error in a scattering medium can be reduced to 3 percent.

The glass needle is virtually insensitive to fast neutrons and only mildly sensitive to thermal neutrons.[7] This property permits an accurate measurement of gamma-ray dose when it is accompanied by a fast-neutron flux. These needles therefore hold forth promise of solving long-standing problems of measuring gamma dose in the presence of neutrons. Preliminary results are encouraging and will be reported shortly.[8]

The authors wish to express their sincere appreciation to Dr. Schulman of the U. S. Naval Research Laboratory and Mr. Attix for their suggestions and evaluations during this investigation. To Mr. Robert Goebel for his comments and opinions and to the Medical Illustration Department of this Hospital.

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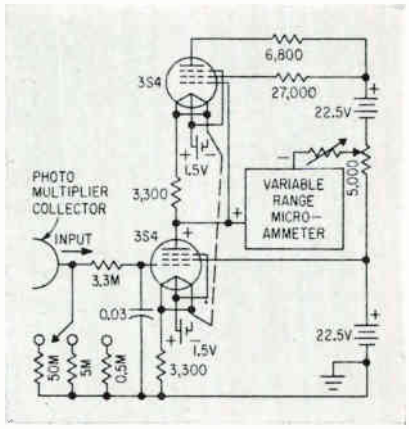
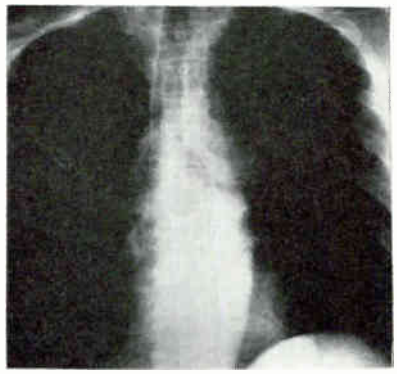
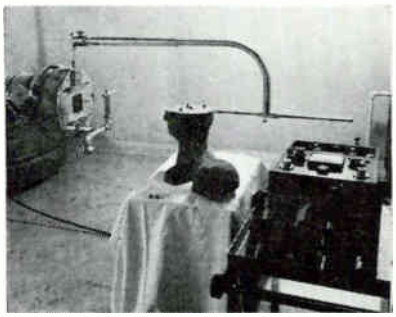


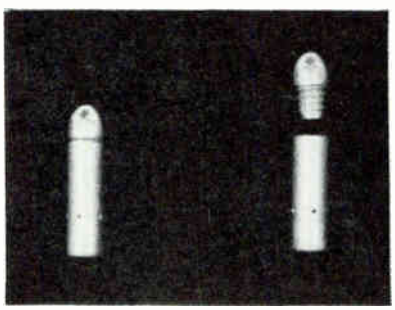
FIG. 2—Output of photomultiplier is amplified by electrometer



Chest radiograph shows dosimetry needle in position



Dosimeter standards produced by subjecting needles to known amounts of radiation



Miniature dosimeter assembly. Gold shield attenuates radiation by known amount

Transistorized Tuners

Microalloy diffused-base transistors applied to typical tv tuner design give 18-19 db power gain at 210 Mc with 12-db noise factor, characteristics sufficiently good for portable receiver applications

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P. V. SIMPSON, Group Engineer (Tv), Philco Corporation, Philadelphia, Penna.

A MAJOR PROBLEM in designing all-transistor battery-operated portable tv receivers has been application of the transistor to the tuning unit. One solution involves the use of microalloy diffused-base transistors which have sufficiently good characteristics in the 50 to 250-Mc region at cost low enough to warrant their use in home-entertainment equipment.

In the tuner discussed here, it was decided to adapt a commercially available tube tuner because of its form factor, relatively small cubic content, and reasonably good flexibility of switch design. As much external capacitance as possible was added to all tuned circuits to minimize transistor variations. To maintain low-impedance ground paths, a metal chassis was used instead of the printed panel specified in the original tube tuner.

Figure 1 shows the tuner's basic schematic. All transistors are *pnp* germanium MADT types. A single-tuned antenna preselector precedes the r-f stage, while a conventional double-tuned bandpass circuit is used between the r-f stage and the T-1600 mixer. Energy from the oscillator is fed into the mixer emitter. Total power drain is 130 to 140 mw as contrasted to approximately 10 w for the average tube tuner. Reduction in heat is an asset in controlling local-oscillator drift.

In Fig. 2, the tuner's average noise factor and power gain are compared to a typical commercial tetrode tuner. In this comparison, the tube-mixer i-f bandwidth and termination were adjusted to agree with that of the transistor tuner. Image and i-f rejections measure better than 55 to 60 db on the transistor unit, figures which are not inferior to those of tube tuners.

R-F Stage

Common-emitter configuration rather than common-base is used. Inherent degeneration of the common-emitter connection, if properly handled, provides greater production uniformity. Proper handling calls for neutralization of the collector-base feedback capacitance. This was arranged in the conventional manner shown in Fig. 1 where an adjustable capacitor feeds out-of-phase energy from the collector tank circuit back to the base.

This feedback control proved so effective that it was possible to over-neutralize to a predetermined point and improve high-channel gain by an additional 2 db, thus realizing an over-all average power gain of 18 to 19 db at channel 13 (210 to 216 Mc) with a 12-db noise factor. Stability of the r-f stage was excellent.

The collector output-resistance component of Q_1 under these operating conditions varies with frequency and is, of course, dependent on the degree of neutralization. Output capacitance is 1.5 pf. It is possible, with available parameters, to choose circuit constants for a double-tuned bandpass filter which present the sharp response curves obtained with tube tuners.

High-channel bandwidth can be varied by adjustment of the low-side mutual coupling derived from strategic placement of the low-potential return leads of the r-f stage and mixer tank circuits. Air mutual coupling is used for variation of coupling and bandwidth in the low channels, and is brought about by physical placement and adjustment of the associated inductances.

The input capacitance of the T-

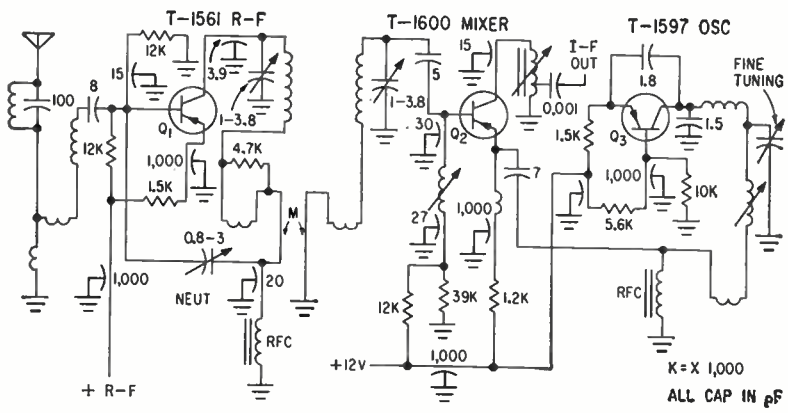
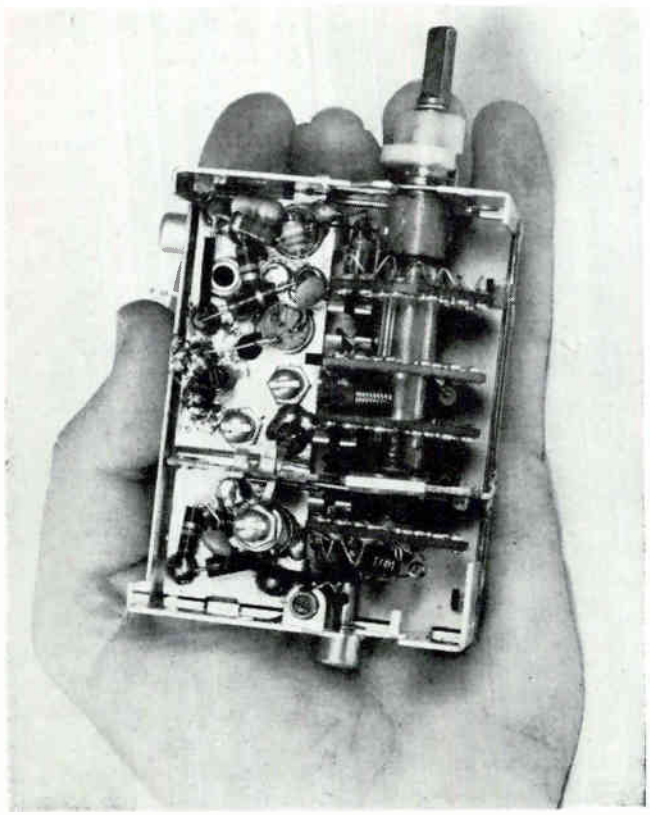
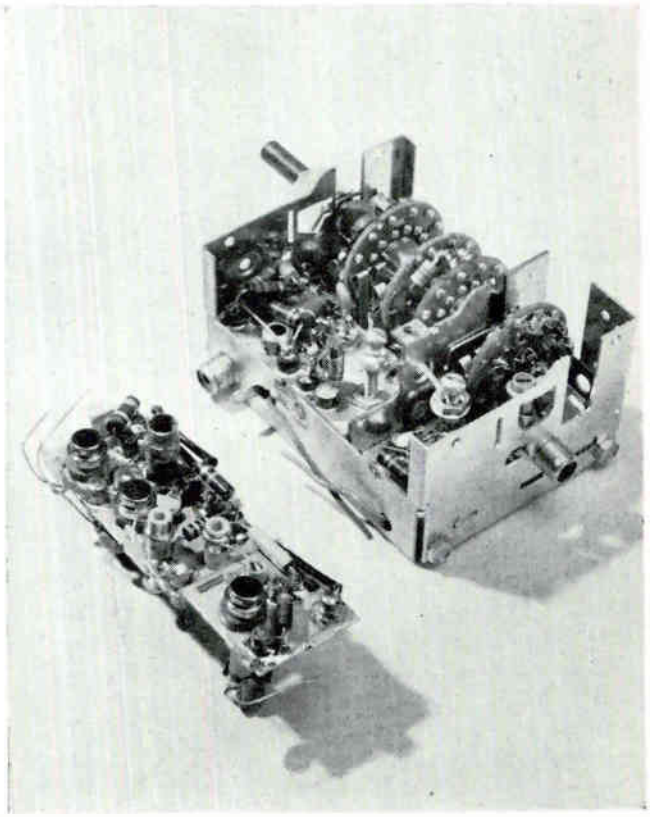


FIG. 1—Basic diagram of transistorized tv receiver tuner

For Portable Television



Dimensions of palm-sized tuner are 3¼ by 2½ by 1¾ inches



A typical commercial-type tuner adapted for transistors

1561 is about 10 pf. The resistance component is approximately 50 ohms at channel 13 and rises to 100 ohms at channel 2. A capacitively-tapped antenna resonant circuit was chosen for convenience in matching the transistor to the tank circuit and thence to a monopole rod antenna. The 70-ohm point for the monopole is inductively tapped on the antenna tank, and the tuner switching system readily adapts itself to this scheme. The shaft serves as a convenient tank ground point in this case. Use of this type input circuit also results in good low-frequency rejection, a significant consideration in cross-modulation.

The transistor experiences little noise-factor change when the source resistance is varied as much as 2 or 3 to 1 with respect to the input resistance. A grounded-cathode r-f amplifier tube, on the other hand, requires mismatching for best noise factor. Since such mismatch can cause transmission-line reflection problems, especially on channels 2 through 6, the advantage of the transistor is obvious.

Power gain of the T-1561 r-f stage closely follows a 6-db-per-octave curve at these frequencies in a matched, neutralized set-up. Typical single-stage gain figures are 9 to 13 db at channel 13 using low-loss tuned circuits.

Mixer Stage

In matching the mixer to its r-f circuit capacitive tapping is used. A series-resonant circuit, tuned to the i-f, and connected from base to ground forms a low-impedance path without which good mixer power gain cannot be achieved in the circuit used. A possible alternative is the connection of the base to a point on the tuned-circuit inductance. In either case, the most important termination of the mixer proved to be the base-circuit impedance at intermediate frequency. The series-resonant circuit obviated the necessity for i-f neutralization. Power-gain improvement was in the order of 5 db; noise figure was reduced about 6 db. Mixer power gain in the circuit used is somewhat less than the gain of the transistor as an r-f amplifier. Approximately 0.5 mw of oscillator power is required for good mixing.

The physical layout of the tuner is such that the bottom end of the oscillator tank coil can be conveniently returned directly to the mixer emitter. The ground path for the tank includes a 1,000-pf feed-through-type bypass capacitor and a small hairpin inductance connected between the bypass capacitor and the emitter pin. This in effect connects the emitter of Q_2 to a low-impedance point on the oscillator tank. By regulating the hairpin inductance, some degree of control can be exercised over oscillator injection. Voltages measured directly on the mixer emitter

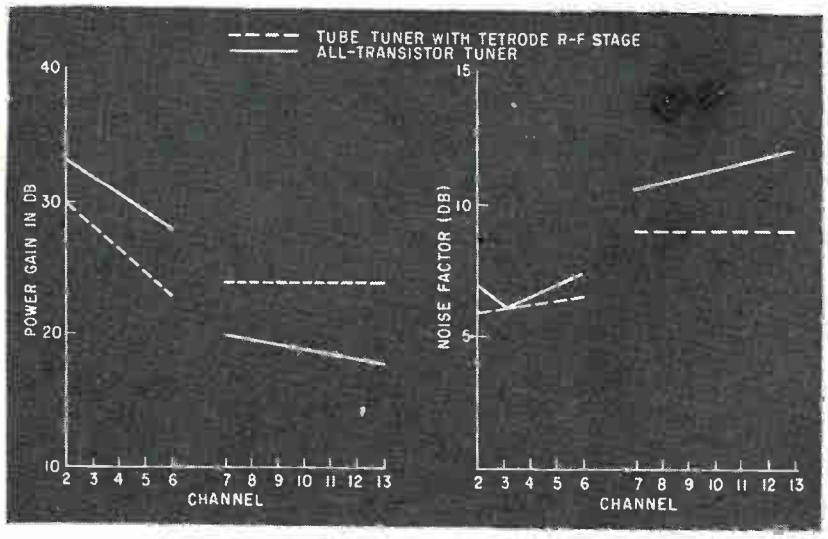


FIG. 2—Noise-figure and power of transistorized tuner compared with tube tuner

socket pin vary between 0.15 and 0.4 v rms.

The lead length for the 30-pf base-to-ground capacitance was selected to be series resonant in the high-channel oscillator range. This resonance keeps the base as close to ground as possible so far as oscillator energy is concerned, and has the added feature of improving mixer-diode efficiency; it also helps prevent oscillator energy from appearing in the interstage circuit, where it may be passed along to the antenna terminals and radiated. Thus, the resonance was a significant factor in keeping oscillator radiation within FCC limits. Another virtue of the injection system is freedom from interaction between the oscillator and r-f circuits.

The oscillator circuit shown in the basic diagram has proved capable of providing useful outputs at frequencies as high as 380 Mc. Feedback is controlled by the ratio of the collector-emitter and base-emitter capacitance. The oscillator functioned over a supply-voltage range of 8.5 to 14 v. Frequency drift characteristics with temperature had to allow for operation to 50 C.

The resultant change in oscillator frequency with change of supply voltage is shown in Fig. 3 for an average transistor. It was possible to keep short-term drift within ±300 Kc of the frequency reached after a one-minute warm-up time (25 C ambient). A fine-tuning range of 3 to 5 Mc cover these variables. Little change in inductance values was required in going from tube to transistor oscillator.

Of further interest is the necessity for keeping the d-c temperature stability factor as low as possible. Small changes in stabilization were found to have a decided influence on high-channel drift.

One of the properties of the MADT that lends itself to agc is dependence of its frequency characteristics on collector voltage. This is attributed to the presence of an

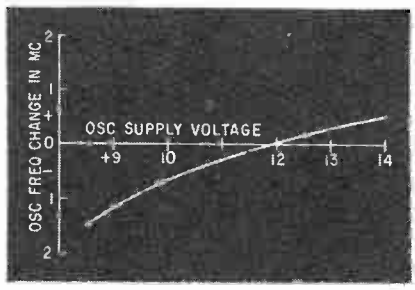


FIG. 3—Frequency stability characteristics of tuner oscillator set for channel 13

intrinsic region in the base. By inserting resistance in the collector circuit, a tuner gain reduction of about 30 db can be obtained with forward biasing. However, the disadvantage of the forward-bias technique with a 12-v supply is the limitation placed on achieving the maximum possible gain because of the lower initial collector voltage. Since measurements show this to be as much as 3 db on channel 13, this loss was considered important in terms of overall noise-figure performance.

It was, therefore, decided to control the r-f stage gain by the selection of specific supply-voltage points. A switch was used to change the r-f stage operating voltage in three steps corresponding to strong, normal and fringe operation. This allowed sufficient overlap of the r-f i-f system gain-control curves to insure good overload characteristics, medium signal snow and fringe performance.

Reverse biasing of the base-emitter diode by itself did not provide satisfactory gain control because of the poor overload capabilities encountered at low collector currents. With the tuner placed ahead of a conventional tube receiver, and the r-f gain varied in the manner described, no particular overload problem was found with levels as high as 0.4 v (300-ohm input).

Cross-Modulation

Cross-modulation characteristics were evaluated by field tests in which the transistor tuner was installed in a production-model tube receiver and compared to a similar model with its tube tuner. The method of field test was based on the vacuum-tube analysis which shows that cross-modulation percentage is proportional to the square of the interfering voltage and independent of desired signal voltage. Therefore, adjustment of the signal levels to each receiver can be made until the desired picture is free of interference.

Using this method, the transistor tuner was consistently within ±6 db of the tube tuner for various desired signal levels. Operating bias point of the transistor r-f stage was a negligible factor in the degree of cross-modulation with the gain-control system used.

Acknowledgment

Sincere thanks are extended to J. Waring, R. Booker and C. Simmons of Philco Corp. for their advice and help in the preparation of this article.

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Precision R-F Capacitors

Compilation of radio-frequency capacitor parameters permits a ready comparison of common types and provides a basis for proper selection

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A TABULATION of a category of capacitors comprising precision fixed receiving styles of the mica, ceramic, glass and vitreous enamel dielectric varieties is compiled in Table I, to acquaint engineers with the numerous styles available and to provide a basis for proper selection of r-f types.

These capacitors generally are used at radio frequencies in tuners, r-f filters, coupling and by-pass circuits, where stability, close tolerance and low-loss properties are required.

The chart includes those styles most likely to be encountered and does not preclude the use of less common or special types which are available.

For simplification, the chart lists only those capacitor parameters, out of a multitude of characteristics, which permit a ready comparison to be made among the various styles. Ranges and values given are approximate but sufficient to show comparative orders of magnitude.

Improved glass-dielectric wafer capacitors (WL types) now come in a capacitance range of 1 pf to 10,000 pf. Performance of these new capacitors is similar to the CY types.

The introduction of ceramic capacitors has resulted in considerable reduction in the size of capacitors compared with those employing mica, paper and other conventional dielectrics. The size reduction is a direct result of the much higher dielectric constant of ceramic materials. Ceramic capacitors have been designed for general purpose applications in bypass-coupling, filtering and blocking circuits.[1]

REFERENCE

(1) Recent Advances in Ceramic Capacitors, ELECTRONICS, p. 96, Jan. 1, 1960.

Table I—Characteristics of Precision R-F Fixed Capacitors

Capacitor Style	Mil Spec	Mil Desig	Temp Range (deg C)	Volt Rating (25 C)	Nom Cap Rating (pf)	Insul Resist Limit at 25C[1] (Megohms)	Q 1 Mc (25 C)	Nom Temp Coef (ppm/C)	Tolerance on Temp Coef (ppm/C)	Cap Drift (Retrace) (%)	Max. Vol Eff (μf/in^3)	Remarks
Glass	MIL-C 11272A	CY-	−55 +125	300–500	5–10,000	>10,000	>1,500	+140	±25	<0.1	0.13	axial
Mica, Molded	MIL-C-5B	CM-	−55 +85	300–500	5–10,000	>7,500	>1,300	Characteristic C ±200 Ppm/c	—	Characteristic C: <0.5	0.05	lead types [3]
Mica, Dipped	—	—	−55 +125	300–500	5–10,000	>7,500	>1,300	D ±100 E −20 +100	—	D: <0.3 E: <0.1	0.06	radial lead types
Mica Button types	MIL-C 10950B	CB-	−55 +125	300–500	5—3,900	>7,500 to >50,000	>1,000	±100	—	<0.3	0.06	feed-through and stand-off types
Ceramic Temp Comp	MIL-C-20	CC-	−55 +85	500	0.5–510	>10,000	>1,000	O through N 750[2]	30–250	<0.2	0.006	tubular
Ceramic Temp Comp	—	—	−55 +100	150	4–470	>10,000	>1,000	O through N 750[2]	15–75	<0.2	0.01	plate type
Ceramic Temp Comp	—	—	−55 +85	100	10—7,500	>10,000	>1,000	O through N 1,400[2]	8–120	<0.2	0.15	Submin, tube close toler temp coef [4]
Vitreous Enamel	—	—	−55 +125	300–500	5–2,000	>10,000	>2,000	+115	±35	>0.1	0.03	axial or radial leads [3]

1—Insulation resistance for above capacitors are greater than 50,000 Megohms at 25 C.
2—O indicates essentially no change in capacitance with temperature; N 750 and N 1,400 indicate a negative change of approx 750 and 1,400 parts per million per deg C, respectively.
3—Sole source for the glass capacitor is Corning Glass; source for the vitreous enamel type is Vitramon, Inc.
4—Under Signal Corp development.

Battery-Operated Transistor Oscilloscope

Using 39 transistors and 3 vacuum tubes, this self-powered instrument has response from d-c to over 5 Mc. Deflection-blanked cathode-ray tube and automatic battery charger are among new circuits used

By **OZ SVEHAUG and JOHN R. KOBBE,** Engineering Division, Tektronix, Inc., Portland, Oregon

RAPID INCREASE in the variety and performance of transistors coupled with the growing need for a high-quality portable oscilloscope for use where conventional power is not readily available led to the design of this battery-operated transistorized oscilloscope.

With the exception of the charger circuit, power sources and the deflection-blanked cathode-ray tube, the block diagram shown in Fig. 1 follows well-established oscilloscope practices.

Vertical Amplifier

A conventional compensated input attenuator is used as shown in Fig. 2. The input amplifier is a vacuum tube because it has high input impedance, requires no temperature compensation, has negligible grid current, is economical and has good bandwidth. Regulated d-c is used for the filament supply to insure low drift.

A swing of better than 30 v is required at each cathode-ray tube deflection plate. Since drift transistors have good BV_{cc} (breakdown voltage collector to emitter), drift transistors tested to 50 v are used. The limitation is power.

To achieve the desired bandwidth, more power was required in the output stage. Checking the thermal resistance showed that with a proper heat sink, 50 percent additional power dissipation could be attained. This permits operating near the manufacturer's maximum ratings with a good margin of safety. A life-test initiated with 50 units being operated near the limit of power rating at 45 v collector to emitter revealed nearly 2,000 hours per unit with no failure.

Saturation of the output transistors had to be avoided as their recovery time is slow. One interesting effect is the offset or thermal time constant. A large low-frequency input signal causes internal heating of the transistors and an increase in low-frequency gain. The proper choice of RC time

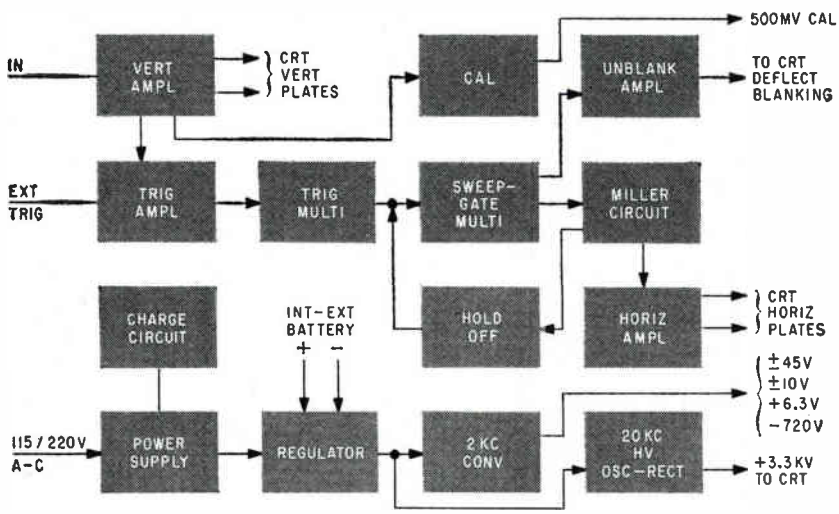


FIG. 1—With exception of power supply and associated circuits, compact oscilloscope follows established design practice

constant compensation increases the a-c gain enough to correct for this effect. A balanced circuit is used for temperature compensation. The bandwidth of sample amplifiers varies from 5.3 to 7 Mc.

Trigger takeoff Q_1 (Fig. 2) is an amplifier that reproduces a sample of the vertical signal for use by the sweep trigger circuit.

Calibrator Q_2 is an overdriven amplifier that gets an a-c input signal from the power supply. Its output calibrating signal is a square wave whose amplitude is determined by ground on one side and diode clipping on the other. The 2-kc output square wave has approximately a 1 μsec rise and fall time that is suitable for probe compensation and amplifier gain checking.

Trigger

The trigger input amplifier Q_1 and Q_2, shown in Fig. 3, is an emitter-coupled amplifier. Trigger multivibrator Q_3 and Q_4 is a conventional Schmitt circuit with one exception. The multivibrator is normally free running at about 50 cps to produce a trace on the cathode-ray tube. By adding R_1, R_2 and C_1, the multivibrator can be triggered to produce a stable presentation at 2 Mc and can be synchronized up to 4 Mc.

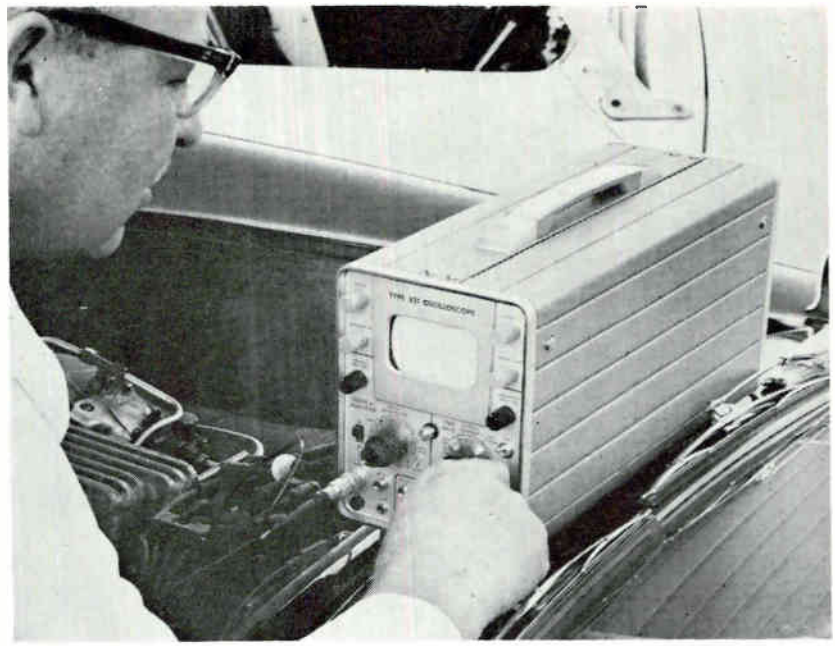
Gating Multivibrator

Sweep-gating multivibrator Q_1 and Q_2, shown in Fig. 4, controls the starting and termination of the sweep. It is a Schmitt multivibrator having large hysteresis.

The trigger and hold-off signals are mixed at the input to the sweep-gating multivibrator. A positive-going trigger signal starts the multivibrator to produce the sweep. When the sweep voltage reaches approximately 20 v, hold-off circuit Q_7 couples back a negative-going signal causing the sweep-gating multivibrator to revert to its normal state. This stops the sweep and causes it to retrace.

A portion of the sweep-gating multivibrator output signal is applied to unblanking amplifier Q_8 and Q_9 to turn on the cathode-ray tube during the sweep.

Sweep generator Q_3, Q_4, Q_5 and Q_6 (Fig. 4) is essentially a Miller cir-



Compact self-powered oscilloscope can be used in areas remote from conventional power

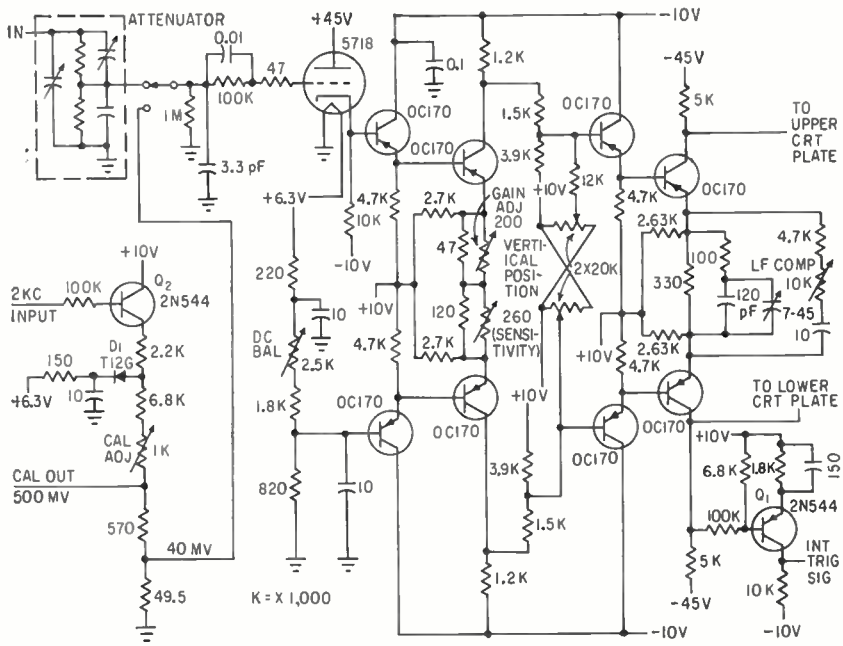


FIG. 2—Calibrator circuit generates 40-mv square wave at 2 Kc. Internal trigger is derived from vertical amplifier

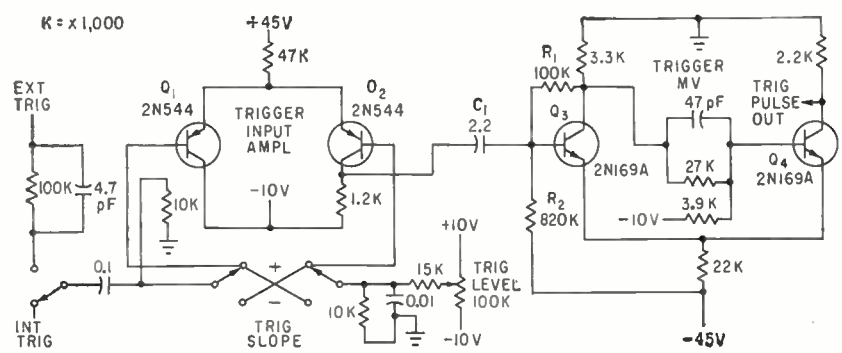


FIG. 3—Trigger multivibration can be synchronized up to 4 Mc

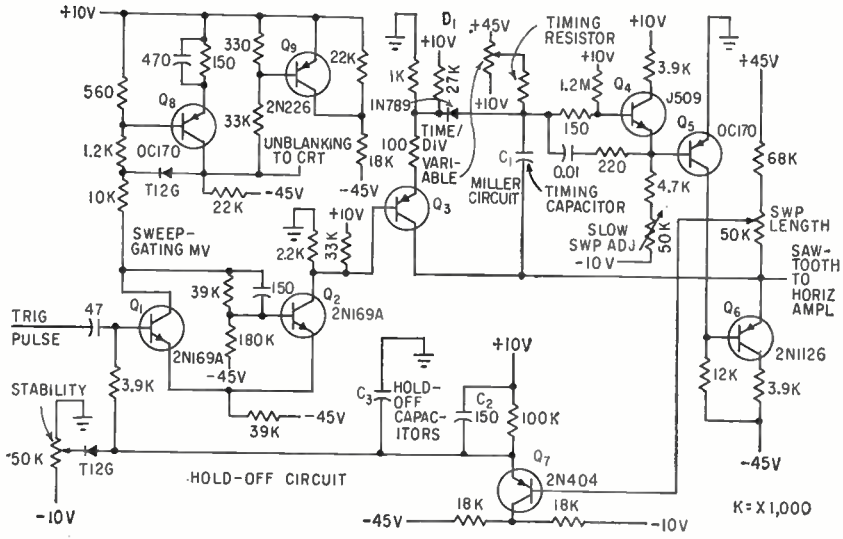


FIG. 4—Unblanking amplifier supplies signal to crt deflection blanking plates. Hold-off circuit insures trace starting from same point every sweep

cuit. Timing capacitor C_1 is initially discharged. When the sweep commences, the capacitor applies a positive voltage to the input of emitter follower Q_1. The change is amplified by sweep amplifier Q_2. Emitter follower Q_6 pulls the timing capacitor in a negative direction.

The action continues with the net result of a 20-v sweep signal at emitter follower Q_6. With a gain of about 400, the signal non-linearity at the input to Q_1 is about 50 mv.

A silicon transistor with high beta and low leakage is required in the sweep generator as any variation in leakage will cause a timing error. To reduce this effect, the timing capacitors are much larger than those used in vacuum-tube circuits. The charging currents are made larger so that accuracy can be maintained over a wide variation of ambient temperature.

The retrace is accomplished by applying a negative signal from the sweep-gating multivibrator to Q_3 which will discharge the timing capacitor through diode D_1.

Since the diode is connected to the timing elements, it must have very low leakage and since the fast sweeps are to be linear, the diode must have a fast recovery time.

It is essential that the trace always start from the same place on the cathode-ray tube screen. This is accomplished by the hold-off circuit. During the sweep, a charge is built up on hold-off capacitors C_2 and C_3. This charge is used to block the input to the sweep-gating multivibrator until the timing capacitor has fully discharged. The hold-off time is 20 to 30 percent of the sweep time.

Unblanking

As the cathode-ray tube grid is operating at approximately −670 v, it is difficult to obtain the required grid blanking signal. To get around this, deflection blanking is used. Additional deflection plates are added to the electron gun of the cathode-ray tube as shown in Fig. 5.

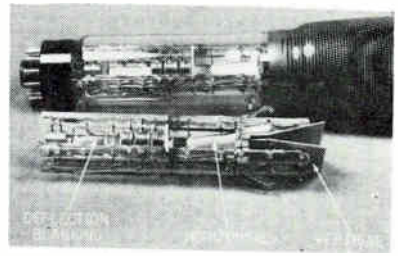


FIG. 5—Electrostatic crt has deflection plate use reversed (horizontal plates nearer gun) and has added deflection plate for beam blanking

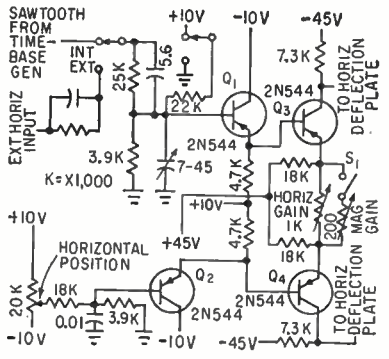


FIG. 6—Horizontal amplifier includes 5 times magnification

The electron beam is deflected out of alignment with the exit aperture by less than 25 v applied to the deflection blanking plates. Power supply regulation is simplified as this method of blanking does not alter the cathode current.

The unblanking waveform is derived from overdriven amplifier Q_5 and Q_6 of Fig. 4. This yields a fast rise and fall time to turn the trace ON and OFF rapidly. Deflection blanking has the advantage that the electron gun control grid is available for Z-axis modulation. The control grid has a higher impedance than the cathode that is usually used.

The cathode-ray tube uses a 2-watt heater in place of the conventional 4-watt filament. A new cathode-ray tube is being developed with a 0.68-watt heater.

Due to the limited voltage swing that can be obtained from small high-frequency transistors, a limit of 30 v per deflection plate is a good compromise. The sweep voltage would then have to come from tubes or stacked transistors. Stacking transistors will work but component tolerance and cost is high.

To overcome this problem, the functions of the deflection plates are interchanged. The usual horizontal plates were brought closer together and used for the vertical sweep. This increased the sensitivity to where they could be driven by transistors.

The oscilloscope uses 39 transistors, 3 vacuum tubes (including the cathode-ray tube); nearly half the total power consumption of 9.2 w is used to heat the 3 vacuum tubes.

Horizontal Amplifier

A balanced circuit as shown in Fig. 6 is used for temperature compensation. The base-to-emitter 2 mv/degree C bias change will cancel as in the vertical amplifier.

Emitter followers Q_1 and Q_2 drive emitter-coupled amplifiers Q_3 and Q_4 respectively. Output stages are pretested on a curve tracer. Operation of switch S_1 permits 5 times magnification. The sensitivity of the horizontal amplifier is 1.5 v per division with approximately 1 Mc bandwidth.

The nickel-cadmium batteries used have a very shallow discharge slope, making it difficult to determine the state of charge of the batteries. Constant voltage charging is elaborate and expensive while constant current charging requires timers or supervision.

To make the charger trouble free and eliminate human errors, the circuit shown in Fig. 7 is used.

The charging circuit consists of thermistor R_1 as part of a bridge circuit that senses the battery temperature as the battery is charging. When the battery approaches full charge, more power goes into heat and less into storage. As the battery temperature rises, the bridge unbalances and turns off the charger. Since the instrument must operate in a variety of ambient temperatures, thermistor R_2 is added so that when battery temperature rises approximately 20 F above ambient, the charger will turn off.

Battery

Since the nominal current drain is 0.8 amperes, the internal battery will operate the instrument for approximately 5 hours. A 12-v car battery can be connected externally should longer continuous operation be desired.

Regulator

The regulator permits operation from 11.5 to 35-v d-c external sources, and maintains a continuous 10-v output. Zener diode D_1 is used as a reference.

At the higher d-c input voltages, series regulator transistor Q_1 has to dissipate more power. The thermal resistance should not exceed 4 degrees C per watt, as this amount would raise the internal temperature; therefore transistor Q_1 is mounted on a heat sink on the rear external wall of the instrument. The 10-v output of the regulator supplies the other power supplies with primary power.

With the exception of the cathode-ray tube voltages, all instrument voltages are derived from a two-transistor d-c to d-c converter operating at 2 Kc. The frequency is a compromise between filtering requirements and efficiency. Separate rectifiers and filters are used for the horizontal and vertical circuits to reduce crosstalk to a minimum.

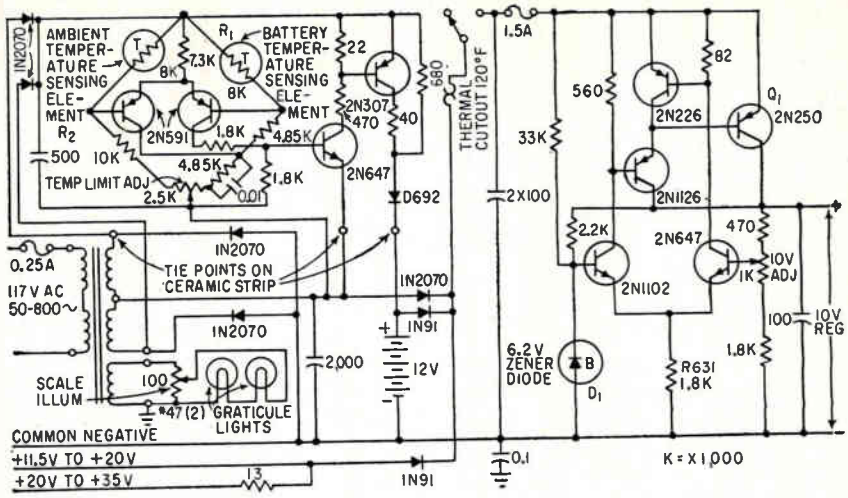


FIG. 7—Regulator circuit maintains constant 10-v output from internal 12 v, from external d-c voltages up to 35 v or from 117 v a-c line

Table 1—Instrument comparison

	Vacuum Tube	Transistor
Power Consumption (w)	175	12
Weight (lbs)	23½	13½
Bandwidth	d-c to 4 mc	d-c to 5 mc
Sensitivity	0.1 v/div	0.01 v/div
Size	10 × 6¾ × 17	8¾ × 5¾ × 16
Tube or Transistor Complement	30 tubes + crt	39 transistors, 2 tubes + crt
Power Source	105–125 v 50–800 cps	105–125 v, 50–800 cps 11.5–35 v ext. battery 12 v internal battery
Reliability	———	better
Ruggedness	———	better

The 3.3 Kv required for the cathode-ray tube post accelerating anode is derived from a separate 20-Kc high-voltage oscillator supply as shown in Fig. 8. The high-voltage rectifier is a vacuum tube; semiconductor high-voltage rectifiers are not commercially practical as their leakage current is equal to the normal load current required in this application.

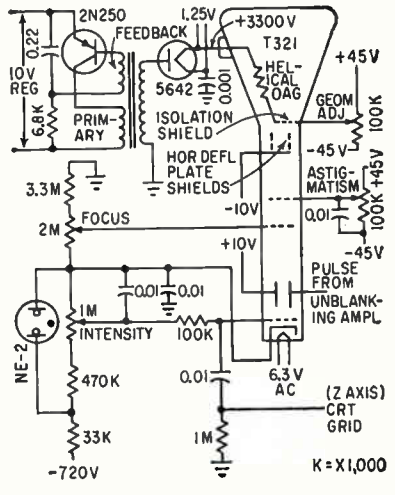


FIG. 8—High voltage circuit for crt uses vacuum-tube rectifier

The diodes located in the various power input leads to the regulator (Fig. 7) perform the switching of the power sources; the highest source of supply voltage is the one automatically selected.

Nickel-cadmium batteries with 4.3 ampere-hour capacity are used.

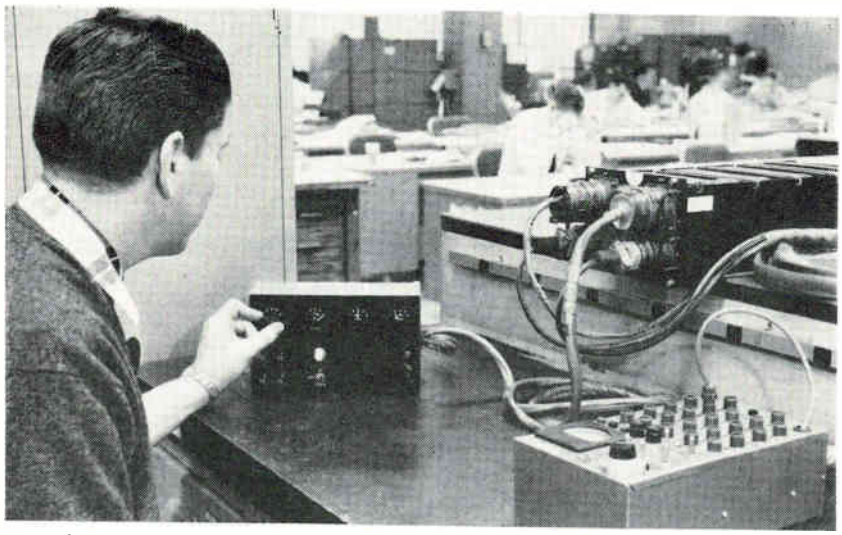
Since the nominal current drain of the instrument is 0.8 ampere, the internal battery will operate the instrument for approximately 5 hours. In normal use, 5 operating hours should enable the operator to complete an 8-hour day with some reserve power if the instrument is turned off when not in use.

Table I compares the specifications of this oscilliscope with those of a similar vacuum-tube version made by the same company.

Aligning Servo Loops

Tester checks control transformers in single or coarse-fine servo systems. Rotors are nulled at 30-degree increments for fast, accurate alignment

By D. G. KINGSBOROUGH and D. H. SWINDELL, McDonnell Aircraft Corp., St. Louis, Mo.



Control transformer tester at left has four rotary switches for applying voltages to stators in three coarse-fine servo systems and one single-synchro system

SERVO LOOPS using synchro control transformers can be accurately and rapidly tested. A unit developed for this purpose does not require costly precision transmitting test synchros, and the operator is not required to make precise settings of calibrated synchro dials. The tester is being used for checking part of an aircraft central air-data computer system for calibration accuracy.

Test Principle

A-c voltage applied to any two stator leads of a synchro control transformer produces a null voltage in the rotor circuit at an angle that is some odd multiple of 30 degrees with respect to synchro electrical zero. (A false null also occurs 180 degrees from the true null position.) Connecting two stator leads together and applying a-c voltage between their junction and the remaining lead produces a null voltage at some even multiple of 30 degrees with respect to synchro electrical zero. Thus null voltages can be produced at 30-deg increments by applying voltage to appropriate stator lead combinations.

Application of this characteristic of synchro control transformers provides for accurately testing servo loops incorporating them. Stator connections for 360 degrees of rotation are shown in Fig. 1.

Using this method only one voltage is applied to the stators. Errors introduced by test equipment that excites the stators with three separate voltages of varying magnitudes from transmitting synchros are eliminated, as are errors due to nonlinearity of a test synchro, or incorrect positioning at test points.

Coarse-Fine Loops

Part of an air-data computer tested by this method uses coarse and fine servo loops. Outputs of each feed into a mechanical differential. The rotor of the fine control transformer rotates many revolutions as input is varied between extremes; the rotor of the coarse rotates less than 180 degrees.

Figure 2A shows a typical arrangement of this type of servo system. In normal use, transmitting synchros from remote unit supplied input signal. In the past, tests of this system required two precision transmitting synchros with graduated dials. Each transmitting synchro had to be adjusted to proper setting at each test point.

A setup for testing the same servo system without precision test synchros is shown in Fig. 2B. The 26-volt, 400-cps excitation voltage normally applied to the test synchro rotors is reduced to between 8 and 10 volts by a miniature step-down transformer. This voltage is applied to appropriate control transformer stators by a multideck rotary switch. Magnitude of the voltage is not critical, but since two stators are connected in parallel at some test points, it should not exceed 0.866 times normal stator voltage rating. Commonly used 400-cps synchros have a stator-to-stator voltage rating of 11.8 volts. This setup has six test points, providing 150 degrees of rotation of the coarse synchro rotor.

The 26-volt, 400-cps excitation comes from the unit under test; however, an external source could be used. With this testing method, gear ratio between coarse and fine synchro control transformers must be a whole number and must be known to establish correct stator voltage switching. Angles at which the coarse control transformer is to be checked must be determined. From these and from the gear ratio, the fine control transformer angles can be determined.

For example, assume a gear ratio of 11:1. Also assume that when the coarse synchro is at zero degrees the fine synchro is also at zero degrees and that maximum ro-

Without Precision Synchros

tation of the coarse synchro rotor is 160 degrees counterclockwise from its zero-degree position.

Test points for the coarse synchro rotor are established in 30-degree increments as 0, 30, 60, 90, 120 and 150 degrees. These angles are assigned to rotary switch positions 1 through 6.

Rotor angle of the fine control transformer is the same as that of the coarse control transformer multiplied by the gear ratio. For switch position 1, rotor position of the fine control transformer is 0 deg, for position 2 it is 330 deg, for position 3 it is 300 deg, etc. Coarse and fine control transformer rotor angles can now be assigned to the test unit rotary switch positions. Voltage is applied to the coarse and fine stators through the switch to correspond to these angles.

For a single control transformer servo system, rotor angles and switch connections are determined in the same manner as for the coarse control transformer in this system.

Phasing

One possible problem, which may occur when the test unit is first used, is that incorrect phasing of the transformer voltage may tend to drive the rotor 180 degrees from the desired angle. When the test unit is first used, the switch should be positioned for an angle near the center of the coarse control transformer range. If the output shaft seems to be driving toward one end of its travel, the power switch should be turned off and either the primary or secondary leads of the step-down transformer reversed.

The test unit for the air-data computer has four rotary switches and four step-down transformers. For convenience a separate step-down transformer is used for each of three coarse-fine servo systems and for one single-synchro servo loop. However, a single step-down transformer could be used.

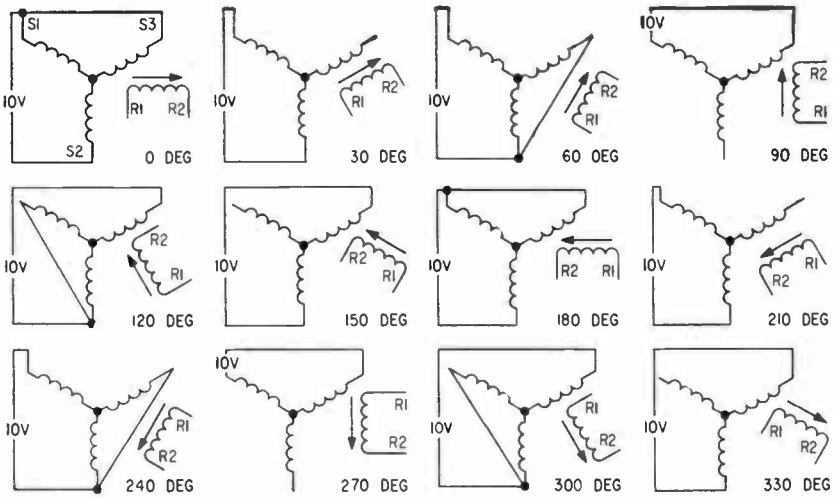


FIG. 1—Application of 8 to 10 v a-c from step-down transformer to appropriate stator windings of control transformers nulls rotors at 30-degree intervals through 360 degrees

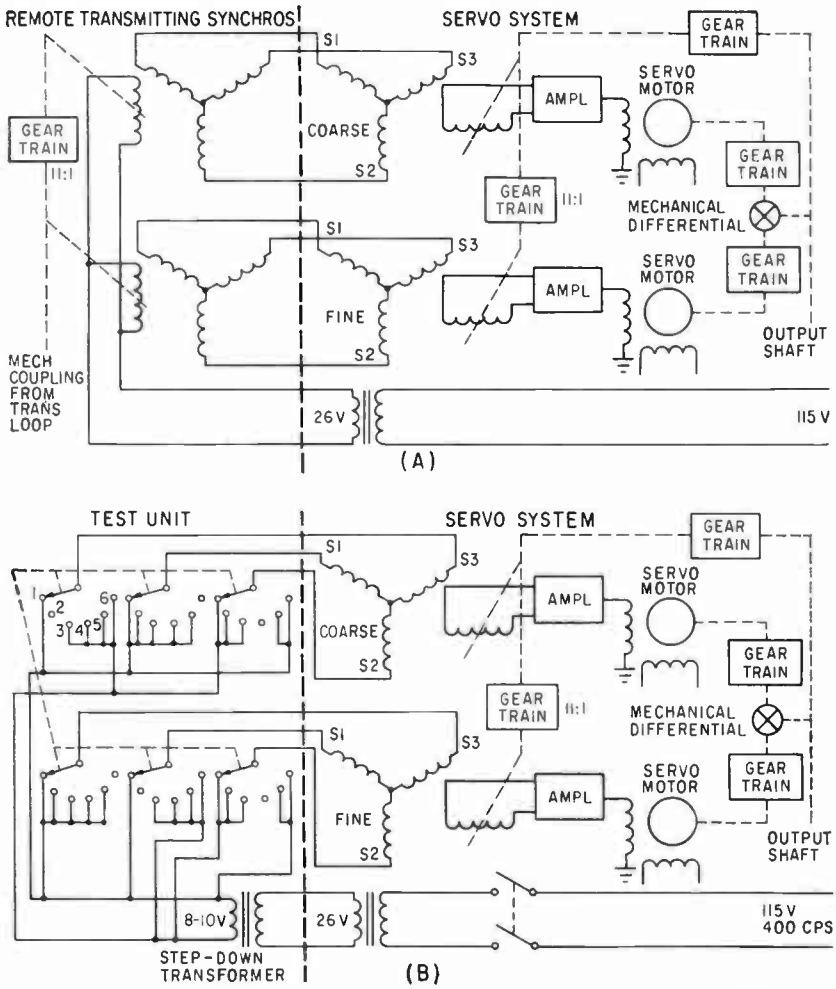


FIG. 2—Conventionally, calibrated synchros are substituted for remote transmitting synchros of servo system in normal use (A). Voltage from step-down transformer is applied by rotary switch to appropriate stator windings (B)

Design Charts for Low-Frequency Antennas

By **GEORGE J. MONSER**, Staff Engineer, Military Electronics Div., Motorola Inc., Scottsdale, Arizona

PROPAGATION of radio waves at lf and vlf is characterized by a high degree of stability and by the long range of useful signal transmission. One limitation that deters greater usage is the antenna size necessary to efficiently radiate power.

This article presents nomograms helpful in estimating the radiation capability of electrically-short antennas once the antenna current is specified.

For an electrically short base-driven antenna as shown in Fig. 1A, the radiation resistance is

$$R_a \doteq 10\,G_o^2 \qquad (1)$$

(valid when $G_o < 0.785$ radians)

where G_o is the electrical height in radians.

Since $G_o = 2\pi h/\lambda$, in which h is the antenna height and λ is the wavelength in the same units as h,

$$R_a = 4.06 \times 10^{-10}\, h^2 f^2 \qquad (2)$$

when h is the antenna height in feet and f is the frequency in Kc.

Equation (2) is shown graphically in Fig. 2.

For an electrically short base-driven antenna, top loaded with a flat horizontal disk as shown

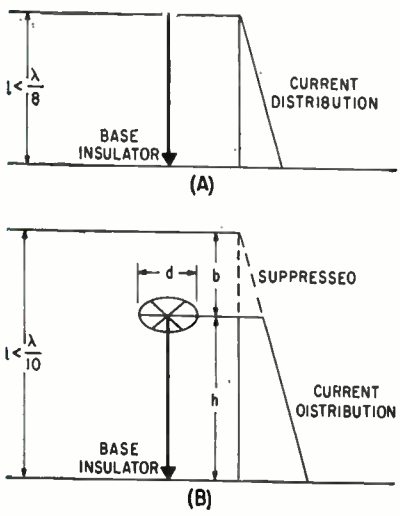


FIG. 1—Stub antenna (A) and stub antenna with top loading (B)

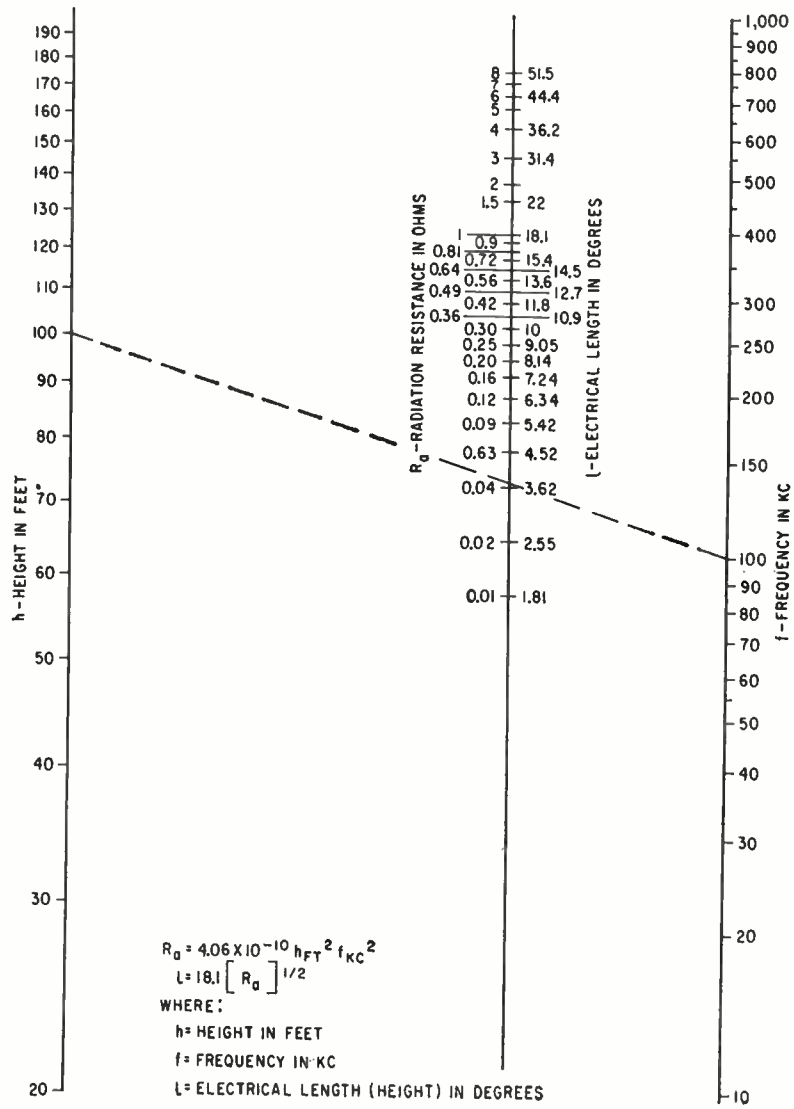


FIG. 2—Stub antenna chart valid for electrical lengths less than λ/8

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1N1507	3.9	35	14
1N1508	4.7	30	12
1N1509	5.6	26	5.2
1N1510	6.8	22	1.5
1N1511	8.2	18	1.5
1N1512	10	15	1.8
1N1513	12	12	2.8
1N1514	15	10	5
1N1515	18	8	9
1N1516	22	6	19
1N1517	27	5	50
B – 1 Watt Rated Basic Series (88 Closer Tolerance Types Also Available)			
1N1518	3.9	50	9
1N1519	4.7	40	8.5
1N1520	5.6	35	5.5
1N1521	6.8	30	1.6
1N1522	8.2	25	1.1
1N1523	10	20	1.5
1N1524	12	15	2.4
1N1525	15	13	5.4
1N1526	18	10	11
1N1527	22	9	18
1N1528	27	7	28

Type Number	Nominal Zener Voltage and Typical Dynamic Impedance: E_Z(Volts)	@ I_Z(MA)	Z_Z(Ohms) @ I_Z
C – 3.5 Watt Rated Basic Series (88 Closer Tolerance Types Also Available)			
1N1588	3.9	150	2.6
1N1589	4.7	125	2.3
1N1590	5.6	110	1.4
1N1591	6.8	100	.58
1N1592	8.2	80	.5
1N1593	10	70	.7
1N1594	12	50	1.4
1N1595	15	40	3.4
1N1596	18	35	6
1N1597	22	30	9
1N1598	27	25	13
D – 10 Watt Rated Basic Series (88 Closer Tolerance Types Also Available)			
1N1599	3.9	500	.84
1N1600	4.7	400	.68
1N1601	5.6	350	.3
1N1602	6.8	300	.2
1N1603	8.2	250	.25
1N1604	10	200	.55
1N1605	12	170	.95
1N1606	15	140	1.5
1N1607	18	110	2
1N1608	22	90	3
1N1609	27	70	4.5

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in Fig. 1B, the radiation resistance is

$$R_a \doteq 1{,}578\,(h/\lambda)^2 \{1-[h/(h+b)]+\tfrac{1}{4}\,[h/(h+b)]^2\} \quad (3)$$

valid for $(h + b) < 0.1\ \lambda$ where b is the increase in height due to the top-loading disk and λ is the wavelength; h, b and λ are expressed in the same units.

To use equation (3) in this form requires considerable computation. A more useful relationship would be

$$R_a = g\,(f, h, d) \quad (4)$$

where f is the frequency, h is the height of the stub and d is the diameter of the disk.

An approximate functional relationship for equation (4) is found by $X_a = Z_a \cot(2\pi h/\lambda)$ which is the stub reactance at f_1; $X_b = 1/2\pi f_1\ C_2$ which is the top loading disk reactance at f_1; and $Z_a = 60\ [ln\ (h/a) - 1]$ is the characteristic impedance for the stub transmission line; where C_2 is the capacitance (0.35 pF) of the disk (remote from earth), d_a is the diameter of the disk in centimeters, h is the height of the stub and a is the effective radius of the stub in the same units as h.

From the equation for the characteristic impedance of a stub transmission line, note that $Z_a \doteq 200$ ohms for the restricted range $60 < (h/a) < 90$. From the equation for stub reactance at f_1,

$$X_a \doteq Z_a\,(\lambda/2\pi h) \doteq 300 \times 10^5/hf = K_a/hf \quad (5)$$

where h is the stub height in feet and f is the frequency in Kc.

From the equation for the top loading disk reactance at f_1,

$$X_b = 150 \times 10^5/df = K_b/df \quad (6)$$

where d is the diameter of the disk in feet and f is the frequency in Kc.

For the short line,

$$h/(h + b) = X_c/X_a \quad (7)$$

where X_a is the stub reactance and $X_c = X_a\,X_b/(X_a + X_b)$ is the stub input reactance with top loading.

Using equations (5) through (7),

$$h/(h + b) = X_c/X_a = 1/(1 + \alpha) \quad (8)$$

where

$$\alpha = K_a d/K_b h = 2\,(d/h).$$

With the aid of the above development, Eq. (3) is reformed yielding

$$R_a = 4.06 \times 10^{-10}\,h^2 f^2 \phi^2 \quad (9)$$

where $\phi = (h/h+b) - 2 = (1/1+\alpha) - 2$, h is the stub height in feet and f is the frequency in Kc.

Figure 3 relates the variables in Eq. (9) for two different d/h ratios. The percentage increase in length for the two d/h ratios has also been indicated.

Figure 4 relates the variables in Eq. (5).

Reference

(1) J. S. Belrose, et al, The Engineering of Communication Systems for Low Radio Frequencies, *Proc IRE*, p 661, May 1959.

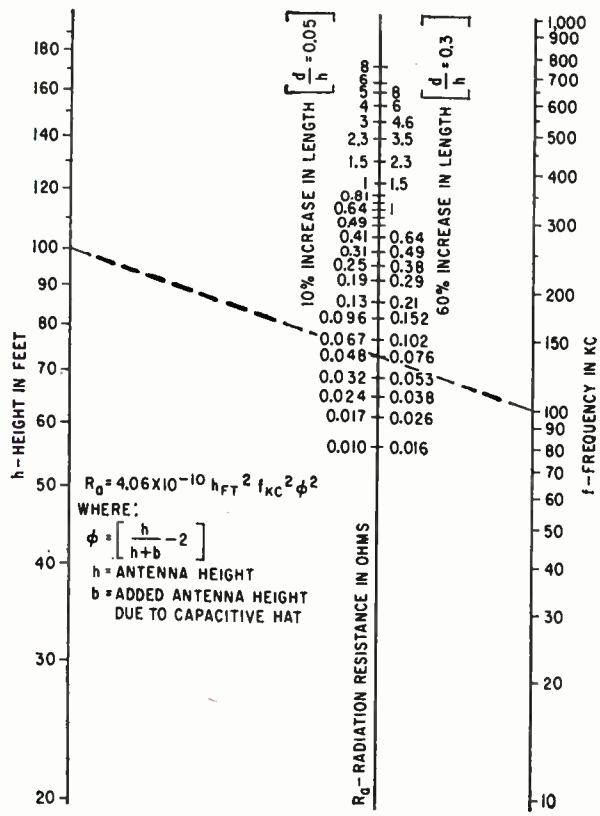

FIG. 3—Stub antenna with two different d/h ratios for flat-top loading valid for $h + b < \lambda/10$

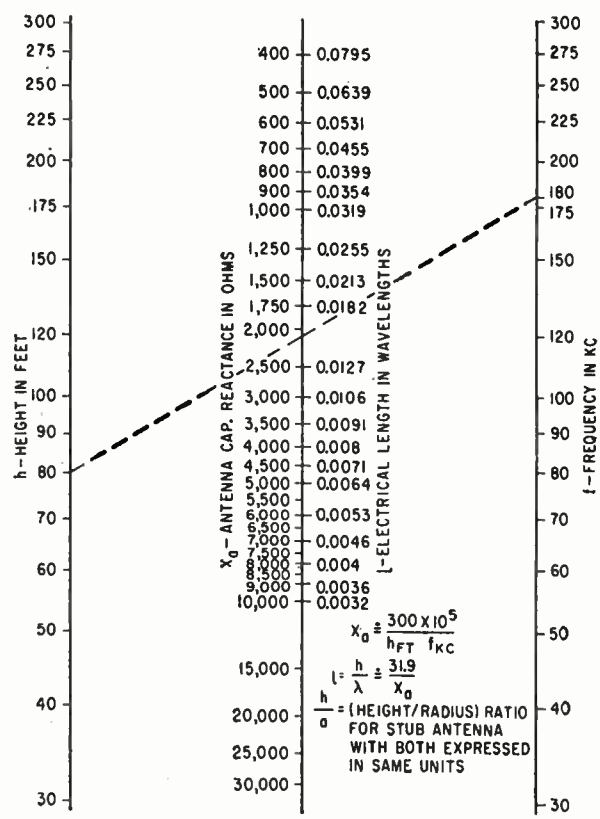

FIG. 4—Stub antenna reactance chart valid for electrical lengths $< \lambda/16$ and for $60 < (h/2) < 90$

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h_{fe} (Min.) (I_C=50ma, V_{CE}=10V, f=20mc.*) *for 2N706: f=100mc.	2.0	2.5	2.5	2.0
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Measuring Dielectric Absorption

By KURT GREENE, Program Director, U. S. Testing Co., Hoboken, N. J.

DIELECTRIC absorption in capacitors can affect differentiating, integrating and time-constant circuits. This characteristic must be carefully measured to avoid misapplication of capacitors and to avoid hazards with high-voltage capacitors.

An investigation was made in conjunction with the Bureau of Ships to standardize measurement techniques. An experimental current-measuring technique resulted.

In representing capacitors by capacitance and resistance in parallel, charge absorbed in the dielectric adds a small current causing initial resistance to appear lower than ultimate true resistance. The absorbed charge may cause measured voltage to exceed calculated voltage by 0.01 to 20 percent. Charge and discharge voltage measuring methods were evaluated for measuring dielectric absorption.

Charge Method

The capacitor is fully charged at rated voltage through a series resistor. Power is removed and voltage monitored. After a specified time, voltage is recorded and percent absorption calculated from $(E_i - E_t)/E_i \times 100$, where E_i is applied voltage and E_t is recorded voltage.

In evaluating this technique, residual dielectric polarization was removed by shorting the terminals for 24 hours before the test. Test potential was regulated to avoid voltage drop with the initial surge. A-c ripple was kept within 1 percent because it affects rate of polarization.

The short charge time (1 to 5 sec) required for a significant difference between initial and final voltages was controlled within 0.5 percent. Voltmeter input resistance and insulation resistance of the capacitor holding fixture must exceed 10^{14} ohms to eliminate possible leakage paths. Series charging resistance should be such that 100 times RC constant is less than charge time.

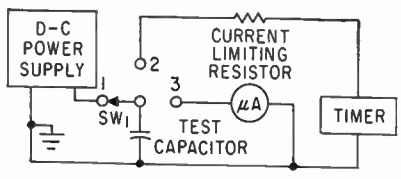


FIG. 1—Test capacitor is charged with S_1 at position 1, discharged by timer at position 2 and polarization current measured at position 3

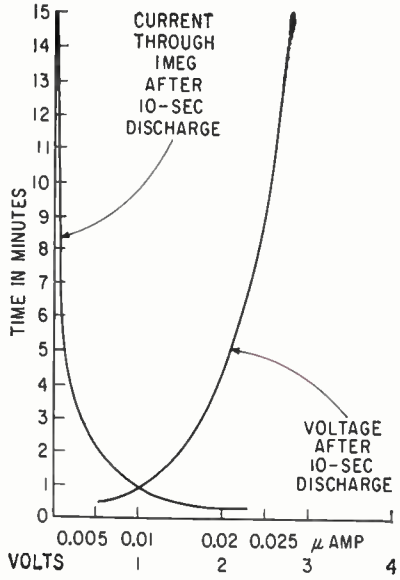


FIG. 2—Curves show current and voltage resulting from dielectric absorption

Theoretically, charge decreases exponentially until it approaches the polarization value. But charge also decreases nearly linearly because of leakage paths in the capacitor, with slope increasing as insulation resistance decreases. Therefore time after charge (10 to 15 minutes ±1 percent) was selected in which dielectric absorption losses approached stability and insulation resistance losses were minimum.

Although this method is fast, calculated dielectric absorption is higher than with the discharge method because of insulation resistance. Accuracy and reproducibility are limited by timer accuracy, leakage paths in test circuit and fixture, and internal capacitor resistance.

Discharge Method

This method is similar except that the capacitor is discharged through a resistor. After a specified time, voltage is recorded and percent dielectric absorption calculated from $E_t/E_i \times 100$.

A long charge time is required to attain nearly full polarization potential. Since dielectric absorption decreases nearly exponentially, charge time can be more accurate. Charge time of 60 ± 5 minutes was used to provide a value close to actual effective dielectric absorption.

Effect of a series resistor of less than about 100,000 ohms is negligible. Time between charge and discharge was limited to 30 seconds to avoid errors from loss of charge by internal resistance. Because discharge should remove charge on the plates without disturbing dielectric polarization, shorter time more accurately controlled results in a measurement closer to actual effective dielectric absorption.

The discharge resistor is not critical but should be proportional to discharge time. Voltmeter input resistance and fixture insulation resistance are not critical.

With relatively high capacitor insulation resistance and with slow charging and fast discharging, charge increases logarithmically toward a specific value. Since effective potential between plates is low, internal capacitor resistance has little effect initially but its effect increases with time and voltage. Therefore, little error results if minimum internal resistance is 10^{12} ohms and maximum measurement time is about 30 minutes. Since dielectric absorption losses stabilize between 10 and 15 minutes after discharge and insulation resistances are low during this time, measurement time is not critical.

The discharge method is more ac-

curate, leakage paths are not as critical since voltages are small, and effects of internal resistance are greatly reduced.

Current Measuring

The experimental technique can be based on either the charge or discharge methods, but the discharge method was used. Current through a known resistance is measured, as in Fig. 1, with a microammeter with internal resistance of 1 megohm ±1 percent.

Since the capacitor is continually discharged through a resistor or the measuring instrument, discharge time is not critical. Leakage paths above 10^8 ohms are negligible.

Current flowing in the measurement circuit as the dielectric is depolarized decreases logarithmically and approaches zero. This current is caused exclusively by polarization effects of the dielectric. Insulation resistance, a high resistance in parallel with measurement circuit resistance, has litle effect if a 100:1 ratio is maintained. Measurement time is reduced by 70 percent.

The current measuring method requires however that dielectric absorption be redefined in terms of current measurements and correlated with results obtained using voltage measurements.

The curves in Fig. 2 show current and voltage measurements of dielectric absorption.

A special fixture for dielectric absorption measurements was developed. It can handle four capacitors simultaneously to reduce measurement time. Special precautions were taken so that there are no leakage paths in parallel with either capacitor or voltmeter.

Overload Protection Circuit for Voltmeters

By F. W. KEAR,
Lytle Corp., Albuquerque, New Mexico

VOLTMETERS used where overloads are likely to occur should have protection for the meter movement. Such protection allows for proper meter functioning during normal measurement and avoids meter damage from voltage surges.

A circut was designed to fulfill

both these purposes. It uses two transistor voltage amplifiers and a latch-type relay. Because of relative response times of movement and circuit, it is possible to interrupt input voltage before damage can occur.

Power is supplied to the instrument by a single 30-volt dry-cell battery. Current drain is limited even under extended use because relay power is only required under overload conditions. A condition light indicates battery condition with momentary actuation of a test switch.

Overload Circuit

Bias on Q_1, set by R_1 in Fig. 1, governs the amount of overload that will be allowed. Voltage applied to the meter for measurement is also applied to the base of Q_1. When turn-on voltage of Q_1 is reached,

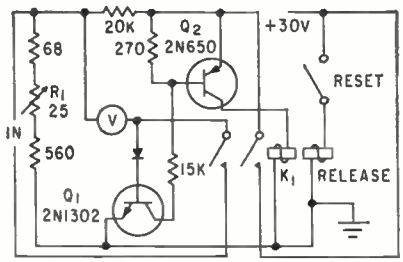


FIG. 1—Two transistor voltage amplifiers energize latch relay to protect voltmeter from voltage surges

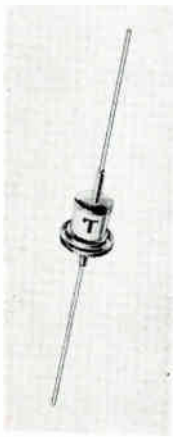
voltage on the base of Q_2 is dropped saturating Q_2 and energizing latch relay K_1. Both input voltage and supply voltage to the safing circuit are interrupted. When the voltage overload condition has been corrected, the relay is reset, again providing power to the safing circuit and completing the meter circuit.

This circuit has been used extensively for monitoring voltage drop of contact closures during normal operating conditions and during environmental tests. Circuit failure elsewhere in the equipment must be allowed for in this case. The voltage necessary to produce the currents at which such contacts are normally rated would damage measuring equipment if contact failure did occur.

A circuit for calibrating overload pull-in point is provided within the instrument, making it entirely self-contained.

Silicon-Carbide Rectifiers Take 500 C

A HOSTILE environment that includes high-temperatures and excessive radiation flux levels creates operating problems for solid-state devices. A combination of high temperature and radiation may wreck havoc on currently-available devices fabricated from either silicon or germanium.



Works at red heat

For the past five years, people in the aircraft field have been looking for devices that can work above 200 C: devices that can be put near the engine or that will not be damaged by excessive heat created by jet-speed aircraft. And there have been similar needs in atomic energy fields and bomb components.

The present upper limit of silicon rectifiers is around 200 C, and even at these temperatures silicon is limited in how much current it can handle.

Demands from Industry

In the laboratories, prototype units have been designed that make use of silicon carbide and gallium arsenide. But in the main these units have been kept under wraps for the military, and other government projects. Gallium arsenide devices have been operated at 450 C and silicon-carbide rectifiers at 650 C.

Last week, after much experimentation with some of the more advanced semiconductor materials, Transitron of Wakefield, Mass. has finally decided to announce the availability of silicon-carbide rectifiers that will meet the demands of industry.

Transitron engineers claim that the new rectifiers represent a major breakthrough in commercially available high-temperature, radiation-resistant semiconductors, and are now offering two types that will sell for about $50 each in small quantities. The units can withstand temperatures of 500 C and are ten times less subject to radiation damage than silicon. Pilot-line production is now underway and prototype orders are now being taken for the new rectifiers.

Integrated Neutron Flux

The SiC rectifiers are useable in a nuclear environment that has been pushed up to 10^{17} nvt. And at high temperatures, the units can glow a dull red while operating satisfactorily. Conventional glass-to-metal seals are hopeless at these temperatures. The unit is neatly packaged in a ceramic body with hermetically sealed ends that are brazed.

Transitron engineers will discuss these units at the IRE show in New York City next week.

Table I—SiC Rectifier Characteristics

Spec at 500 C:	Peak Inverse Voltage (v)	Max Inverse Curr I_b (μa)	Max Forward Volt at ma
TCS10	100	500	6 at 100
TCS5	50	500	4 at 100
At 25 C:			
TCS10	100	10	12 at 100
TCS5	50	10	8 at 100

Ratings at 500 C	Max Average Forward Curr Io (ma)	Max Peak Inverse Volt (volts)
TCS10	100	100
TCS5	100	50

Resilient Mesh Cushions System

KNITTED METAL WIRE mesh, familiar to housewives in pot cleaners, is the classic method developed by Robinson Aviation, Inc., Teterboro, N. J. to protect electronic equipment in aircraft, missiles and heavy gear from shock and vibration. The wire is knitted into a metal-mesh structure consisting of a multiplicity of interlocking spring-like loops.

All-Metal Structure

Forming the required amount of this knitted mesh into the desired size and shapes results in a multi-directional orientation of the spring loops and permits close control of compressibility and resiliency.

Using this construction, operating efficiencies are unaffected by temperature changes and the selection of the metal is the only limiting factor for sub-zero or high temperature service. The effective damping characteristics are not altered in use, and the heat generated in flexing is readily dissipated by the metal wire structure.

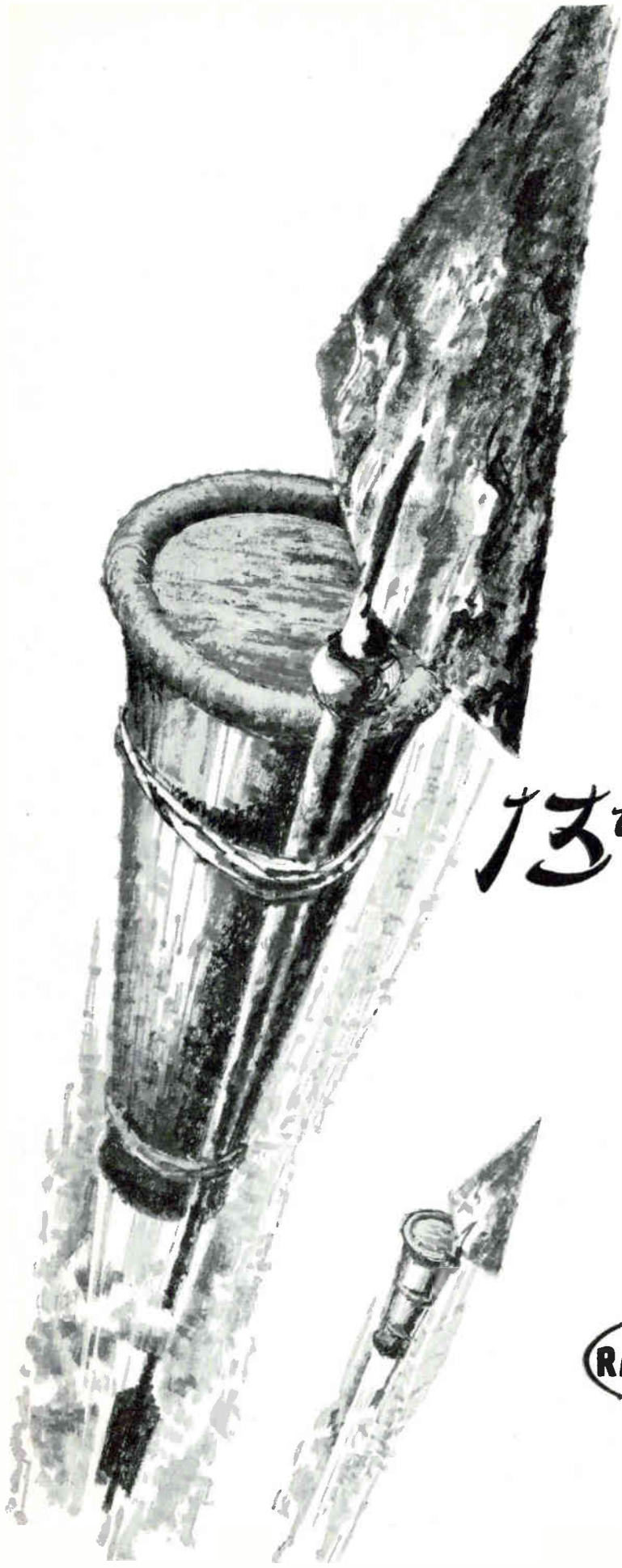
The cushions purge themselves of dust, oil and condensed water, and break up ice formations within the interlocking loops, and the units are unaffected by air density, or factors that may cause deterioration.

Polaris Communications

These principles are now incorporated into a low-frequency mounting system that will protect a single-sideband transceiver system on one of the newest Polaris firing nuclear submarines.

This latest Robinson mount has been designed to protect the Collins URC-32 from damaging shock and vibration, and to insure communications reliability during high-speed underwater operation. The mount provides a natural frequency of 6 cps with a transmissibility at resonance of less than 3. Mounting systems of this type have demonstrated isolation of all disturbances above 15 cps.

Structural members of the mount are made of steel, resilient elements are fabricated of stainless-steel wire and passivated. All-metal multi-directional mounting was developed by Robinson almost five years ago. Their shock and vib-



Flames swept across the open plains as the Mongol hordes ran in terror from the "arrows of flying fire". When the smoke had cleared the Chinese had won the battle of Pienking with the first rocket.

Missiles have become greatly more sophisticated since this crude unguided arrow was propelled by gunpowder packed in an open-ended bamboo tube. Today, as a vital part of one of the world's largest electronics companies, Raytheon's Missile Systems Division is making significant contributions to the art of missilry. The exciting new Pin Cushion Project for selective missile identification, the constantly advancing Navy's air-to-air SPARROW III and Army's HAWK are examples of their outstanding creative work.

We are seeking highly creative people to maintain Raytheon's leadership in this challenging field. For these people, Raytheon's Missile Systems Division creates a climate for talent — perhaps *your* talent.

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Please apply to Mr. W. F. O'Melia, Employment Manager, Bedford Laboratory, Missile Systems Division, Raytheon Company, Bedford, Massachusetts.

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ration techniques will be explained at next week's IRE show.

Pulsed Magnetrons Achieve High Power

FOUR EXPERIMENTAL magnetrons for wavelengths of 32, 12, 8 and 4 mm, and with peak outputs of 1,100, 70, 80 and 40 kw respectively, were recently described by Philips.[1] The peak power output of these tubes is, in round figures, 1,100, 70, 80 and 40 kw respectively. In the case of the 32 mm magnetron, the emphasis is placed on obtaining a high mean power as well as a high peak power. The other magnetrons may be regarded, according to the report, as steps on the way to the highest operating peak frequency. All tubes are equipped with an L-type (dispenser) cathode, which has been found to give good results in magnetrons.

Life tests on the magnetrons demonstrate the excellent properties of the L cathode. Not one of the tests was terminated by lowered emission. The most frequent cause of failure was leakage due to inadequate cooling. The 8 mm unit was still working well after a life test of almost 1,500 hours.

Particulars of life tests on a 32 mm, a 12 mm and an 8 mm magnetron are listed in Table I.

The pulse durations and the repetition frequencies were rather arbi-

Table I—Life Tests of Magnetrons

Wavelength (mm)	31.3	12.2	8.35
Anode curr (A)	55	14	14
Anode volt in kv	31	15.4	16.8
Peak power (kw) begin of test	783	46	52
Peak power (kw) end of test	695	40	45
Effic (%) begin of test	46	21	22
Effic (%) end of test	41	18	19
Pulse dur in μsec	2.0	0.44	0.50
Pulse-rep freq (c/s)	500	2,300	1,000
Mean init power (W)	783	46	26
Duration of test (hours)	238	700	1,488

trarily chosen; the mean powers given for the 12 mm and 8 mm magnetrons are therefore not the maximum permissible values. A point of importance for short-range radar is that the 8 mm and 4 mm magnetrons work excellently with pulses of only 0.01μ sec.

With a shorter wavelength and the same size of aerial the received fraction of the transmitted power is greater and the beam narrower. This makes for better resolution of the image on the radar screen and allows the shape of objects to be better distinguished, which is important for short-range radar as used on airfields and in harbours.

REFERENCE

(1) J. Verweel and G. H. Plantinga, A Range of Pulsed Magnetrons for Centimeter and Millimeter Waves, Philips Tech Rev, 21, p 1-9, 1959/60 (No. 1)

Exploding Wire Aids Hypervelocity Work

NEW APPLICATIONS for electrically exploded wires have been proposed by Electro-Optical Systems, Pasadena, Calif., as a result of a year-long basic research study in exploding-wire use for fuse initiators and detonators, sponsored by the Army Ordnance Corps.

Based on this research, exploding wires now appear feasible for such applications as high intensity light sources for communications purposes; propulsive devices for vehicles in outer space; use for hypervelocity particle impact research; and possible use as fusion for thermonuclear energy generation.

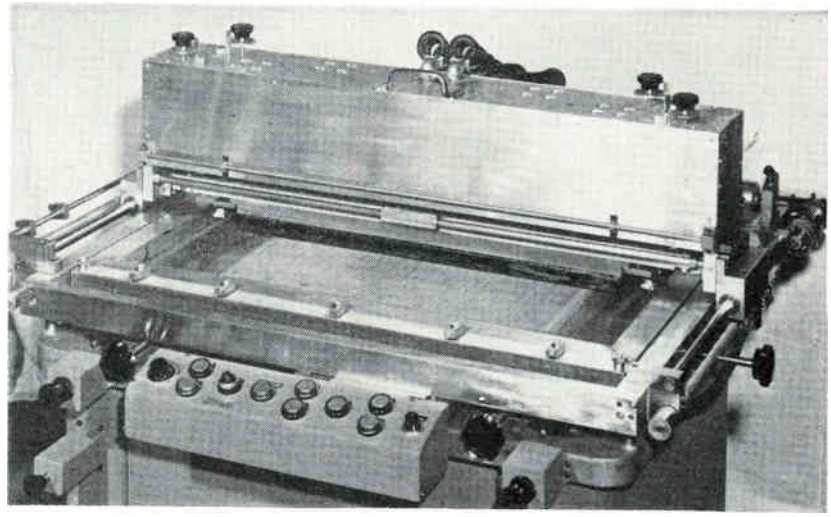
Key to these heat and light applications lies in techniques developed for switching tremendous amounts of current into thin wires in millimicrosecond time. This fast switching capability evolved from work done in the development of a 5 millimicrosecond Kerr Cell camera. The technique allows many times the material's vaporization energy to be dumped into the wire, creating temperatures above 100,000 C and pressures in the megabar range. Specific impulses of 1,000 seconds have been achieved in an exploding aluminum wire, and a 1,000 to 5,000 second impulse range appears possible.

Silk Screener Has Traveling Head

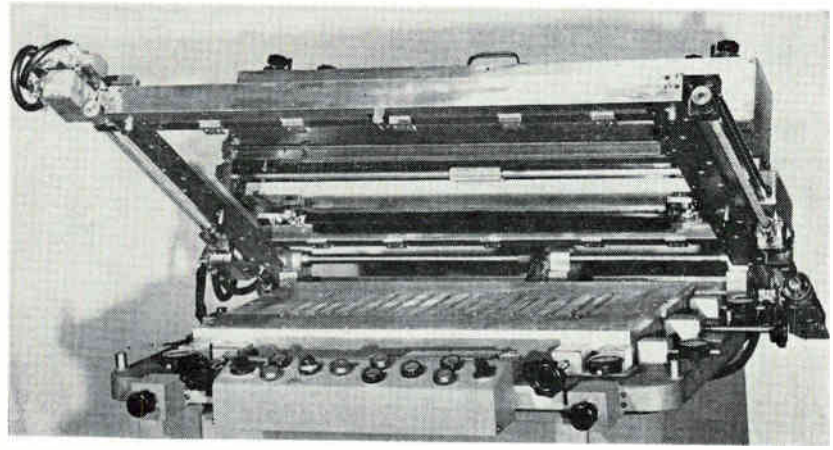
SILK SCREENING machine developed for semiautomatic production of printed circuit boards keeps screen and board stationary during printing. The squeegee head moves parallel to the normal circuit pattern.

The design of the machine, according to the manufacturers, eliminates fuzziness and permits high-speed printing of standard-sized boards, miniature boards in multi-unit panels and double-sided boards. Registration accuracy is reported to be within 0.001 inch and variations between boards in a run within 0.0005 inch.

The machine was designed for a computer manufacturer by Wyrco Products Inc., Binghamton, N. Y., and built by Crown Instruments Corp., Owego, N. Y. It consists of a cabinet containing the board hold-down vacuum system, adjustable worktable and operating controls; a hinged cover which carries the screen; and a motor-driven head which operates the resist flooding and squeegeeing blades.



Machine about 2/3 through printing cycle. Cover and screen are in locked position and squeegee is wiping screen



Loading position. Wheels which adjust worktable position are alongside control panel and at right. Screen has been removed from cover to show blades

Operation

Automatic cycling begins with cover open and head retracted. The operator places a board on the vacuum table, switches on the vacuum and depresses 2 palm switches until the cover latches. The head lowers the flood blade and advances to spread resist over the screen. The squeeze blade is lowered on the return and when the head stops, the cover opens for unloading.

Cycle speed and head travel can be adjusted to suit board size. A typical 10-by-22-inch panel is printed in 10 seconds. Resist is ladled on the screen about once in 15 boards. Controls are interlocked to forgive operator error.

Setup cycle is similar to automatic cycle except that the position of the head is controlled by a jog switch. The cover is fixed in position with a base casting. The worktable is adjusted laterally or angularly by moving it, with handwheels, in reference to the base casting. Dial indicators show how much correction must be applied. Adjustable bushings in the cover frame permit the screen to be placed in the same plane as the boards.

The head is supported on guide rails and is driven by an electric motor through a power train and drive screws. The 2 blades are driven by adjustable pressure bars which are spring-loaded to equalize pressure along the blade length. The head is hinged to provide access to the blades.

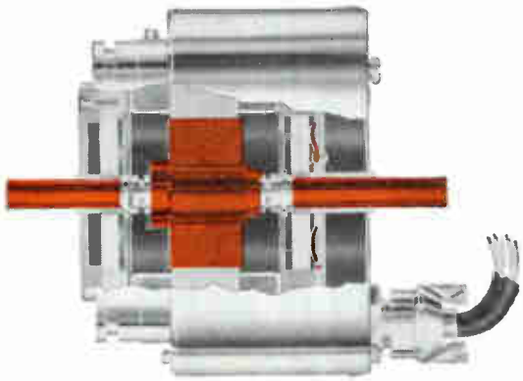
Layouts Expedite R&D Production

STREAMLINED DRAFTING procedures and the coordination of parallel production operations will expedite the production of military quality R&D equipment in limited quantities.

At Electronic Engineering Company of California, Santa Ana, Calif., these techniques helped produce in 4 months 7 instrumentation timing signal systems.

Drawings of system components previously made were red-penciled and immediately used as working drawings. In preparing new drawings, identical dimensioning of tube

NOW ultra-accuracy possible in 2-speed servo systems with use of Ketay Vernier Resolvers



Ketay has developed a Vernier Resolver which permits the Systems Engineer to achieve utmost accuracy in his two-speed system. Replacing the fine speed transmitter and associated gearing on one end, and the fine speed receiver with coarse-to-fine gearing on the other end, it provides a basic system accuracy from input to output shaft of the order of 20 seconds of arc, maximum.

Operating on a variable reluctance principle, this resolver accomplishes its gear-up electrically . . . permitting coarse and fine speed units to be coupled directly. Thus, costly gearing with its contributing errors is eliminated. Also, as a variable reluctance device, it requires no windings on the rotor and therefore no sliprings or brushes. Errors due to brush contact resistance are eliminated, while greater reliability, extremely low breakaway torque and longer life are achieved.

The Vernier Resolver, in conjunction with a standard resolver, may also be used as a highly precise shaft angle encoder.

TYPICAL SPECIFICATIONS

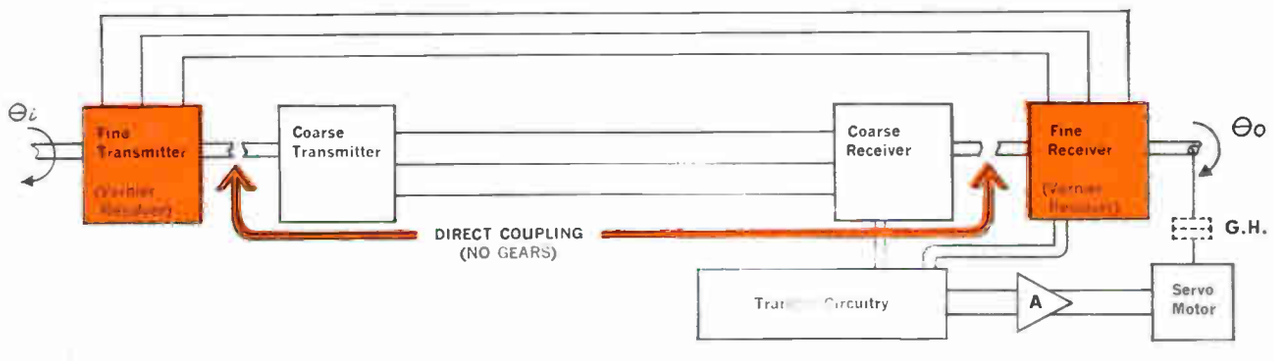
These typical specifications are for a particular vernier resolver designed for a specific application and are included here to give a general idea of what parameters are available. Vernier resolvers can be supplied for a wide range of voltages, currents and frequencies. Electrical to mechanical ratios can be changed to suit specific needs.

	Type #	SP-164
	Electrical to Mechanical Ratio (Gear up)	64 : 1
	Excitation	10 volts, 2.441 K.C.
	Error Spread of Null Crossover points (Max.)	12 (seconds)
(3), (2)	Error Spread over a Vernier interval (Max.)	4.5 (minutes)
	Maximum over-lapping error between intervals—approx.:	21 (seconds)
	Peak Output Voltage: (volts)	2.3 ± 10%
	Peak Output Voltage on reference winding: (volts)	2.5 ± 4%
	Open Circuit excitation current (untuned) (amps)	0.64 ± 4%
	Open Circuit excitation current (tuned) (amps)	0.065 ± 10%
	Open Circuit power (watts)	0.65 ± 10%
	Max. Starting Torque (in-oz.)	0.1
	Input impedance (ohms)	15.6 ± 4% /84°
	Null Voltage at Zero Points: (total rms)	7.5 mv.
	Peak Third (3) harmonic voltage (mv.)	8.5
	Phase Shift of output to input, approx.	3°
	Ambient temperature (C)	−20° to + 70°
	Weight—approximately	8 lbs. 13 oz.

NOTES:
1. Configurations, size, weight, etc. can be modified to suit specific applications.
2. Error spread can be trimmed down to value of over-lapping error or less.
3. Error is for unit being used as 2 Phase Transducer.

Submit your problems to us and a qualified Ketay engineer will show you how a vernier resolver may solve them.

USE OF VERNIER RESOLVER IN TWO SPEED SYSTEM



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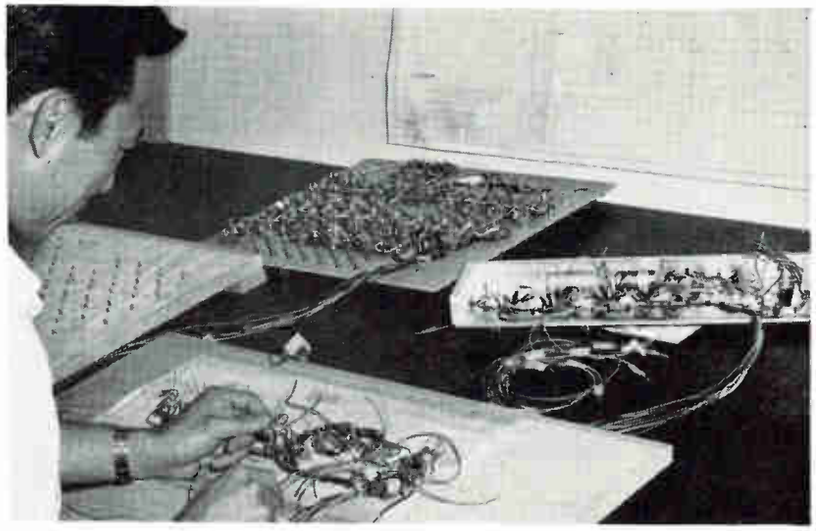
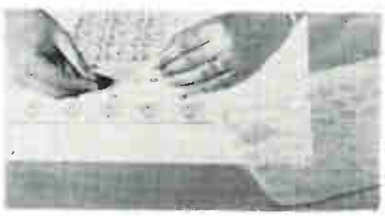
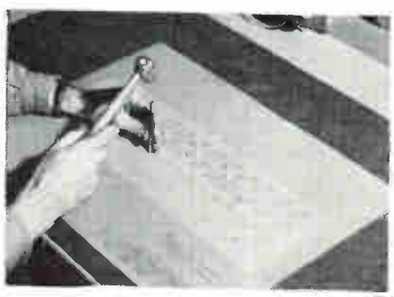


Wiring, sockets and other components are assembled on panel layout prints while the metal panels are being made

or plug-in sockets was eliminated by the use of reference symbols to indicate identical dimension. Schematic diagrams were made, but



Panel layout drawings are prepared with stick-on symbols



Film masters are used as metalwork templates

rack cabling diagrams were the only true wiring prints. Panel layout drawings were made with stick-on symbols to eliminate hand drawing of duplicated items.

Prewiring

Dimensionally-stable film masters were made from the panel layouts. Prints were attached to wiring harness boards. Hole patterns were drilled for sockets and other components. Wiring and sockets were assembled on the dummy panel boards, lifted off and laid aside.

In the metal shop, meanwhile, the film masters were being used as direct layout templates for the metal work. When the metal panels were completed, the harnesses were bolted in place, final connections soldered and the assemblies installed in systems cabinets by rack crews.

Each system, for use in a nose cone recovery program, is housed in 3 7-foot cabinets and 4 small chassis-type cabinets. They were made for Philco as part of the Agena Program managed by Lockheed.

USSR Reports Drawing Wires in Micron Size

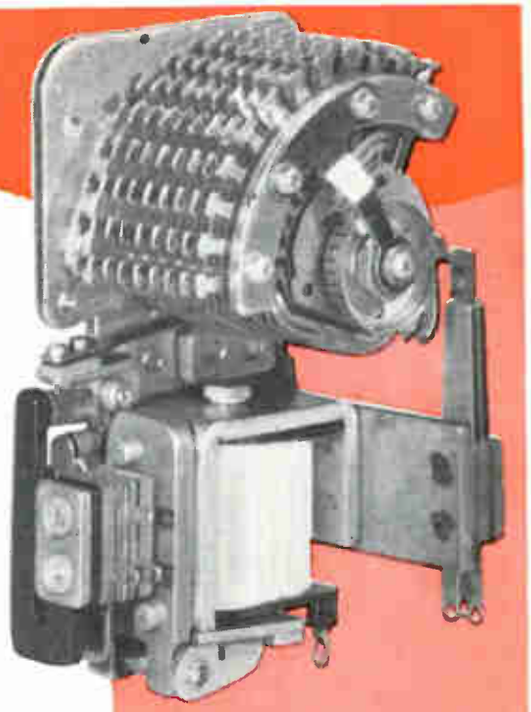
METHOD OF PRODUCING wire as fine as 1 or 2 microns in diameter by machine has been developed in the Soviet Union, according to a report relayed by McGraw-Hill World News, Moscow. The machine uses compressed nitrogen to force molten metal from a tightly-sealed container through a narrow aperture. The jet cools into fine wire.

Plans for carrying the process beyond the laboratory stage were not disclosed in *Sovietskaya Aviatsiya* report by the Institute of Metallurgy's Electrophysics Laboratory. Among proposed uses for the wire were miniature resistors, galvanometers, rolling aluminum wires into high-strength plates and rolling lead wires into plates for high-capacity storage batteries.

NEW

CLARE 211

Stepping Switch



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CIRCLE 101 ON READER SERVICE CARD 101

On The Market

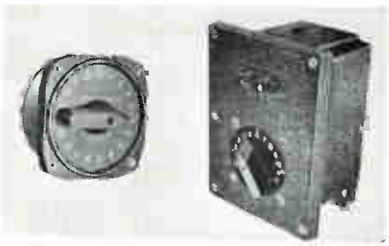
Annunciator digital type

PANALARM, division of Panellit, Inc., 7401 N. Hamlin Ave., Skokie, Ill. Instantly identifies sequence in which a group of alarms occurs. Models are available whereby up to 7, 15 or 31 off-normal points may be sequentially identified by binary readout with resolution between points in msec. Model 51-DS is designed for monitoring complex industrial processes. Alarms are audible as well as visible.

CIRCLE 301 ON READER SERVICE CARD

Multicircuit Switches for critical circuits

WINSLOW CO., 701 Lehigh Ave., Union, N. J. For industrial and military thermocouple and resistance-thermometer applications. Series of models provides for 2 to 20 circuits with OFF position. Design incorporates silver-to-silver contact paths, high circuit-to-circuit insulation. Models are available in housings protecting against explosion, fungus, splash and sand and dust.



CIRCLE 302 ON READER SERVICE CARD

Power Transistors save space

CLEVITE TRANSISTOR PRODUCTS, Waltham 54, Mass. The Spacesaver power transistor is designed for application where space is at a premium and weight is a critical factor. Its low base resistance gives lower input impedance for the same power gain and lower saturation resistance, resulting in lower "switched on" voltage drop. Lower cut off current means better temperature stability in direct coupled circuits and higher "switched off" impedance. The Spacesaver is currently available in eight 3-ampere switching types with breakdown voltages of 40, 60, 80 and 100; direct current gain ranges of 30-75 and 60-150 and frequency responses of 20 and 15 Kc. Leakage current at 90 C is 10 ma.

CIRCLE 303 ON READER SERVICE CARD

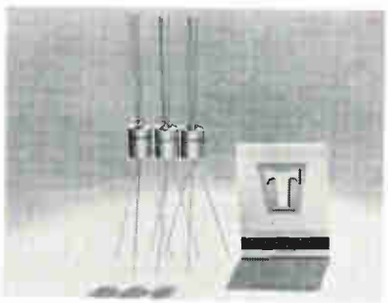
Miniature Pots ruggedized

INTERNATIONAL RESISTANCE CO., Box 11628, St. Petersburg, Fla., has introduced a matched series of new rugged, moisture-resistant miniature precision multiturn pots. Standard construction includes metal housing and O-ring shaft seals. Types 5000, 7500, and 1000 are ¼-, ⅜- and 1-in. in diameter, respectively. Resistive values range from 50 to 350 K, and linearity tolerances range down to ±0.075 percent. Housings are of nickel-plated brass, and terminal headers, of molded diallyl phthalate. Units meet most applicable MIL specs.

CIRCLE 304 ON READER SERVICE CARD

Pulse Transformers hermetically sealed

TECHNITROL ENGINEERING CO., 1952 E. Allegheny Ave., Philadelphia 34, Pa., has developed type BME series of subminiature low power pulse transformers for use with transistorized blocking oscillator and interstage coupling circuits. Units are available in a range of pulse widths from 0.05 to 5.0 μsec at repetition rates up to 10 Mc. The transformers are wound on high permeability ferrite cup cores and are hermetically sealed in cylindrical brass cases approximately ½ in. long with a diameter of 0.4 in. Units can be obtained with two or three windings and a choice of nine different turns ratios. Connections are provided through pig-tail type leads, 1⅜ in. minimum length. Type BME are



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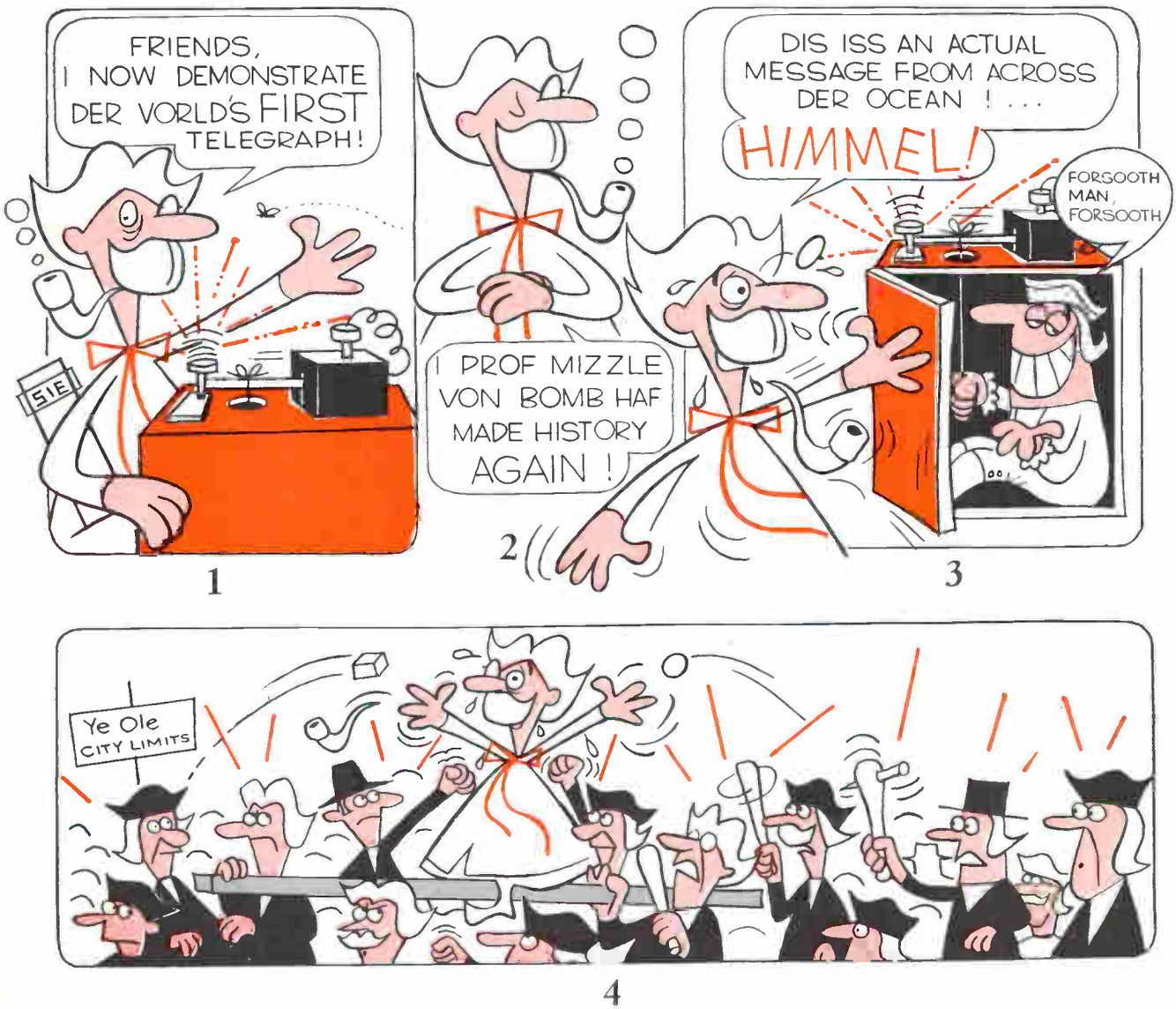

"Zhame on you!", Professor. You'll please people (and EE's too) when you demonstrate SIE's T-1A Vibration Meter. It's transistorized and portable for measurement and analysis of vibration velocity, acceleration, and displacement.

Acceleration	0.1 — 1000 g
Velocity	0.01 — 100 in./sec.
Displacement	0.001 — 10 in.
Accuracy	Better than 5%
Frequency range	5-10,000 cps

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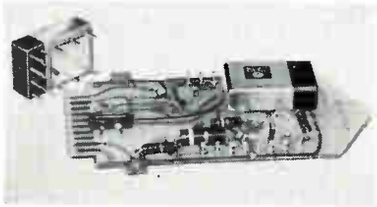
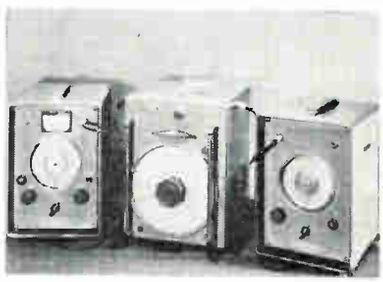


Component Modules for p-c cards

ELECTRONIC COMPONENTS, A Division of Telecomputing Corp., 12838 Saticoy St., N. Hollywood, Calif., announces a subminiature line of environmentally tested components designed for p-c cards. The modularly designed ceramic capacitors and side-mounted relays are packaged to meet requirements of the 0.100 in. gridding used on standard printed circuits, and will not project further than the 0.400 in. limit. Capacitors range from 47 $\mu\mu$f to 56,000 $\mu\mu$f. Rated at 200 wvdc they have a power factor of 2.5 percent at 1 Kc or 1.0 percent at 10 Kc. The hermetically sealed 2p2t relays, with epoxy potted connectors, will withstand acceleration forces to 100 g, vibration forces to 25 g and mechanical shock to 125 g along all three major axes.

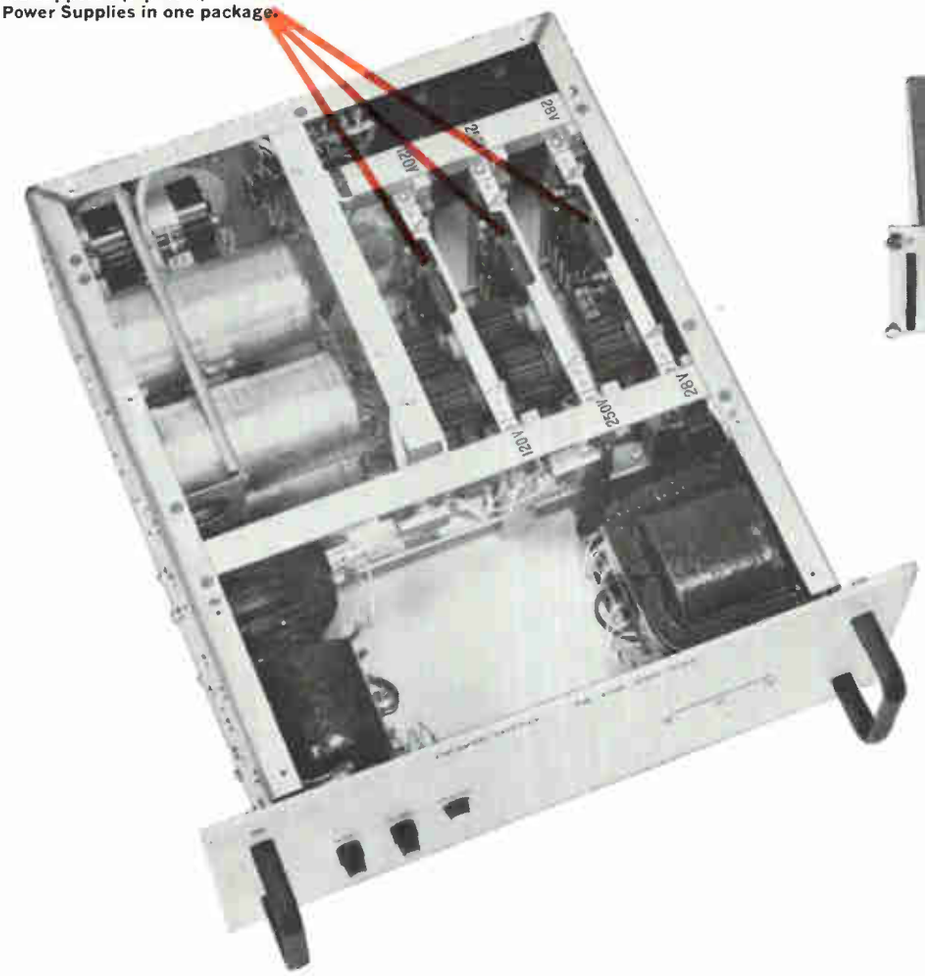
CIRCLE 306 ON READER SERVICE CARD



VHF Bridge 30 to 300 Mc

MARCONI INSTRUMENTS, 111 Cedar Lane, Englewood, N.J. A miniature thermistor element working in a servo feedback system is used as a conductance standard in model 978 vhf bridge. Measurement accuracy is 2 percent to 300 Mc. Capacitance and conductance range

Model pictured is a unique design, developed by Hydro-Aire Electronics for ground support equipment, which combines three AC/DC Power Supplies in one package.



Another *New* Hydro-Aire Product for the *Aircraft, Missile Support, Missile* and *Electronics* Industries

The AC/DC Power Supply shown is typical of many new electronic products being developed, engineered and produced by Hydro-Aire—a name well known for quality, reliability and fast delivery. The unit illustrated is one of a unique family of fixed voltage, transistorized, power supplies. Through unusual design, Hydro-Aire engineers have combined three power supplies into a single package. The same basic circuit allows regulated outputs over a wide range. Range is determined by selection of transistorized, printed circuit, plug-in modules.

Characteristics Model #50-121

Input: 120 ± 5 % VAC
Outputs: 28 VDC @ 2.5 amp; 120 VDC @ 250 ma;
250 VDC @ 500 ma
Regulation: ±0.1% for combined temperature, time and load variations
Temperature: −10°F to +125°F operating; −54°F to +165°F non-operating
Ripple: 5 millivolts RMS (maximum)
Size: 8¾ x 17 x 20 (for 19″ rack mounting)
Weight: approximately 70 lbs.

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CIRCLE 105 ON READER SERVICE CARD

is ± 40 $\mu\mu$f and 0-50 millimhos. Two terminal measurements can be conveniently made on r-f components, semiconductors, transmission lines, etc. The voltage applied to the component under test is seldom more than 50 mv. Separate bridge source and detector are illustrated. Any signal generator and receiver covering 30 to 300 Mc could be used.

CIRCLE 307 ON READER SERVICE CARD

Cathode-Ray Tube low-power heater

SYLVANIA ELECTRIC PRODUCTS INC., 730 Third Ave., New York 17, N. Y., introduces type SC 2751 low-power heater crt. It offers a high efficiency 1.5 v, 140 ma heater, and will operate on an ordinary flashlight battery. It employs a lightweight design and requires only $\frac{1}{10}$ of the power necessary to operate a conventional 6.3 v, 600 ma heater. It is ideally suited for portable oscilloscope, radar and monitor applications.

CIRCLE 308 ON READER SERVICE CARD

Signal Generators stabilized

STRAND LABS, INC., 294 Centre St., Newton Centre 58, Mass. Models 300 (illustrated) and 500 variable

see full-page ad page 39

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2. DIFFERENTIAL AC VOLTMETER
Precision measurement of AC voltages is accomplished in the Model 803R by utilizing the basic DC measurement circuitry plus a special AC to DC converter.

3. VACUUM TUBE VOLTMETER
The jf Model 803R may be used as a conventional DC or AC VTVM, a feature frequently helpful when making precise measurements of voltage by locating the approximate value of unknown in the 500 volt spectrum.

FEATURES

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- Accuracy 0.05% of input voltage
- Four search ranges and four null sensitivities
- Infinite input resistance at null

AC

- Accuracy 0.2% of input voltage
- Converter frequency response 30 cps to 5 kc
- Measures RMS value of true sine wave

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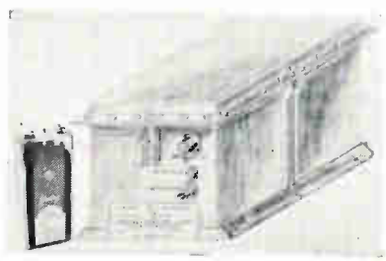
frequency c-w microwave sources are frequency-stabilized to a tunable reference cavity. Model 300 is a compact unit with a power output of 10 mw average; stability (short-term deviation), 1 part in 10^5 average; weight, 20 lb. Model 500 is a high power type. Its exceptional high-gain d-c stabilization amplifier provides a klystron variation corrections for maximum long-term stability. Power output is 500 mw average; frequency stability (short-term deviation), 1 part in 10^8 average; (long-term deviation), 1 part in 10^6 average. Frequency range for both models is 8,500 to 9,600 Mc.

CIRCLE 309 ON READER SERVICE CARD



Missile Battery silver-zinc

YARDNEY ELECTRIC CORP., 40-50 Leonard St., New York, N.Y. The PM Silvercel 61700 is a rechargeable battery made up of cells capable of delivering 80 watt-hours per lb. Unit is made up of 19 cells of 200-ampere-hour nominal capacity. It weighs a total of 140 lb. including all hardware; measures 11⅞ in. wide, 14⅞ in. long, 11½ in. high. In typical application, it offers five cycles, supplying 65 amperes at a 6½-hr discharge rate, with three pulses of 90 amperes for one minute each. Specific energy of the total package is 60 watt-hours per lb. Voltage is from 26 to 30 v. Operating temperature range is 20 F to 80 F. Activated stand time is 15 days.

CIRCLE 310 ON READER SERVICE CARD

Molding Compounds versatile materials

AMERICAN-MARIETTA CO., Seattle, Wash., announces new epoxy molding compounds, known as EMC, for advanced design and product devel-

opment. Soft-flow molding characteristics make possible high-speed molding of a host of electronic and electrical parts from materials not previously workable in manufacturing processes. EMC incorporates an outstanding balance of physical, electrical and chemical properties characteristic of epoxies in an easily handled single component system. Other major advantages include low-pressure transfer and compression molding, non-outgassing, self-extinguishing and self-releasing. EMC is said to have reduced manufacturing costs to as low as one-sixth of former outlays.

Circle 311 on Reader Service Card

D-C Relay
rated at 5 amperes

GUARDIAN ELECTRIC MFG. CO., 1621 W. Walnut St., Chicago 12, Ill. Series 2505 d-c relay features 6 pdt contact combinations rated at 5 amperes. Unit is completely hermetically sealed in a standard metal enclosure less than 1⅛ in. by 1⅝ in. by 1⅝ in. in size. Weight is 0.23 lb maximum. Has broad approval for military use. All contacts are staked—not welded—for utmost reliability. "Fluxless solder" sealing is used to eliminate possibilities of internal contamination. Standard terminals are solder hook type. Plug-in terminals or potted leads also available.

Circle 312 on Reader Service Card

A-C Ratio Boxes
in a range of types

NORTH ATLANTIC INDUSTRIES, INC., 603 Main St., Westbury, N.Y., has available ratio boxes for lab, pro-

duction and field service applications. Series RB-500 includes portable bench and rack mount models, in general purpose, deviation, sine-cosine, binary and automatic stepping types. In all models precise voltage division is accomplished by means of an adjustable ratio transformer. The design provides the advantages of high input and low output impedance, preventing loading of the input circuit and minimizing the effect of capacitance between the bridge arms and ground. Units feature in-line window readout, and provide a range of ratios from + 1.111111 to − 0.111111. Depending upon the particular model, accuracy specifications are 1 ppm to 10 ppm.

Circle 313 on Reader Service Card

High-Speed Relays
two models

THE BRISTOL CO., Waterbury 20, Conn. The C1440 series relay is a high-speed, low-noise model especially designed for reliable switching in low-level circuits. The external coil construction of the Bristol Syncroverter choppers is used for low-noise performance. The C1445 series is a new plug-in model high-speed relay which offers both low thermal-drift and low-noise level characteristics.

Circle 314 on Reader Service Card

Cathode-Ray Tube
highly sensitive

ALLEN B. DUMONT LABORATORIES, INC., 750 Bloomfield Ave., Clifton,

N.J. Type K1951 is an extremely sensitive 3-in. crt for oscilloscopes and other instruments. It has a flat face and is electrostatically focused and deflected. Deflection voltages are less than 15 v in either direction. Combined with low accelerating voltage (500 v), the new tube permits small size deflection and power supply circuits for compact equipment design and the use of transistors in the circuitry. Tube features high light output in relation to the voltages. It has a linear post accelerator for maximum deflection uniformity and minimum pattern distortion.

CIRCLE 315 ON READER SERVICE CARD

Toroidal Inductors encapsulated

BURNELL & Co., 10 Pelham Parkway, Pelham, N.Y. New adjustoroids, slotted for screw driver adjustment, are especially suitable for commercial and military applications in phase networks, variable transformers, oscillators, discriminators, variable tuned circuits, etc. The ATE11, $\frac{3}{4}$ in. in diameter by $\frac{13}{16}$ in. high, weight approximately 0.75 oz, maximum inductance 5 h. Diameter of the ATE 0 is $1\frac{1}{16}$ in. by 1 in. high, weight $1\frac{1}{2}$ oz, maximum inductance 0.5 h. The ATE 4 is $1\frac{5}{16}$ in. in diameter by $1\frac{1}{16}$ in. high and weighs 3.5 oz, maximum inductance 15 h. Useful range of full line is 500 cycles to 100,000 cycles.

CIRCLE 316 ON READER SERVICE CARD

Teflon Tape for wire wrapping

DIXON CORP., Bristol, R. I. A new development in Teflon tape is a regular skived tape with controlled low-leakage. It is specified to show no more than 2 percent change in any dimension when heated free at 730 F for 15 minutes. This im-

proved Teflon tape is of importance to wire manufacturers requiring insulating materials which are capable of withstanding prolonged exposure to high temperatures without cracking or splitting, problems common to tapes with large or variable shrinkage characteristics. Tape is available in thicknesses from 1 mil up and widths from ¼ in. to 12 in.

CIRCLE 317 ON READER SERVICE CARD

Transducer
underwater type

ADVANCED ACOUSTICS CORP., 67 E. Centre St., Nutley, N. J. The Dual-D underwater transducer provides two orthogonal beams for supersonic sensing of sea bottom depth simultaneously with forward obstacle detection. One transducer element operates at 200 Kc providing a sensing beam for depth of water measurement, while a second transducer operating at 300 Kc provides a horizontal forward beam of approximately eight degree angular spread. Both elements are encapsulated in a common epoxy housing with the transducer mounted so that interference between the two is eliminated.

CIRCLE 318 ON READER SERVICE CARD

R-F Oscillator
short pulse length

ARENBERG ULTRASONIC LABORATORY, INC., 94 Green St., Jamaica Plain 30, Mass. One-half μsec pulses at any frequency between 0.5 to 150 Mc are now available on the high powered pulsed oscillator, PG-650-C. Pulses may be continuously varied over a 10-1 range in steps up to 50 μsec. Peak amplitude is 300 v peak to peak into a 93 ohm load. Unit can be self-triggered or synchronized externally up to 3 Kc prf. Calibrated delay ranges to 11,000 μsec are provided as well as

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3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	383
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225	GRAIN-ORIENTED SILICON Crystaligned Microsil	.004"

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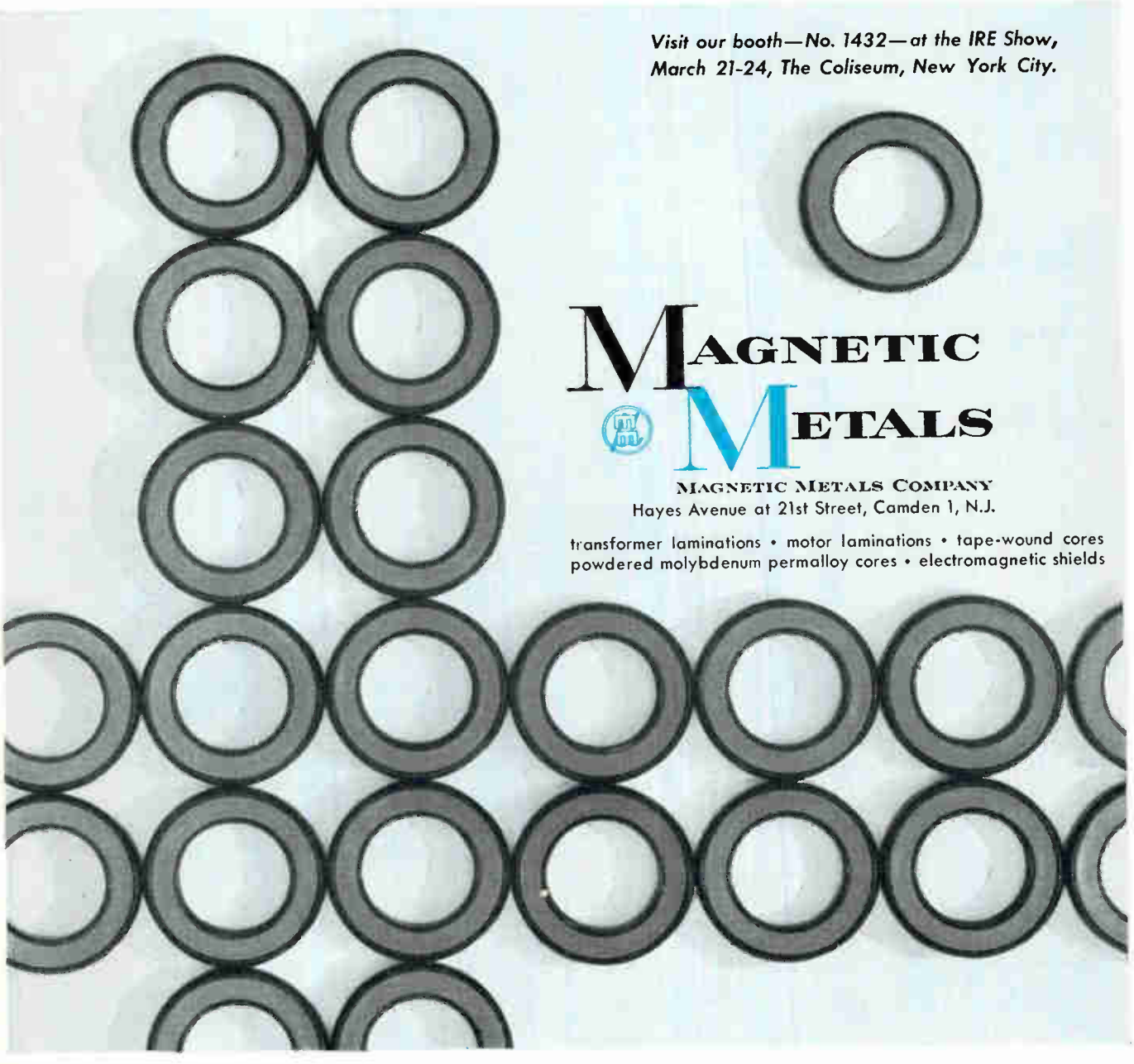
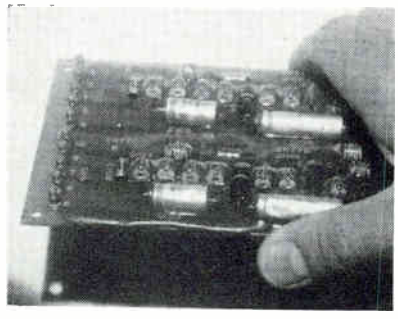


external modulation of the pulse or r-f frequency. By a few simple modifications, the unit may be converted to give c-w as well as pulsed operation over most of its range in frequency with a power output of 10-20 w into a 100 ohm load.

CIRCLE 319 ON READER SERVICE CARD



Epoxy Coating for circuit boards

EMPCOR, 101 West Verdugo Ave., Burbank, Calif., announces Empcote, an epoxy coating for circuit boards. It is tough, flexible, and highly resistant to moisture, vibration, and thermal shock. Company reports successful environmental testing in units per MIL-5272-A and MIL-E-5400. It has been especially compounded to permit a faulty circuit board component to be cut out with a heated knife blade, replaced, spot-patched with Empcote and returned to service with a minimum of down-time.

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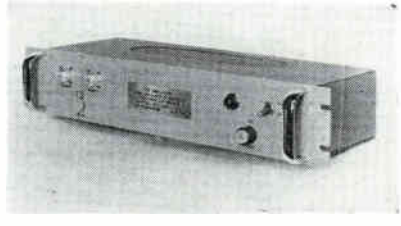
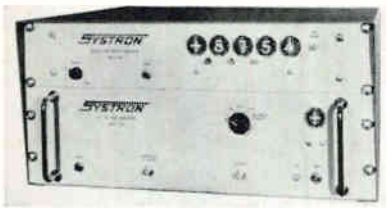


R-F Amplifier tunable

APPLIED RESEARCH INC., 76 S. Bayles Ave., Port Washington, N. Y. Model UH-2 (AT) is a v-t operated tunable wideband amplifier with self-contained power supply. Tunable center frequency ranges of as much as ± 10 percent of the nominal frequency, not to exceed 150 Mc, are possible. Center frequency may be between 300 Mc

and 1,000 Mc. Representative noise figures ranging from 5 db at 400 Mc to 8.5 db at 1,000 Mc are obtained by the use of co-planar low noise triodes. Only two stages are needed to realize an overall gain of 18 db. Nominal bandwidth of 10 Mc is available. Input and output impedances are standardized at 50 ohms, with vswr of less than 1.5 at input, less than 1.75 at output.

CIRCLE 321 ON READER SERVICE CARD



Digital Voltmeter high speed

SYSTRON CORP., 950 Galindo St., Concord, Calif. Model 1231 all electronic digital voltmeter features accuracies to better than 0.05 percent, 20 millisec conversion, in-line readout, and automatic polarity for $1,895. It provides a 4-digit indication from ±0.0001 to 99.99 v with optional ranges down to 1 μv and up to 1,000 v. Complete line of converters available which operate with model 1231 for automatic component testing of diodes, capacitors, resistors, etc.

CIRCLE 322 ON READER SERVICE CARD

Rectifiers axial-lead package

MOTOROLA, INC., 5005 E. McDowell Road, Phoenix, Ariz., has introduced a series of 750 ma rectifiers in a flangeless, axial-lead package designed to simplify automatic insertion in p-c boards. Types 1N2611 through 1N2615 are diffused-junction silicon devices and feature exceptionally high surge handling capacity with very low back current at high temperature. They are available in ratings from 200 to 600 v, and are especially suitable for use in communication equipment, computers, magnetic amplifiers and many applications requiring reliability up to 175 C.

CIRCLE 323 ON READER SERVICE CARD

Literature of

MARINE RADAR. Associated Electrical Industries Ltd., Blackbird Road, Leicester, England. Publication No. 4231-71 is a colored brochure containing comprehensive details of BTH Escort marine radar. The main features of "Chart-Plan" true-course displays are described, while also included is a technical specification and list of world service agents.

CIRCLE 350 ON READER SERVICE CARD

ALUMINUM FOIL CAPACITORS. International Electronic Industries, Inc., Box 1368, Nashville, Tenn., has available a bulletin describing the specifications and performance characteristics of its miniature and subminiature aluminum foil capacitors.

CIRCLE 351 ON READER SERVICE CARD

ACCELEROMETERS. Columbia Research Laboratories, MacDade Blvd. and Bullens Lane, Woodlyn, Pa. A line of true compression accelerometers, series 200, for use in applications where size and weight are critical factors, is described in a recent bulletin.

CIRCLE 352 ON READER SERVICE CARD

TRANSISTOR INDEX. Zeus Engineering Co., 635 S. Kenmore Ave., Los Angeles 5, Calif., has published a bulletin describing and listing the advantages of the transistor index, which, by utilizing Keysort card sorting techniques, can in seconds sort out all transistors of a given characteristic.

CIRCLE 353 ON READER SERVICE CARD

MEMORY BULLETIN. Telemeter Magnetics Inc., P. O. Box 329, Culver City, Calif. Bulletin DF115.1 describes a series of general purpose high speed memories which operate at rates up to 125 Kc and provide both random access and sequential types of operation.

CIRCLE 354 ON READER SERVICE CARD

ROTARY INPUT SWITCHES. MicroSwitch, Freeport, Ill. Data sheet 170 describes a new line of rotary switches for use on computer control consoles to intro-

the Week

duce information by converting decimal constants to a positional number code.

CIRCLE 355 ON READER SERVICE CARD

METALIZED CERAMICS. Metalizing Industries, Inc., 338 Hudson St., Hackensack, N. J. Technical bulletin M-100 is a one-page data sheet describing metalized ceramic components.

CIRCLE 356 ON READER SERVICE CARD

ULTRASONIC SOLVENT CLEANER. Hi-Grade Alloy Corp., 3034 E. 9th St., Chicago 17, Ill. Hi-Grade No. 6 ultrasonic solvent cleaner which combines superior cavitation properties with excellent stability is described in a recent bulletin.

CIRCLE 357 ON READER SERVICE CARD

TRANSFORMERS. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif., has released a new brochure on miniature, epoxy molded transformers for use with transistors in printed circuits.

CIRCLE 358 ON READER SERVICE CARD

DYNAMIC RECTIFIER ANALYZER. Wellson Associates, Inc., 912 Westfield Ave., Elizabeth, N. J. Data sheet 106 contains a detailed description of the completely self-contained model 141A 20-ampere dynamic rectifier analyzer.

CIRCLE 359 ON READER SERVICE CARD

COMPUTER LANGUAGE TRANSLATOR. Electric Engineering Co. of California, 1601 E. Chestnut Ave., Santa Ana, Calif. A 16-page application information manual on the model ZA-100 computer language translator describes its data translation capabilities, the basic translation system, common translation modes, and other basic information.

CIRCLE 360 ON READER SERVICE CARD

RELAY MAGNETIC AMPLIFIER. Acromag, Inc., 22519 Telegraph Road, Southfield, Mich., has available a 6-page relay magnetic amplifier application bulletin.

CIRCLE 361 ON READER SERVICE CARD

Alpert: ask the right questions

A GIFT FOR ORGANIZATION and an intuition for asking the right questions are the main assets of Leon Alpert, president of Loral Electronics.

With a formal education in law and accounting, Alpert came to the electronics industry to help run a small subcontracting company during World War II. While working with William Lorenz, owner of the firm, Alpert realized the important role electronics would play in the postwar world. His lack of engineering training, no drawback even then, has since become a positive asset. His full energies go into running the business, not getting involved in technical details.

In February of 1948, the two men each put up $25,000 to establish a small plant in the Bronx. They called their company "Loral", a combination of their last names. "Besides the name, we had little else. There were no orders, no contracts - - - just an open door leading to a lot of hard work," says Alpert.

Today Loral reports 1959 sales of more than $10 million, a backlog of about $30 million, and the acquisition of its first company last month.

Alpert's initial introduction to the business world came the hard way: selling newspapers at the age of six on New York's lower East Side. One of seven children, he spent most of his boyhood in the shadow of poverty.

As a young man, he attended New York University's School of Commerce at night and worked during the day as a bookkeeper and public accountant. More years at night school eventually led to a law degree - - - and the meeting with Lorenz.

Today, in his tastefully-furnished office, Alpert greets each day with enthusiasm as he works continuously to perfect his organization. He appears to be in almost constant touch with each key man in the company.

One basic Alpert philosophy that keeps things humming is his belief in spotting a need and filling it. His management people are trained to anticipate new ways electronics can be put to work, tell him about it, and then get busy making it come true. Alpert himself works hardest of all at this concept. He even keeps what he calls his "idea pocket". Notes of new ideas and methods are jotted down at any time of the day (or night) and then brought in for evaluation.

As to the future, Alpert expects to be steering his company, now in military work, into commercial projects. Also slated for expansion are distribution patterns for present and future products.

Alpert's activities outside the office stand out in contrast to his fast pace on the job. The energies of his 5-ft-7-in frame are turned to golf, reading and watching tv. And as a change from the law, accounting and technology that make up his workday, he finds westerns, science fiction and similar light fare to his taste.

Alpert lives in Harrison, N. Y., with his wife Jeanett, his son and daughter.

Fenwal Advances Welch to V-P

E. SOHIER WELCH, JR. has been appointed vice president—engineering of Fenwal Inc., Ashland, Mass., manufacturer of precision temperature detectors and controls for industrial, missile, and aircraft use. Previously he was chief research engineer at Fenwal, where he directed a group exclusively concerned with long-range applied research projects.

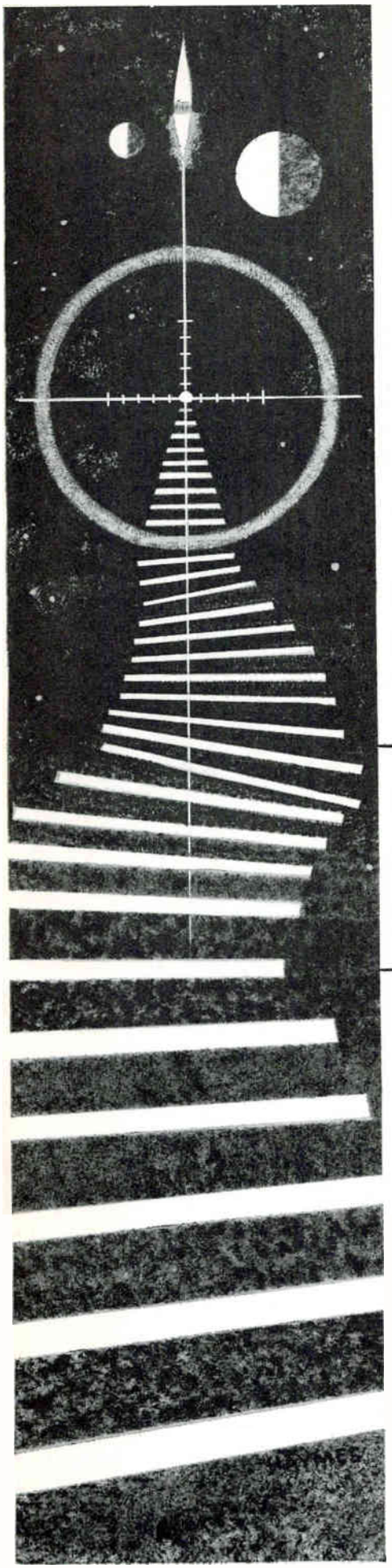
In his new position, Welch will be responsible for all Fenwal engineering and research activities, including those of the newly formed Monitor and Controls division. He will also continue to serve as chief research engineer.

Potter Assumes New Position

HAROLD C. POTTER, with the company since 1949, was recently appointed manager of sales for General Electric's Semiconductor Products department, Syracuse, N. Y. In his new position, he directs and is responsible for the national sales of GE transistors and component rectifiers.

Reporting directly to Potter are the department's eastern, central and western regional sales managers who, in turn, direct sales to the industry's original equipment manufacturers.

In addition, Potter is also responsible for the sale of the depart-



Horizons Unlimited

Development of a high-performance inertial guidance system of unprecedented performance for long-range guided missiles, satellites and space vehicles has been announced by Bell Aircraft Corporation's Avionics Division.

Bell Avionic's engineers describe the highly-classified system as "the most successful and reliable of any new inertial instrumentation concepts so far tested."

The system was developed under the direction of Dr. Helmut W. Schlitt, recognized within the industry as an outstanding authority in the field of inertial guidance.

The new system has undergone extensive flight tests at the Niagara Falls, N. Y., Municipal Airport. Some of its components already are being used in guided missiles.

For more information about Bell Avionics INERTIAL GUIDANCE SYSTEMS AND COMPONENTS, as well as Battlefield Monitoring Systems, All-Weather Automatic Aircraft Landing Systems, Secure Data Link Systems and many others, you are urged to talk to Avionics Division engineers in Booths 3822 and 3824 during the I. R. E. Show.

ELECTRONICS ENGINEERS

Bell Aircraft's *Avionics Division* will conduct interviews in New York City during the I.R.E. Radio Engineering Show March 21 through March 24 for urgently needed competent, qualified engineers in the following categories:

Electronics Engineers to design and develop transistor circuits for digital systems.

Electronics Engineers to design digital and data handling systems in connection with inertial navigation equipment.

Electronics Engineers to analyze digital computers and systems.

Electronics Engineers to design complex transistor circuits operating over a large temperature range in inertial guidance systems.

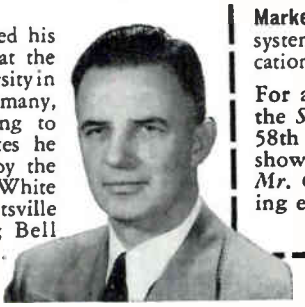
Electronics Engineers to design very high frequency receivers and multi-stage transmitters.

Dynamics Engineers to conduct simulation studies of compatability of aircraft with automatic all-weather landing systems.

Marketing Engineers for complex electronics systems involving radar, airborne communications and flight instrumentation.

For a personal, confidential interview at the *Savoy Hilton Hotel*, Fifth Avenue at 58th Street, while you are attending the show, telephone CI 7-2805 and ask for *Mr. George Klock*, director of engineering employment.

Dr. Helmut W. Schlitt, manager of the Avionics Division's Inertial Development Laboratories, who has directed the development of the high-performance inertial guidance system.



Dr. Schlitt earned his doctor's degree at the Technical University in Darmstadt, Germany, and after coming to the United States he was employed by the U.S. Army at White Sands and Huntsville before joining Bell Aircraft in 1952.

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Pearson Takes New AMF Post

ROBERT W. PEARSON, formerly director of manufacturing for American Machine & Foundry Company's Government Products Group, has been appointed to the newly-created staff position of director of production for the company. He joined AMF as deputy general manager of the former Electronics division in Boston in 1956 and was made director of manufacturing for the Government Products Group in 1958.

Before joining AMF, Pearson was with RCA at Camden, N. J., as senior staff engineer in the production department, and later was administrator of mechanical design and manager, engineering standards and services. He was subsequently named manager of product planning.

Appoint Clark Chief Engineer

FRANK K. CLARK, JR., has been named chief engineer of the M. C. Jones Electronics Co., Inc., Bristol,

Conn., it was announced recently by George E. Steiner, president of the Jones company and general manager of the Scintilla division of Bendix Aviation Corp.

The Jones company, a subsidiary of Bendix, manufactures test equipment for monitoring radio frequency coaxial transmission lines.

Clark joined the Bendix Radio division in Baltimore in 1954 and worked on the development of high-powered radio transmitters and microwave tube applications. Previously he was with Electro Precision Products, Inc. and Hazeltine Electric Corp.

News of Reps

The W. J. Ruscoe Co. announces the appointment of the **C. J. Voneman Co.** of Cleveland, Ohio, as sales rep for its Perma-Form coil retainer stock. Voneman and associates will cover Ohio, western Pennsylvania, Indiana and Michigan.

The **Sanford Company**, Wichita, Kansas, has been named sales rep by Task Corp., Anaheim, Calif. Rep firm will cover Texas, Oklahoma, Kansas, Missouri and Iowa.

The Fred Goat Co., Inc., Brooklyn, N. Y., manufacturer of relays and precision metal stampings, appoints the following companies to extend its marketing coverage:

Maury E. Bettis Co. of Kansas City, Mo., covering Missouri, Kansas, Iowa and Oklahoma; **Corwin Associates** of Dallas, Texas, covering Texas; **Gallagher Co.** of Cincinnati, Ohio, covering Ohio, Kentucky, and lower Michigan.

Magnetic Research Corp., Hawthorne, Calif., appoints the **Applied Engineering Products Co.** of Salt Lake City, Utah, to its list of engineering sales reps. Territory assigned includes Utah, southern Idaho, Wyoming, Colorado and New Mexico, including county surrounding El Paso, Texas.

The **Robison Co.** of Torrance, Calif., is named California representative of M.E.C., Inc., Nashville, Tenn.

BACKTALK

National Goals

As regards "Debate: Defense Orders . . . Or Cuts?" (p 26, March 4) . . . If the American people and government would finally realize that the basic objectives of communism do not change there would not be so much debate over defense. Every time Khrushchev smiles we think the whole ideology of communism has been revised. The sooner we face reality on this point, decide how we stand in relation to it, what we must do, and what we WANT to do—this applies to space exploration as well as defense—our national life will have more direction and run more smoothly than it now does.

DONALD ROMEO

GLOUCESTER, MASS.

Any Information?

We understand there is on the market in the United States a dust precipitating unit suitable for domestic use.

We have tried to obtain information regarding this from various sources, but so far without effect. We would be most grateful if you could give us any information at all regarding a product of this type, with some indication of the maker and, if possible, technical information regarding the product. My address is Bonochord Ltd., 48 Welbeck St.

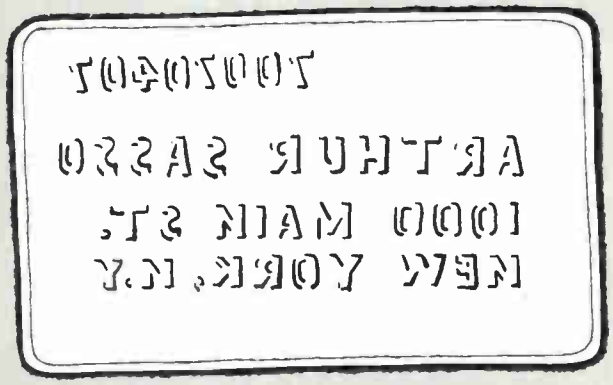
M. CLARKE

LONDON W. 1.

Electronics in Archaeology

Reader Donelson (Comment, p 92, Oct. 30, '59) is perhaps unaware of developments in the application of electronics to archaeological problems here in Europe.

Since Atkinson, then of Edinburgh, now professor of prehistoric archaeology at Cardiff, published the first information concerning the use of resistivity surveying for mapping buried prehistoric structures in 1952, a whole mass of data has been accumulated. At least three laboratories are engaged in



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continuous research on the problem. The Research Laboratory for Archaeology at Oxford was the first to apply the proton resonance magnetometer of Packard and Varian to archaeological problems. The Fondazione Lerici of the Politecnico di Milano has used resistivity survey extensively. Here in Bonn we have three resistivity teams in the field and they are kept supplied with newly developed equipment constructed by us. Furthermore, we have under development a refined form of proton resonance magnetometer especially designed for archaeological purposes with automatic compensation of diurnal variation and automatic recording of results. Electronic computers have been used on a lease basis for evaluating and filtering results.

Reader Donelson's wish for airborne instrumentation is still a long way off, though air photography for archaeological purposes has been used since 1906! If he is willing to sweat out his measuring close to the ground, any of the above named persons or institutions can supply him with publications and advice.

IRWIN SCOLLAR

RHEINISCHES LANDESMUSEUM
BONN, GERMANY

Radioactive Tracers

We would like to note two errors in the circuit diagram in "Radioactive Tracers Find Jet Fuel Flow Rates," (p 58, Feb. 19).

1. From the base of Q_1 the 100k resistor should be returned to the + 19v line rather than to the −9v line.

2. From the base of Q_2, the 100k resistor leads to a two position switch. One position is shown left open where in fact it should be returned to the +19v line.

We regret that we did not have the opportunity of correcting this error before the article went to press and trust that the above corrections will answer the questions that will arise.

J. D. KEYS

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Band	Tube Type	Fixed Freq. or Tunable	Frequency Range Mc	Min. Peak Power Watts	Output Mates With
C	BL-212	Tunable	5400-5900	100	UG699/U
C	BL-243	Tunable	5400-5900	200	UG699/U
C	BL-242	Tunable	5400-5900	400	N
C	BLM-022	Tunable	5400-5900	500	TNC
C	BLM-026	Tunable	5400-4900	500	TNC
C	BLM-020	Tunable	5400-5900	700	TNC
C	BL-245	Tunable	5400-5900	900	TNC
C	BL-250	Tunable	5400-5900	150	TNC
X	BLM-003	Tunable	9000-9500	150	TNC
X	BLM-014	Tunable	8500-9000	150	TNC
X	BLM-012	Tunable	8900-9400	1000	TNC
X	BLM-021	Tunable	8900-9400	1000	UG40A/U
X	BLM-024	Tunable	9300-9500	150	TNC

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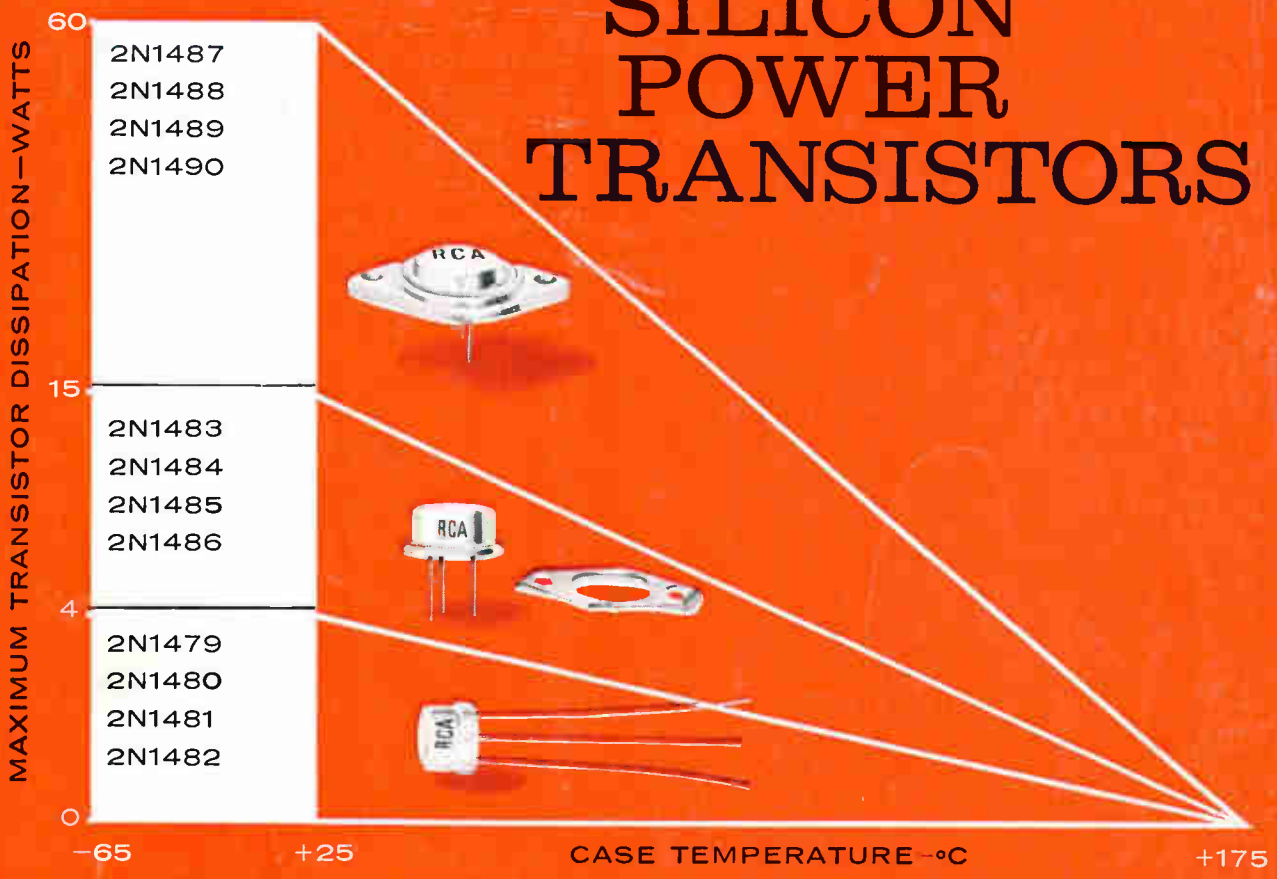

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ELECTRICAL CHARACTERISTICS
Minimum and Maximum Values at Case Temperature = 25°C

RCA Type	Min. V_{CEX} (volts)	Min. V_{CEO}* (volts)	Max. I_C (amp)	Max. I_{CBO} (μa)	Max. Saturation Resistance (ohms)	h_{FE}
				V_{CB} = 30v	I_C = 0.2 amp	I_C = 0.2 amp
2N1479	60	40	1.5	10	7	15-75
2N1480	100	55	1.5	10	7	15-75
2N1481	60	40	1.5	10	7	35-100
2N1482	100	55	1.5	10	7	35-100
				V_{CB} = 30v	I_C = 0.75 amp	I_C = 0.75 amp
2N1483	60	40	3	15	2.67	15-75
2N1484	100	55	3	15	2.67	15-75
2N1485	60	40	3	15	1.00	35-100
2N1486	100	55	3	15	1.00	35-100
				V_{CB} = 30v	I_C = 1.5 amp	I_C = 1.5 amp
2N1487	60	40	6	25	2.00	10-50
2N1488	100	55	6	25	2.00	10-50
2N1489	60	40	6	25	0.67	25-75
2N1490	100	55	6	25	0.67	25-75

*sustaining volts

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